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Global Value Chains and the Role of Innovation for Sustainable Palm Oil: An International Bioeconomy Analysis for Malaysia

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Zusammenfassung

Palmöl gehört mit einem Drittel des Gesamtverbrauchs zu den acht meist genutzten Pflanzenölen weltweit. Der Gesamtverbrauch beträgt jährlich 130 Millionen Tonnen. Die Verwendung von biobasierten Rohstoffen in der Palmölproduktion und die Möglichkeit einer abfallfreien Produktion waren der Anlass, den Beitrag der Palmölproduktion an der nachhaltigen Bioökonomie zu untersuchen. Politikansätze zur Verbesserung der Produktionskette und Bioökonomie-Programme werden in der Arbeit diskutiert. Um die Produktivität und Effizienz der Palmölherstellung zu untersuchen, werden Fallstudien in zwei Regionen von Malaysia durchgeführt: Johor auf der Halbinsel Malaysia dient als Beispiel für einen langfristigen Anbaustandort und Sabah auf Borneo für einen neu etablierten Anbau.

Weiterhin werden Deckungsbeitragsanalysen innerhalb einer globalen Wertschöpfungskette durchgeführt. Hierzu werden die Bauern in drei Gruppen (Kleinbauern, mittele Bauern und Großgrundbesitzer) unterteilt. In Johor ist der Deckungsbeitrag der Kleinbauern niedriger als der der Großgrundbesitzer aufgrund langfristigen Einflusses auf die Palmölproduktion. In Sabah, Borneo, mit der jüngeren Palmölindustrie wurde eine inverse Beziehung zwischen Anbaufläche und Einkommen ermittelt.

Mit Hilfe einer Kosten-Nutzen-Analyse werden die Opportunitätskosten und externen Effekte der Palmölproduktion bestimmt. Umweltfaktoren wie Landnutzungsänderung, Kohlenstoff-emissionen aus Düngemitteln, Pestiziden und Transport sowie die Emissionen von Methan und Kohlendioxid durch Ölmühlen gehen in die Bewertung ein. Letztere werden von Kritikern der Palmölproduktion häufig als bedenklich eingeschätzt. Für die Kosten-Nutzen-Analyse werden ein Zeitraum von 25 Jahren (Zyklus der Palmöl-Industrie) und Realzinsszenarien von 1-8 % angenommen. Die produktivsten Plantagen unter der „Federal Land Development Authority“ (FELDA), einem wesentlichen institutionellem Akteur der malaysischen Palmölproduktion, erzielen einen Kapitalwert von 84.980 RM(US$26,776) pro Hektar in 2010 und damit ein ungefähr 293% höheren Kapitalwert als unproduktiverer Betriebe. Die Überführung von Wald in Palmölplantagen führt zu höheren externen Kosten als die Umwandlung von Gummi- oder Kakaoplantagen, da die Kapazität zur Kohlenstoffspeicherung von Ölpalmen geringer ist. Vergleiche zwischen den beiden untersuchten Regionen ergeben, dass die Kleinbauern und die Großgrundbesitzer der Johor Plantagen (die Pionierregion in dieser Branche) einen höheren Kapitalwert pro Hektar erwirtschaften als diejenigen der Sabah Plantagen (Neulinge in dieser Industrie). Dies gilt nicht bei Farmen mittlerer Größe. Auch die Ölmühlen in Johor erwirtschaften einen höheren Kapitalwert pro Tonne als die Öl-Mühlen in Sabah.

Als Politikoptionen im Hinblick auf Bioökonomie-Programme in der malaysischen Palmölproduktion wurde die Biokraftstoffpolitik zweier industrialisierter Länder betrachtet, nämlich die Herstellung von Biodiesel aus Rapssaat in Deutschland und die amerikanische Äthanolgewinnung aus Mais. Eine Übernahme diese internationalen Politikbeispiele durch die malaysische Regierung kann die Politikstrategien bezüglich der Gewinnung von Biokraftstoff aus Palmöl verbessern. Anderseits können auch die von der malaysischen Regierung angewandten Politiken zur Entwicklungsbeschleunigung der Palmölindustrie von anderen Palmöl produzierenden Ländern übernommen werden.

Stichwörter: Palmöl, Globale Wertschöpfungskette, Bruttomarge, Kosten-Nutzen-Analyse, Wissenschaftspolitik.

Abstract

Palm oil constitutes approximately one-third of the 130 million tonnes of major vegetable oils and fats consumed annually worldwide. The use of bio-based materials in palm oil production and the potential to achieve a zero-waste production process motivated this study of the potential of the Malaysian palm oil industry participating in sustainable bioeconomy. Thus, assessment of policies on chain upgrading and bioeconomy programme is discussed in this study. In order to assess the productivity and the efficiency of oil palm plantations, field research was conducted in two regions in Malaysia: Johor in Peninsular Malaysia as an example of a long-term production area and Sabah in Borneo, a newly established oil producing site.

A gross margin analysis was also conducted within a global value chain framework. The growers were disaggregated into three groups according to scale (smallholders, medium-sized growers, and large estates). In Johor, smallholders earned lower gross margins than large scale growers as a result of the long-term impacts of this industry. However, in Sabah, where the palm oil industry is a relatively recent development, there was an inverse relationship between farm size and income.

Thus, a cost benefit analysis (CBA) was applied to evaluate the opportunity and the external costs of producing palm oil. The CBA also considers environmental factors, such as land-use changes, carbon emissions from fertilisers, pesticides, transportation for oil palm fruits, and methane and carbon emissions from extraction mills (which have frequently drawn concerns from critics of palm oil). A 25-year period (the length of a commercial cycle of the palm oil industry) and real interest rate scenarios (1–8 %) were adopted for the analysis. Based on the findings, the most productive plantations under the Federal Land Development Authority (FELDA) scheme, which has been a key institutional actor in the development of the Malaysian palm oil industry, earned a Net Present Value of RM84,980 (US$26,776) per hectare, earning more than the less productive plantations under the same scheme (approximately 293% higher) in 2010. Moreover, the external costs of converting forests to oil palm plantations were higher than that of repurposing existing rubber or cocoa plantations for oil palm plantation (which also stores less carbon). Comparing the two study regions, it was found that the small- and large-scale growers in Johor (the pioneer region of the industry) performed better than their Sabahan counterparts (where the palm oil industry is a more recent development) in terms of net present value (NPV) per hectare. However, this was not the case for medium-sized growers. In addition, the mills in Johor also performed better than those in Sabah in terms of NPV per tonne.

To examine policy options that could be adopted to turn the Malaysian palm oil industry into a bioeconomy, two biofuel policies adopted by industrialised countries were reviewed, namely German rapeseed biodiesel and US corn ethanol policy. These international policies could serve as examples for the Malaysian government to improve their policy strategies for the Malaysian palm oil biofuel industry. The mixed experiences of the Malaysian policies for accelerating the development of the palm oil industry can be important lessons for other palm oil producing countries.

Keywords: Palm oil, Global value chain, Gross margin, Cost benefit analysis, Science policy

Table of Contents

List of Tables

List of Figures

Acronyms

AAR	Applied Agriecological Research Sdn. Bhd.
AD	Anaerobic Digestion
AS	European Standards
ASTM	American Society for Testing and Materials
ACRE	Average Crop Revenue Election
Agrmc	Agricultural Marketing Resource Center
BCR	Benefit-Cost Ratio
BOD	Biochemical oxygen demand (BOD)
BCIC	Bumiputera Commercial and Industrial Community
CH_4	Methane
CO_2	Carbon dioxide
CoP	Codes of Practices
CSR	Corporate Social Responsibility
CBA	Cost benefit analysis
CBR	Cocoa Butter Replacer
CCP	Counter-cyclical payments
CDM	Clean Development Mechanism
CPO	Crude Palm Oil
CPKO	Crude Palm Kernel Oil
CVM	Contingent Valuation Method
DOE	Department of Environment
DP	Direct Payments
EPU	Economic Planning Unit
ETP	Economic Transformation Programme
EF	Effluent
EFB	Empty Fresh Fruit Bunches
EOP	End of Pipe
EN	European Standards
EPA	US Environmental Protection Agency
ERR	Economic Rate of Return
EU	European Union
FAO	Food and Agriculture Organisation of the United Nations
FSA	Farm Services Agency
FELCRA	Federal Land Consolidation and Rehabilitation Authority
FELDA	Federal Land Development Authority
FFB	Fresh Fruit Bunches
FOA	Farmer Organisation Authority
GJ	Gigajoule
GCC	Global Commodity Chain
GDP	Gross Domestic Product

GHG	Greenhouse Gas
GNP	Gross National Product
GTZ	German Technical Cooperation
GVC	Global Value Chain
HUTAN	Kinabatangan Orang-utan Conservation Programme
ICRA	International Centre for Development Oriented Research in Agriculture
IDA	International Development Association
Iluc	indirect land use change
IADP	Integrated Agricultural Development Programs
IMF	International Monetary Fund
IR	Inverse relationship
IPM	Integrated Pest Management
IPCC	Intergovernmental Panel on Climate Change
ISCC	International Sustainability and Carbon Certification
KH	Kaldor-Hicks
K-Economy	Knowledge based Economy
KESEDAR	*Lembaga Kemajuan Kelantan Selatan* (South Kelantan Development Authority)
KETENGAH	*Lembaga Kemajuan Terengganu Tengah* (Terengganu Tengah Development Authority)
KEJORA	*Lembaga Kemajuan Johor Tenggara* (South East Johor Development Authority)
KLCC	Kuala Lumpur City Centre
KM	Kilometre
KWSP	*Kumpulan Wang Simpanan Pekerja* (Employees Privident Fund)
LDPs	Loan Deficiency Payments
LCA	Life Cycle Assessment
LCC	Land Capability Classification
MOU	Memorandum of Understanding
MARA	*Majlis Amanah Rakyat* (Council of Trust for the People)
MIDF	Malaysian Industrial Development Finance Corporation Berhad
MPOB	Malaysian Palm Oil Board
MPOC	Malaysian Palm Oil Council
MARDI	Malaysian Agricultural Research and Development Institute
MP	Malaysian Plan
MIGHT	Malaysian Industry Government Group for High Technology
MLGs	Marketing Loan Gains
MOSTI	Ministry of Science, Technology and Innovation
MPC	Malaysia Productivity Corporation
MPOWCF	Malaysian Palm Oil Wildlife Conservation Fund
MT	Mulching Technology
MF	Mesocarp Fibre
MW	Megawatts
N_2O	Nitrous oxide
NEP	National Economic Policy

NKEA	National Key Economic Area
NPP	Net Primary Production
N	Nitrogen
NGO	Non-Governmental Organization
NPV	Net Present Value
OECD	Organisation for Economic Cooperation and Development
OPEFB	Oil palm empty fruit bunch
POME	Palm oil mill effluent
PCP	Posted county prices
PPO	Processed palm oil
PKO	Palm Kernel Olein
PETRONAS	*Petroliam Nasional Berhad* (Malaysian oil and gas company)
PPKO	Processed Palm Kernel Oil
PV	Present Value
RBD	Refined Bleached Deodorized
RE	Renewable Energy
RED	Renewable Energy Directive
RISDA	Rubber Industry Smallholders Development Authority
RM	Ringgit Malaysia
R&D	Research and Development
RSPO	Roundtable on Sustainable Palm Oil
SME	Small and Medium Enterprises
SIRIM	Standards and Industrial Research Institute of Malaysia
SOCSO	Social Security Organization
SPS	Single Payment Scheme
SCP	Structure, Conduct and Performance paradigm
T/t	Tonne
TOT	Transfer of Technology (seminars)
TEEB	The Economics of Ecosystems and Biodiversity
UCLA	University of California, Los Angeles
UFOP	Union zur Förderung von Oel- und Proteinpflanzen e. V. (the German Oilseed Grower Organization)
UNIDO	United Nations Industrial Development Organisation
UNFCC	United Nations Framework Convention on Climate Change
UK	United Kingdom
US	United States
USD	US Dollar (2012 exchange rate)
USAID	U.S. Agency for International Development
USDA	United States Department of Agriculture
WTO	World Trade Organisation
WWF	World Wide Fund for Nature

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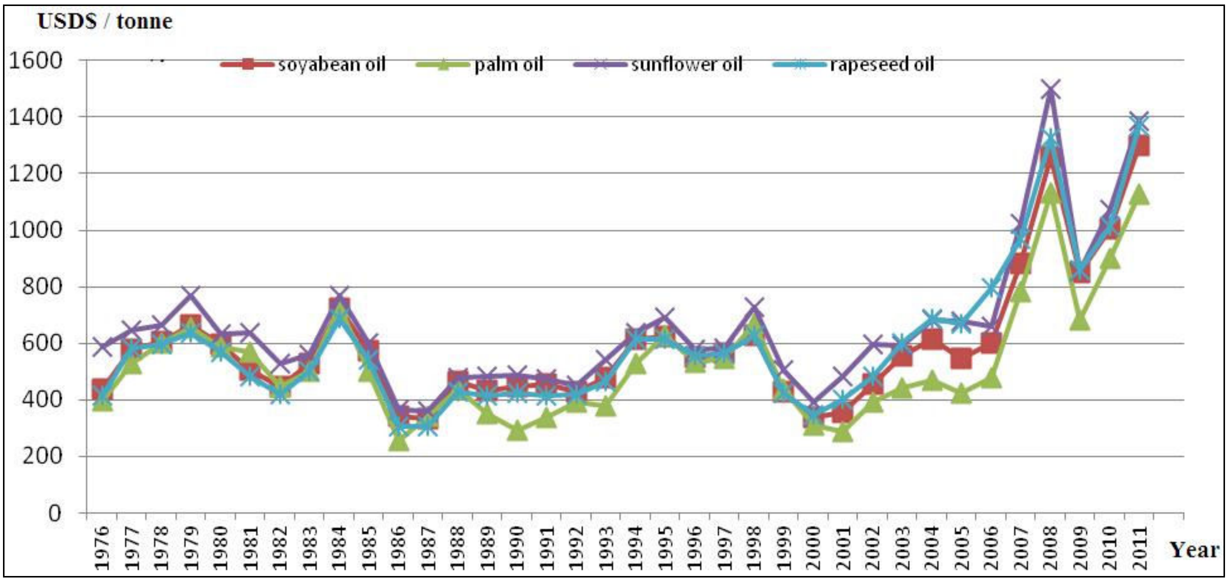
Chapter 1 Introduction

1.1 Introduction

The continually increasing global population and the globalisation of agriculture have led to an increased demand for food, including 17 vegetable oils and fats used for cooking and food processing. Palm oil constitutes approximately one-third of the combined annual worldwide consumption of 130 million tonnes of the eight most common vegetable oils and fats (Oil and Fats, 2010). In 2008, Malaysia and Indonesia produced 96% of global palm oil exports (USDA, 2009). Indonesia is the leading exporter of palm oil, accounting for 49% of exported oil in 2008, followed by Malaysia (47%), Benin (2%), Papua New Guinea (1%), and the United Arab Emirates (1%). The major global palm oil importers in 2008 were India (29%), China (26%), the European Union (EU) (5%), Egypt (4%), Bangladesh (3%), and Iran (2%) (USDA, 2009). Palm oil is popular because of its chemical properties. It is very stable, especially under high temperature processing, and it is cheaper than other oils and fats (Figure 1.1).

Figure 1.1 European Market Prices of Selected Vegetable Oils 1975–2011 (USD/tonne)



Source: Oil World, Oil World Annual, Hamburg, Germany, (various issues); Hameed and Arshad (2010) and MPOB (2014).

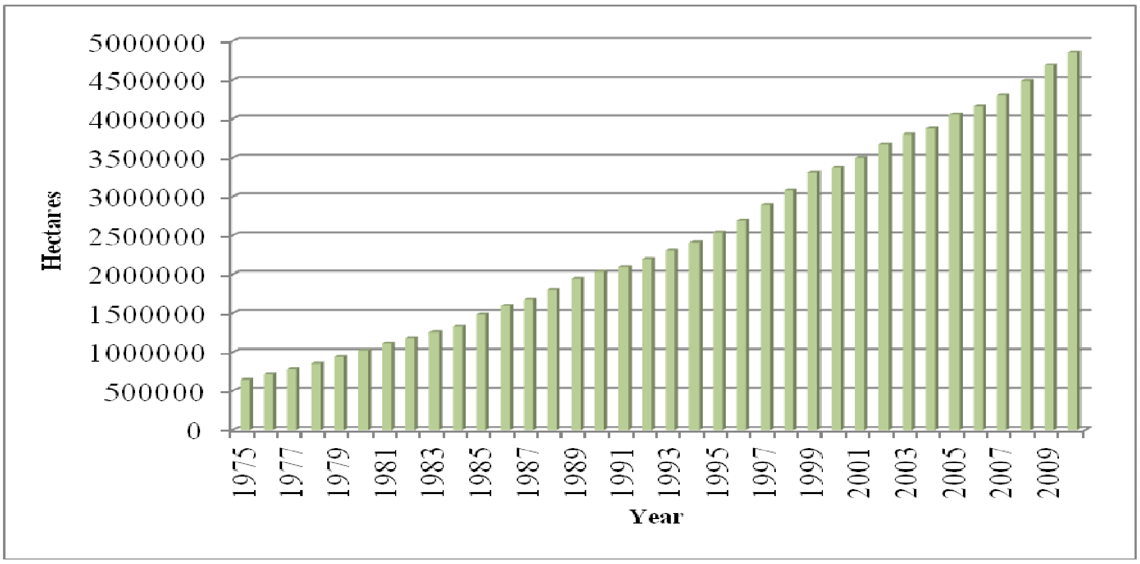
Besides, the growing global demand for food has created a dilemma for major producing and exporting countries, such as Malaysia, as the palm oil industry is one of the main contributors to the economy and the development of the nation. On top of that, the palm oil industry has been proven to be successful in reducing poverty as this industry has positively changed the lives of small-scale farmers in Malaysia (Pletcher, 1991; 623). This industry generated employment opportunities for around 860,000 workers in 2006, supporting the livelihoods of two million people (Kamaleswari, 2009). Nevertheless, a number of current issues related to palm oil production are widely perceived as negative (Yusoff and Hanson, 2007; Nazir and Setyaningsih, 2010; Henson, 2005; Mattson et al., 2000; Devisscher, 2007). In particular, there have been environmental concerns about oil palm plantations replacing natural forests. This has been the case in some areas in Peninsular Malaysia through the land development programme of the Federal Land Development Authority (FELDA) and also due to the Government New Economic Policy (1970–1990). In 2012, the existing planted area in Malaysia reached 4,352,872 hectares of mature plantations and 724, 057 hectares of immature plantations (Ling and Pillai, 2001; Corley and Tinker, 2003, 17; MPOB, 2012). The trends in the expansion of oil palm plantations are presented in figure 1.2.

1.2 Definition of Problem

According to Abelson (1996; 3), population growth will increase the pressure on depletable and renewable resources and the demand for food by a factor of three; energy and water by up to a factor of six. As domestic and international demands have grown and continued to increase, the land areas used for palm oil production has increased tremendously to meet these demands (Figure 1.2). Despite the economic benefits of the industry, this expansion has resulted in negative social, environmental, and economic externalities; such as displacement of rural communities, deforestation, soil erosion, and the loss of biodiversity. These are becoming major issues, provoking debate on the environmental and human rights issues surrounding the industry. In developing countries, the overall environmental costs are expected to increase rapidly at first and subsequently slow down after a turning point. Countries experience this turning point when their society's standard of living and their governance capacity enable them to develop effective policies and adopt cleaner technologies. This is a scenario described by the Environmental Kuznet's Curve, which is also believed to have a complex distributional effect.

Currently, the pivotal actors in the palm oil industry have been striving to improve sustainability; many stakeholders have begun initiatives that work towards that goal. These initiatives have, however, failed to fulfil the expectations of various consumer and environmental groups, whose concept of "sustainability" is constantly evolving. In addition, a cohort of NGOs and other social groups claims that the palm oil industry is inherently unsustainable; therefore, they seek to either eliminate the industry or reduce its size (Aikanathan, 2013).

Figure 1.2 Areas Planted with Oil Palm, Malaysia: 1975–2010 (in hectares)



Source: Department of Statistics, Malaysia: 1975–1984; MPOB: 1985–2010).

In the Malaysian palm oil industry, large private estates are pivotal actors in the source end of supply chains (comprising of 61% of the total plantation areas). These are followed by plantations owned by FELDA (14%), independent smallholders (14%) with FELCRA and RISDA, and state owned plantations under Government Linked Companies (GLC) that represent the remaining 11%. Independent smallholders constitute of a large proportion of the industry; they have different systems and approaches to farm management. The published figures on Malaysia's production efficiency (in tonnes per hectare) are questionable when compared with the mean global palm oil yield (Table 1.1). Production efficiency may be better assessed on a per tonne, per labourer, or per hectare basis. The figures in Table 1.1 do not show the differences in yield between large estates, medium-scale producers, and smallholders. These differences could offer greater insight into the internal production dynamics of the industry.

As petroleum reserves in Malaysia remain stagnant and oil consumption increases, Malaysia may consider developing its domestic biofuel/biodiesel industry. Currently, there are no comprehensive national-level policies on biofuel and biodiesel production in Malaysia; therefore, several policy options were assessed in this thesis. This is to identify the initial considerations for developing future strategies aimed at supporting the "bioeconomy" concept.

Table 1.1 Mean Global Palm Oil Yields (T/ha) and Mature Plantation Area, 1980–2007 (1000s ha)

Country	Yield (tonne per ha)						Mature Area ('000 ha)					
	1980	1990	1995	2000	2005	2007	1980	1990	1995	2000	2005	2007
Cameroon	2.5	2.6	2.6	2.6	2.8	2.9	28	41	49	53	55	60
China	2.4	2.3	2.3	0	n.a.	n.a.	5	6	7	0	47	n.a.
Colombia	3	2.8	3.1	3.9	3.9	3.6	25	81	125	134	170	205
Congo	1.5	1.4	1.4	1.3	1.3	1.3	64	74	78	76	76	78
Cote D'Iviore	1.9	1.9	1.8	1.9	2	1.9	100	125	161	139	160	168
Ecuador	2	2.6	2.1	2.3	1.7	2	19	53	87	102	150	203
Honduras	1.7	2.6	2.4	2.8	2.6	2.9	9	30	31	33	69	75
Indonesia	3.3	3.9	3.6	3.5	3.8	3.7	210	620	1167	2014	3690	4540
Malaysia	3.6	3.6	3.5	3.4	4.2	4.2	1023	2029	2540	3189	4051	3741
Nigeria	1.9	2.2	1.8	2.1	2.2	2.1	230	270	350	359	370	390
P.N.G	2.7	3.7	3.9	4.7	3.5	4	12	37	58	72	88	96
Thailand	2	2.4	2.6	2.6	2.2	2.5	10	94	139	202	316	410
Others	2.2	2.2	2.1	2.4	2.2	2.3	159	259	310	76	497	1000

Source: Oil World (various issues); Hameed and Arshad (2010).

1.3 Significance of the Study

The use of organic materials as inputs in palm oil production (processed fruit waste as fertiliser and mulch), the potential for palm oil to substitute for petroleum products, and the potential for a zero-waste production process prompted this study to assess the potential of palm oil as a bioeconomy[1] product. The palm oil industry in Malaysia currently faces international market barriers due to sustainability standards required by developed countries, such as the member states of the EU. A detailed study was carried out to investigate the sustainability issues among growers and oil extractors, which have been identified as the segments of supply chains that emit the most greenhouse gas (GHG). This research aims to identify the environmental costs and benefits brought about by growers and oil extractors, who are the source-end actors in the Malaysian palm oil industry; the potential benefits; externalities; and opportunity costs of this industry. The policy options aim at directing the

[1] Bioeconomy refers to all industrial and economic sectors, as well as their associated services, that produce, process, or engage in any commercial uses of biological resources, such as plants, animals, and micro-organisms. (Source: BMBF, 2012)

current supply chains of the industry towards internationally recognised sustainability standards were also investigated. This research included the following analyses:

I. Supply chain mapping: a functional and institutional analysis
II. Historical review of the Malaysian palm oil industry: including interviews with industry experts
III. Globalisation, poverty, and income distribution: financial, economic, and gross margin analyses
IV. Externalities and sustainability of the Malaysian palm oil industry: cost and benefit analyses
V. Malaysian industrial policy in the industrialisation strategy: Malaysian Palm Oil Biodiesel policy in comparison with the German rapeseed biodiesel and the US corn bioethanol policy

1.4 Research Objectives

The main objective of this study was to analyse the construction of a value chain, thereby making recommendations on sustainable practices for the Malaysian palm oil industry so that the industry may contribute to the development of the bioeconomy in Malaysia.

The secondary objectives were as follows:

I. To identify the actors in palm oil production in Malaysia.
II. To estimate the gross margins per hectare, per labourer, and per tonne for small-medium, and large-scale producers.
III. To identify the opportunity costs and externalities of producing palm oil in Malaysia.
IV. To review international policies and norms with the aim to identify policy options for bioeconomy strategy that can upgrade the Malaysian palm oil industry as well as those of other palm oil producing countries.

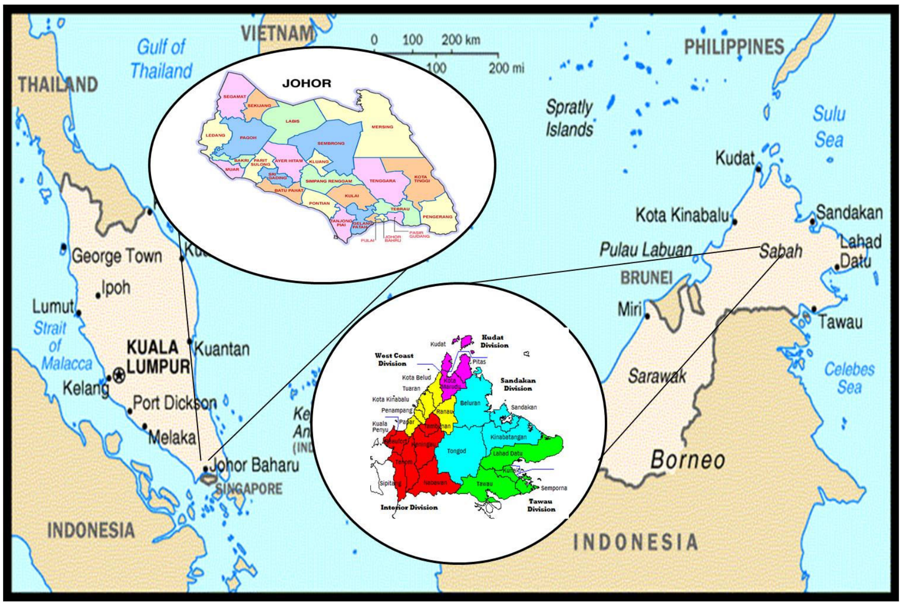
1.5 Research Background

Oil palm originated from Africa. However, Malaysia and Indonesia are currently the major producers of palm oil in the international market (Corley and Tinker, 2003). Malaysia has the most mature palm oil industry in the world, and its overall economic development has been progressing rapidly. The shift towards palm oil production first began as a result of the introduction of synthetic rubber, which subsequently caused a decline in demand for natural rubber in the 1980s. The Malaysian government began to encourage poor farmers to plant oil palm in the tropical rainforests. Most of the oil palm plantations in forested areas were established by federal and state agencies, including government-sponsored settlement schemes.

Malaysia is a federation that comprises thirteen states (Figure 1.3), covering Peninsular Malaysia (West Malaysia), as well as Sarawak and Sabah in Borneo (East Malaysia). Peninsular Malaysia accounts for 40% of the land area in the country and over three-quarters of its population. Initially, lowland evergreen tropical rainforest covered most of Peninsular Malaysia at low altitudes (Collins et al., 1991). Since the 1960s, most of the tropical rainforest in Peninsular Malaysia has been cleared for palm plantations. From 1990 onwards, the palm oil industry has expanded to East Malaysia (especially Sabah).

Johor and Sabah were chosen as study sites to represent Peninsular Malaysia and East Malaysia respectively for several reasons. The state of Johor has the highest GDP among the Malaysian states. It is the state with the largest palm oil production in Peninsular Malaysia. Furthermore, it has the most severe air and water pollution issues related to the palm oil industry as well as the largest volume of palm oil exports in Malaysia. Therefore, Johor was chosen to be representative of regions in Malaysia where the palm oil industry has a long history and oil palm plantations have had significant impacts. Meanwhile, Sabah is the state with the largest palm oil production in East Malaysia. It has the largest land area used for oil palm plantations in Malaysia and the highest oil yield in the country in terms of tonnes per hectare. Sabah is also part of Borneo, a region that is frequently the subject of concerns over the recent loss of biodiversity. The impacts of the palm oil industry on land-use changes in the two states were assessed under three scenarios: 1) rainforests converted to oil palm plantations, 2) rubber plantations converted to oil palm plantations, and 3) cocoa plantations converted to oil palm plantations.

Figure 1.3 Study Regions



Source: Adapted from Geography and Map of Malaysia (2009).

1.6 Research Questions

The research questions were as follows:

I. Who are the key actors in the palm oil industry and how are the supply chains segmented?

II. Which segments of the industry cause the most concern on the topic of sustainability?

III. What are the opportunity costs of producing palm oil as a second generation crop in areas converted from rubber or cocoa plantations?

IV. What are the externalities of palm oil production with regards to the sustainability issues associated with the industry?

V. What policies have been adopted by the Malaysian government to strengthen its domestic palm oil industry?

1.7 Expected Contribution to Existing Knowledge

This study intends to contribute to the growing list of literature that focuses on the global value chain (GVC) framework by applying gross margin and cost-benefit analyses (CBA) to describe the efficiency of this industry and its externalities. The scope of previous research on the GVC concept has been limited to economic/financial analyses or the total factor productivity of small-scale production. In the case of CBA, previous research on the Malaysian palm oil industry has applied CBA without considering the externality effects of the industry. Most studies employed life-cycle assessments to analyse the negative aspects of the industry. In this study, however, various palm oil producers were analysed, including smallholders, medium-size plantations, and large private estates; the results obtained were compared to those from the previous studies that only described the role of smallholders. This is because collecting relevant data in Malaysia is difficult. Indeed, this had inhibited the research on various producers and other industrial actors. A temporal dimension was also included by examining both the historical and the current impacts of the palm oil industry. Previous research in Malaysia had focused only on the Western peninsular region, as data collection in Borneo is costlier and more challenging. This study is the first attempt to date to conduct a bioeconomy GVC analysis of the palm oil industry, including all the key supply chain actors, to provide a more comprehensive view of the industry than previous efforts (i.e. Amitabha, 2004; Nordin et al., 2004; Vermulen and Goad, 2006; Hameed and Arshad, 2010, Duijn, 2013). This study assesses the yield performance and impacts of land use at different cultivation scales, which have yet to be addressed in past research.

1.8 Structure of the Study

In the first chapter, a general introduction, which details the problem statement, objectives, research questions, conceptual framework, and the expected value of this study, is presented. The Malaysian palm oil industry was evaluated using the concept of industrial organisation. This concept measures the industrial actor efficiency, and takes the behaviour of industrial actors and their commitment to palm oil industry bioeconomy development into account. This could strengthen the future of the industry despite mutual competition. The government policies and interventions that influence the behaviour of the actors and their development in the industry were also reviewed.

In the second chapter, the history of the Malaysian palm oil industry was recount up to its present state. The results of interviews with industry experts were presented; the experts including Tun Dr Mahathir Mohamed (the fourth prime minister of Malaysia), Tan Sri Dr Yusof Basiron (president of the Malaysian Palm Oil Council and former director of the Malaysian Palm Oil Board [MPOB]), and two well-known policy makers in Malaysia who have played critical roles in the development of the industry.

In the third chapter, functional and institutional analyses based on the GVC concept were discussed. The analyses were conducted using a combination of approaches, which were described by Kaplinsky and Morris (2000), McCormick and Schmitz (2001), and FAO

(2006a). The entire Malaysian palm oil industry was analysed based on the gross margin per hectare, per labourer, and per tonne. The growers were categorised into small, medium, and large scale producers according to the size of their plantation. The calculations were based on the Northern Victoria (2009–2010) gross margin analysis framework. The value added to the supply chain by the growers, calculated in terms of per hectare and per tonnes, was also identified. Lastly, the inverse relationship between productivity and profitability, as well as the gap filled in by this research, are discussed.

In the fourth chapter, topics related to externalities and sustainability were discussed; they were adapted from the framework used by Boardman et al. (2006), and Noormahayu et al (2009). The CBA and benefit-cost ratio of both growers and oil mills located in Johor and Sabah were taken into account to investigate the external effects of this industry. The social costs and benefits brought about by oil palm plantations and oil extraction mills were determined using field data collected by the researcher and other supplementary data. These two segments on the supply chain were selected because they have caused the most concern among environmental groups. This chapter also describes the design of the cost benefit framework, and the process of evaluating the externality factor in the CBA.

Finally, the fifth chapter proposes a policy for Malaysia, which could, at the same time, serve as a model for other palm oil producing countries. The chapter also discusses the construction of a policy framework for the Malaysian palm oil industry based on similar industries in developed countries. The theoretical framework on Industrial Organisation and Infant Industry argument were reviewed in the first part of the discussion. Next, the chapter discusses and compares two policies of two countries for their biofuel industries, namely the German rapeseed biodiesel and the US corn ethanol industries. Policy options were also proposed with the aim of improving the efficiency and sustainability of the Malaysian palm oil industry. In addition, the factors that have made Malaysia one of the main palm oil producers despite facing competitions from West African countries, from which the palm oil industry originated, are also discussed. Lastly, based on research findings and literatures, policy recommendations and the role of the state in drafting industrialisation strategies for the Malaysian palm oil industry were discussed.

Chapter 2 The History and the Current Issues of the Malaysian Palm Oil Industry

2.1 Introduction

In this chapter, the history of Malaysian palm oil industry is discussed in detail. The topics include policies, expert opinions on the current policy initiatives, and current issues in this industry. Business study and narrative approaches were employed based on the interviews with experts and major players in the palm oil sector. The narratives provide the original tone of the interviewees. The following experts and policy makers were interviewed: 1) Tun Dr Mahathir Mohamed, the fourth prime minister of Malaysia; 2) Balu Nambiappan, the head of the Trade and Development Unit of the Malaysian Palm Oil Board (MPOB) in Kelana Jaya; 3) Hilalluddin Abdul Rahim, the former director of the Farmers Organisation Authority (FOA) in Negeri Sembilan; 4) an FOA officer in Johor; 5) Professor Ir Dr Halim Shamsuddin (a renewable energy policy design and pellet biofuel technology expert) at the University of Duisburg, Germany; and 6)Tan Sri Dr Yusof Basiron, the former director general of the MPOB. Tun Dr Mahathir was interviewed again for the second time on the 8th of May 2013 at his office in Putrajaya, and Dr Yusof Basiron on the 25th of April 2013 at his MPOC office in Kelana Jaya to discuss the findings related to the state of the palm oil industry and the biofuel policy in Malaysia. The interviews lasted for an hour on average; the questions were drafted based on the interviewees' field of expertise.

2.2 The History of the Malaysian Palm Oil Industry

A Frenchman named Henri Fauconnier is considered the father of the oil palm industry in Malaysia because he established the first oil palm plantation in the country (Basiron, personal communication). Fauconnier is also the author of "The Soul of Malaya", published in 1930, a well-known book about the country. Peninsular Malaysia used to rank fourth among the major oil palm producers after Nigeria, Belgian Congo, and the Dutch of East Indies. At that time, palm oil from Malaysia accounted only for 11% of global production. Oil palm plantations in Malaysia used to be exclusively owned by Europeans because establishing required significant capital investment and technical processing capacity. After 1945, unstable political conditions in competitor countries and deliberate strategies target at developing this industry led to the rapid growth of the number of oil palm plantations in Peninsular Malaysia (Basiron, personal communication). In the 20th century, during the colonial era, English- and European-owned companies began developing their plantation businesses. They had initially transformed forested land into tea, coffee, and rubber estates. Some of the old companies that have been established in the Malaysian industry are Kumpulan Guthrie Berhad, Golden Hope Plantations Berhad, Sime Darby Berhad, Kuala Lumpur Kepong Berhad, and United Plantations Berhad (Teoh, 2002).

In addition, Dr Basiron stated that oil palms are abundant in tropical Africa under natural conditions and are widely used by the natives. Vegetable oil is an important food resource, and therefore, merchants in the 18th century were keen to test oil palm cultivation in other tropical countries. Oil palms were reportedly grown in Mauritius and Calcutta in 1836 (Basiron, personal communication). Oil palms, the so-called 'golden' or 'platinum crop', came to Malaysia in the 1870s from West Africa (Abdul Rahim, personal communication). The first oil palm seeds planted in Malaysia were imported from Ceylon in the 1980s via the Singapore Botanic Garden. It is believed that this planting material originally came through Sumatra (Basiron, personal communication).

According to MPOC (2013), the oil palm industry grew because of the British Industrial Revolution and international trade. As the demand for palm oil products, such as soaps, lubricants, and edible oils increased, the number of oil palm plantations grew tremendously in both West Africa and Southeast Asia. The first private oil palm estate was established in Sumatra in 1911, and the Malaysian Department of Agriculture conducted the first experimental planting of oil palm at Batu Tiga, Selangor, in 1903. In 1912, another fifteen acres (6 hectares) of oil palms were grown as an experimental plantation in Kuala Lumpur by the Department of Agriculture. In 1917, oil palm estates were founded in Tennamaran Estate in Selangor (MPOC, 2013). It was first in the 1960s that growing oil palm began gaining popularity because of the increased confidence in oil palm and the need for crop diversification. FELDA also provided access to new pieces land, this contributed significantly to the increase of oil palm acreage. Furthermore, the growing interest in oil palms coincided with emergence of commercial plantations in the 1890s; growers often replaced rubber crops with oil palms (Basiron, personal communication; Nambiappan, personal communication; Abdul Rahim, personal communication). Growing oil palm is more cost-effective than rubber: oil palms mature quicker than rubber (oil palms take 3 to 4 years, while rubber trees take 6 to 7 years). Rubber also faced competition from synthetic rubber, and booming palm oil prices encouraged growers to favour growing oil palms over rubber crop, contributing to the shift in land use. Most importantly, from 1962 onwards, the government's second rubber planting scheme allowed growers to replace rubber with other crops. Another factor that contributed to the accelerated development of oil palm cultivation was the labour shortage in rubber plantations (Basiron, personal communication; Nambiappan, personal communication; Abdul Rahim, personal communication). This was concurred by ICRAF (2002), which noted that rubber plantation is a labour intensive crop.

2.3 The Expansion of Oil Palm in Malaysia

In the 1960s, 54,000 hectares of land were used for oil palm cultivation; this figure rose to 800,000 hectares by 1980 as a result of the national government's crop diversification policy, and initiatives to develop forested land for the landless people via FELDA settlement scheme[2] (Wong, 2011; 125). Oil palm was the preferred crop because palm oil prices were relatively high during that period (Abdul Rahim, personal communication). Mahathir Mohamad, the former Malaysian Prime Minister, claimed that his strategic decision to promote palm oil in the 1980s was prompted by the increasing global population, particularly in countries neighbouring China. Demand for palm oil products, such as cooking oil and processed foods with palm oil ingredients, increased in the 1960s, motivating the government of Malaysia to expand the oil palm industry. This opinion concurs with that of Sanders et al. (2012), who noted that increased demand in developing countries, such as India and China, may have contributed to the growth of palm oil. Sanders et. al. also added that policies that are less supportive of the soybean sector, and the multilateral trading system supported by the World Trade Organisation (WTO), may also have contributed to the expansion of the palm oil industry. The demand for palm oil in the European Union is growing because of labelling requirements on oils derived from GM crops. The market preference has already been shifting from GM soybeans toward non-GM soybeans. However, the availability of non-GM soybeans is limited (leading to soybean price increase), causing consumers to turn to cheaper oil seeds such as oil palm (Sanders et al. 2012). Moreover, the falling rubber prices at that

[2] FELDA was previously abbreviated as FLDA. ``The Federal Development Authority was established in July 1956 under the Land Ordinance (1956) of the Ministry of Land and Cooperative Development´´. FELDA has developed forest land to resettle the rural communities which are landless and poor. Prior to 1961, FELDA used to only provide financial assistance to the State governments for land development programmes, but it is also responsible for the development of new land, commercial plantation and settlement throughout the country.

time also further incentivise growing oil palm. According to Dr Mahathir (personal communication), most rubber plantations in Malaysia have been replaced by oil palm. Koh and Wilcove (2008) found that 41% to 45% of the plantations growing rubber or other crops were converted to oil palm plantations in Malaysia between 1990 and 2005.

In the 1960s, Malaysia was the largest producer and exporter of palm oil due partly to investment, and research and development supported by the national government, as well as the participation of small-scale growers in FELDA. Dr Mahathir mentioned that the Malaysian government decided to invest heavily in the research and development of oil palm clones to obtain better quality fruit and oil. The Malaysian palm oil industry also owns an advanced research laboratory in the USA. The increase of palm oil exports, especially to China, was due to the open economic policy in China; China is the largest importer of palm oil products from Malaysia (Mahathir, personal communication). When asked how his team assessed the long-term competitiveness of the sector, Dr Mahathir stated that the costs of production inputs are cheaper for oil palm than other food oil crops. Oil palm is a permanent crop that only needs to be replanted every 25 years. This lengthy rotation cycle reduces production costs. Essentially, palm oil has become the cheapest food oil because it is less expensive to meet the basic biological needs of oil palm than other alternative oil crops. This assessment is consistent with that of Bharat (2013), who noted that because the life cycle of oil palm is between 25 and 30 years, the cost of labour and fossil fuel is comparatively lower.

2.4 Strategic Plan for the Palm Oil Industry in Malaysia: Lessons Learned from the West African Palm Oil Industry

West Africa is the origin of the palm oil industry and formerly the largest producer and exporter of palm oil. Dr Mahathir said that oil palms from West Africa were not cultivated in plantations. Rather, oil palm fruits were collected from the forests. The West African oil palm industry was not systematically managed. The production remained at a small scale and the quality of fruit was low. Dr Mahathir also claimed that the production had been unstable and inconsistent.

Malaysia, in contrast, has developed industry policies to ensure that palm oil production is more consistent and systematic. For instance, FELDA has been a major actor in the Malaysian oil palm industry. Palm oil research institutes, such as the MPOB and the Malaysian Palm Oil Council (MPOC), are developed to advance research needs. The World Bank has acknowledged achievements of FELDA as one of the most successful resettlement initiatives in the world (Pletcher, 1991; 628). Nonetheless, Dr Mahathir noted that further research and development is needed to improve the quality of palm oil products.

Further researches are required to develop the ability to use every part of an oil palm tree for commercial products, thereby adding more value to the industry. For instance, oil palm leaves have the potential to be made into a commercial product because of its high vitamin E content. Dr Mahathir also believes that it is necessary to adopt diversified farming systems. One such example is integrated farming, in which farmers raise cattle in oil palm plantations, so that in addition to cultivating oil palm, growers can also produce beef products. However, cattle can damage immature palms, and therefore, it is only advisable to pasture cattle in mature plantations. Abdul Rahim (personal communication) agreed that integrated farming is good when it is well planned and structured.

2.5 Contributions of Palm Oil to the Malaysian Economic Development

Palm oil is considered as the backbone of the Malaysian economy (FAO, 2012). It is often claimed by Malaysian policy makers that palm oil helps farmers emerge from poverty in Malaysia; therefore, I asked the experts how palm oil has contributed to poverty alleviation in Malaysia. Basiron mentioned that oil palm plantations, as well as most palm oil mills, are mainly located in rural areas. The plantations require a large number of labourer, thereby providing employment for the rural population. The plantations also cause a multiplier effect on employment in rural areas: the demand for labourers to be employed in other services increase. FELDA serves a good example; small towns with amenities have developed in, and around, FELDA settlement areas (Basiron, personal communication). Dr Mahathir mentioned that FELDA also provides land (at least 4 hectares per household) to poor people who participate in oil palm settlement projects. All production activities were previously managed by the farmers themselves; however, FELDA currently manages all production activities, and farmers receive a monthly income of at least RM 1,200 (Mahathir, personal communication).

On top of that, FELDA has resettled 102,737 families through its 278 resettlement projects (Malaysia, 2000; 276). The projects also involve building basic infrastructures. Each household is allocated 4 hectares of land for crop cultivation and 0.1 hectares for housing. The land titles of both parcels are given to the settlers by the state government. Outstanding development loans are often successfully repaid by the settlers within a 20-year period. For instance, as of the year 2000, 47% of the settlers had successfully received their land titles

(Malaysia, 2000; 276). Some studies on FELDA policies, however, have offered different points of view, as shown in Table 2.1:

Table 2.1 Researches pertaining to Federal Land Development Authority (FELDA)

Nolten[*a] (1988)	FELDA was only successful in terms of micro economic level, but not in terms of macro economy.
Bahrin and Dorall *[b](1992)	FELDA was not found successful as the settlers were only receiving the minimum income, as stated in the objectives of FELDA.
Kottak *[c](1985)	FELDA investment was very high in terms of cost per acre and per settler.
World bank*[d] (1985)	There is a lack of participation among settlers in any decision making made by FELDA.
Puthucheary (2011)	FELDA did not provide job opportunities for the second generation settlers.

Source: *a, *b,*c, *d in Sutton and Buang (1995).

Nambiappan, the Head of the Trade and Development Unit of the MPOB, said that by opening of previously inaccessible areas, the government agencies (FELDA, KESEDAR, KETENGAH, and KEJORA) and private oil palm companies have enabled the development of thriving social and business activities in these areas that benefited a significant portion of the local population (Nambiappan, personal communication). By helping families out of poverty, the palm oil industry has made an important contribution to one of the main goals of the Malaysia New Economic Policy. The industry provides direct employment to more than 570,000 people (Nambiappan, personal communication). In addition, Saravanamuttu (2013, p. 123) noted that between the mid-1980s and 2007, they were 350,000 more workers in oil palm plantations. Ever since the lands were developed into oil palm plantations, more infrastructures have been built, and an agriculture-based industry was established, thereby providing more employment opportunities. There are, however, problems faced by the industry. According to Fadzilah and Dayang (2013, 141), many labourers in oil palm plantations are migrant workers; some migrant workers use fake identity cards to gain the rights of a Malaysian citizen. Stringent policy and stronger law enforcement may be needed to solve these issues. Fadzilah and Dayang (2013) also found that Malaysians consider plantation jobs to be menial and incapable of improving their standard of living. Locals do not usually work in a plantation out of choice; they often work there because they lack personal properties, such as land, or for other personal reasons. The Malaysian government has enlisted the help of the palm oil industry to mitigate urban poverty by reducing the scale of rural-urban migration (Nambiappan, personal communication). According to Bharat (2013), several oil palm plantations have disregarded land tenure systems of the local communities. This usually happens when a corporation acquires a large piece of land for the development of commercial oil palm plantation. Low wages paid to farm labours and unsafe working conditions have also been noted as the drawbacks of oil palm expansion. Other emerging issues related to oil palm plantation include land conflicts, labour issues, and human rights violations (see Wakker 2005).

2.6 The Reason Malaysia Recently Fell Behind Indonesia in Palm Oil Production

Indonesia recognises the profitability of the palm oil industry (Basiron, personal interview). It has a vast territory and a large land area used to cultivate oil palm. Compared to Malaysia, Indonesia has a higher palm oil production. This is mainly because Indonesia dedicates a larger land area, 6.5 million hectares in Indonesia as compared to 5 million hectares in Malaysia, to oil palm cultivation (Basiron, personal communication). However, most of the oil palm plantations and extraction mills in Indonesia belong to Malaysians. Indonesia has more land and the production costs of palm oil are lower there. Producers from Malaysia are drawn to invest and operate palm oil-related businesses in Indonesia (Mahathir, personal communication). The Malaysian palm oil production has also been decreasing because of limited land area for expansion and slow replanting rates. According to Malaysian law, "no non-farming land can be newly brought under oil palm cultivation" (Bharat, 2013; 185). The slow replanting rate is a result of the current high crude palm oil (CPO) prices discouraging growers from replanting their trees (Nambiappan, personal communication). Older oil palm plantations, especially those more than 27 years old, have lower yields, and produces fruits and seeds with lower oil content.

2.7 Issues related to the Palm Oil Industry: Land Rights and Externalities

The palm oil industry is highly regulated in Malaysia (Basiron, personal interview). Oil palms are only allowed be grown on legally zoned agricultural land as opposed to land designated as Permanent Forest Reserve. The oil palm plantations have legal land titles, which can be obtained from the state governments. The state governments are obligated to ensure that the land is free from encumbrances, such as tenure claims, before land titles can be issued. All palm oil businesses are registered and licensed by the MPOB; non-compliance could entail fine or even a revocation of the licence by the MPOB. When asked how the

Malaysian palm oil industry policy differs from other countries, Basiron said that every business or actor along the supply chains of the oil palm industry are licensed by and registered with the MPOB, whereas this is not typically the case in other palm oil producing countries.

Even though palm oil producers are licensed by the MPOB and there are rules by the chain governance, land degradation remains a contentious issue in the Malaysian palm oil industry. The other serious problems include biodiversity loss and deforestation. These issues are partly the results of policies and land codes created by the federal and state governments (McMorrow and Talip, 2001; 217). Koh and Wilcove (2008) corroborated this claim and argued that the converting primary or secondary logged forest to oil palm plantation leads to a significant biodiversity loss. In Sabah (the second study region), there are three contributors to environmental degradation: land cover changes in the region, timber industry, and conversion of land to agricultural crops (Brookfield and Byron, 1990); while the three critical policy instruments are: land alienation and gazettement, land capability classification (LCC), and the land tenure system, as stated in the National Land Code 1965 (McMorrow and Talip, 2001; 218).

In Malaysia, the federal government is responsible for land-use planning, but individual state governments control land production. According to McMorrow and Talip (2001), each state in Malaysia is required to designate at least 47% of its land area as Permanent Forest Reserve, which serves three functions:

I. Sustainable production of timber and non-timber products;
II. Protection of soil, water, and wildlife;
III. Provision of other amenities.

The Sabah Forest Department, the Department of Agriculture, and the Land and Survey Department are the three prominent governmental actors in Sabah. The Sabah Forest Department manages its forest resources with the aim of benefiting the society, economy, and environment; whereas the Sabah Department of Agriculture fosters agricultural development to enhance the value of agricultural industries.

On the subject of deforestation in Borneo for the palm oil industry, Basiron (personal communication) explained that every government has an important role in uplifting the economy and creating employment opportunities for its citizens. The use of land is the sovereign right of a nation in accordance with its national development priorities. In tropical developing countries, agriculture is an excellent means of driving the economy and creating employment. Given the large amount of forest land in Borneo, it seems logical to use part of it for oil palm cultivation. Furthermore, many developed countries have also previously experienced this phase of development, in which forests are clear for agricultural purposes. Only later did the current developed countries industrialise. Borneo is currently going through this phase (Basiron, personal communication). However, Panayotou (1997) argued and claimed that the government as an institution play a pivotal role in reducing externalities at low levels of income. Hence, policy makers in Malaysia need to consider the holistic value of land when making policies on land-use. The externalities of land-use will improve efficiency, and in turn, lend credibility to policymakers. Dr Basiron also pointed out that even though forests have been cleared for agriculture (including oil palm) in Borneo, it still has a high proportion of forest cover at more than 50% (Basiron, personal communication) (figures according to various existing literatures: 62.73% [Seegraf, 2010]; 62% [FAO, 2011]; and 61.9% [World Bank]). The initial emergence of the oil palm industry did not cause concern among the NGOs, but the NGOs started highlighting environmental issue associated with the industry ever since forest fires in Indonesia caused "most of Southeast Asia to be blanketed by smog for several months" (WWF, 1997).

Basiron argued that Malaysia still has a significantly greater percentage of forested land than some developed countries, which generally have less than 25% of forest cover (Basiron, personal communication). Malaysian policies stipulate that only 20% of its land area is allowed to be used for agriculture, while 60% of the land area is to be preserved for forests (Bharat, 2013, 185). Basiron (personal communication) also exemplified the lesser negative influence of oil palm agriculture on the environment: less forested land needs to be cleared for oil palm plantations as oil palms are eleven times more productive than soybeans; 1,000 hectares of land used for oil palm plantation is capable of producing the equivalent amount of food that 11,000 hectares of soybean crop can produce. The productivities of oil seeds (tonnes per hectare) are: soybean (0.36 tonnes), sunflower (0.46 tonnes), rapeseed (0.6 tonnes), and oil palm (3.66 tonnes) (MPOC, 2007; Lane, 2011). This study, however, focuses on the opportunity cost of not developing the Malaysian oil palm industry rather than the comparison between the oil seeds. In particular, oil palm plantations on peatlands, known carbon sinks, require drainages that extend 60-80 cm below ground, thereby increasing peat decomposition and CO_2 emission (see Germer and Sauerborn, 2007; RSPO, 2009).

Basiron also noted that (including Malaysian Borneo) virgin forests are seldom converted to oil palm plantations in Malaysia. For the most part, degraded forests, which have been logged for several cycles until it is incapable of producing economic timber (i.e. low carbon stocks), are converted to oil palm plantation. However, a study conducted by Koh and Wilcove (2008) revealed that from 1990 to 2005, 55% to 60% of oil palm plantations in Malaysia and Indonesia were established by converting virgin forests. Koh et al. (2011) also noted that one-tenth of the total forested area that was cleared in Peninsular Malaysia was former peat swamp forest (880,000 hectares or 6% of total peatland). Nambiappan agrees with Basiron's assessment and added that Malaysia has protected forest reserves from development. These permanent forests, which comprise 56% of the total land area, are devoted to the conservation of wildlife and biodiversity. He added that people often overlook the economic contribution of the oil palm industry, to the global population; the per capita income of developing countries rises, particularly those of small-scale growers. Nambiappan also mentioned that Malaysian plantations have made improvements to their agricultural practices to mitigate the environmental impacts. Many growers adopt a zero-burning policy. This not only reduces negative environmental impacts, but also improves the biodiversity in soil by enhancing soil organic matter, physical properties, and fertility. The other improved agricultural practices in Malaysia include using leguminous and grass cover crops to enhance soil fertility and to reduce soil erosion; using oil palm waste like mulch to reduce runoff, waste, and usage of chemical herbicides; and maintaining water catchments. Some growers also employ Integrated Pest Management (IPM), which reduces pesticide usage, by promoting the growth of beneficial plants and attracting natural predators, such as barn owls (*Tyto alba)*, as a form of biological pest control. Barn owls are able to provide long-term rat control so that rat damage in oil palm plantation falls below consequential levels without chemical intervention. In August 2007, the Malaysian Ministry of Plantation, Industries, and Commodities adopted a Codes of Practice (CoP) as guidelines for a more sustainable palm oil industry. The CoP lays down rules in these six areas: 1) good nursery practices; 2) good agricultural practices; 3) good milling practices; 4) good kernel crushing practices; 5) good refinery practices; and 6) good handling, transport, and storage practices.

Malaysia also actively educates its farmers, millers, and refiners along the industrial supply chains on the uses of palm oil by-products, such as sustainable livestock feed and biodiesel production. At the same time, the government has been engaging palm oil consumers and other potential stakeholders to be committed to the use of palm oil as food ingredients, livestock feed, and for biodiesel. Through its palm oil related agencies, Malaysia will continue to collaborate with their foreign counterparts in order to enhance consumer perceptions of the sustainability of the Malaysian palm oil industry (Nambiappan, personal communication).

2.8 Palm Oil Industry and Biodiversity-related Issues

Answering to criticisms on the palm oil industry regarding biodiversity loss and potential extinction of species, such as orang-utans in Borneo, Basiron explained during the interview that much of this criticism has been sensationalised (Basiron, personal interview). Besides orang-utans, a study conducted by Koh and Wilcove (2008) also found that oil palm plantations converted from primary forest and logged forest caused a reduction in species richness by 83%, For example, the species richness of forest butterflies reduced by 79%, and that of birds species by 60-80% (Danielsen and Heegaard, 1995; Wilcove, 2008). Basiron added that a study commissioned by the MPOC and a French NGO (HUTAN) found that there were 11,000 orang-utans in Sabah in 2009. He added that it is easy to make accusations and express criticism, and that if such claims are really true, the NGOs should be responsible for the identification of, and finding solutions to, the factors that cause the loss of species richness and extinction.[3] Basiron also felt that the conservation efforts of the NGOs would be more effective if they were to work together with plantation managers to develop mutually beneficial solutions. He claimed that NGOs have refused to cooperate with the industry despite invitations from the MPOC. Malaysian Borneo deserves more attention, and in this respect, The Malaysian government and the palm oil industry have established the Malaysian Palm Oil Wildlife Conservation Fund (MPOWCF), a revolving fund whose purpose is to facilitate wildlife conservation and protection. There are numerous on-going projects, including courses on wildlife conservation for plantation managers, relocation of animals displaced by forest clearing for oil palm cultivation, and many other initiatives[4] (Basiron, personal communication). Another environmental issue is indirect land use change (iLUC),

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[3] 'Demand for palm oil is rapidly growing. At the moment, most of it ends up in hundreds of food products, from margarine and chocolate to cream cheese and oven chips. Although it is also used in cosmetics and increasingly, for use in biodiesel, the cost to the environment and the global climate is devastating - to feed this demand, tropical rainforests and peatlands in South East Asia are being torn up to provide land for oil palm plantations' (Greenpeace, 2012).

[4] Dr Basiron mentioned that many initiatives of the Malaysian government are listed on the MPOC website.

the unintended consequence of releasing more carbon due to the development of new areas for food crop production to replace areas displaced by oil palm plantation used to meet demand for biofuel. The policy experts interviewed opined that the science behind iLUC is still very vague; that the effects are uncertain and the estimations are inconsistent. Basiron specifically claimed that scientists have yet to come up with a general consensus on how to measure iLUC. Thus, further scientific studies are needed to strengthen the criticisms on the palm oil industry pertaining to iLUC.

2.9 The Key Actors in the Malaysian Palm Oil Industry

As many environmental issues and debates focus on the growing and the milling segments of the industry, the policy experts in Malaysian palm oil industry development were asked to identify the pivotal actors in the Malaysian palm oil industry. Dr Mahathir identified the land owners and growers as the key actors in the palm oil industry because they profit the most. Dr Mahathir added, the mills and refineries also add significant value to palm oil; however, Basiron believed that these segments need to diversify by also utilising crude palm oil and palm kernel oil. While Nambiappan mentioned that all industry actors do benefit from the palm oil industry, the magnitudes of their benefits vary considerably.

2.10 Institutional Aspects of the Malaysian Palm Oil Industry

The effectiveness of the Roundtable on Sustainable Palm Oil (RSPO), an international association that developed and implemented a sustainability certification standard for palm oil, has been debated in several studies (i.e. Schouten and Glasbergen, 2011). Dr Basiron mentioned that in the beginning, the actors in the palm oil industry were excited and thought that the RSPO certified oil would command a premium. Primarily, the RSPO is a global standard for sustainable palm oil production, and it claimed to be “the world's toughest standard for sustainable agriculture production, which has been variously adapted for other crops.” (RSPO, 2012). However, the demand for RSPO-certified oil has lagged, leading to disappointment among certified oil palm growers, particularly after investing considerable time, effort, and money to meet the certification criteria. The RSPO is currently the only sustainability certification for palm oil, and Dr Basiron believed that alternative certification systems should be developed and implemented to ensure that there are options for the industry. Malaysian Sustainable Palm Oil (MSPO) standard, a non-mandatory certification, was inaugurated at the end of 2014. A pilot trial was completed for seven palm oil processing mills and seven estates. MSPO adheres to the Malaysian and the international concessions and congresses. The standard covers laws on “land, wildlife protection, employee rights, crop protection, environmental protection, preservation, safety, and health issues”. The evaluation is conducted by an independent party, and two panels will review the audit reports (Eco-Business, 2014).

Nambiappan said that markets in certain countries now require that palm oil to be produced sustainably. Developed nations, such as the EU states, the USA, and Australia, have laid out stringent environmental policies. Several Malaysian producers found that the RSPO may help them to strongly penetrate the European market (Schouten and Glasbergen, 2011); 20% of players from the Malaysian palm oil industry comply with the RSPO certification standards (Eco-Business, 2014). Nambiappan believed that the principles and criteria of the RSPO standard are the best approach to sustainable palm oil production at the current state of knowledge. Sustainable palm oil production should be legal, economically viable, environmentally appropriate, and socially responsible. This can be achieve through compliance with the standards and criteria. Malaysia’s commitment to the RSPO is an attempt to improve the sustainability of its palm oil production. To encourage the growth and consumption of sustainable palm oil, Malaysian palm oil companies have participated actively in the RSPO. Companies with RSPO certifications have better opportunities to market their products in foreign markets, particularly in the EU states and US markets (Nambiappan, personal communication). However, some developed countries and NGOs have raised objections to the implementation of RSPO certification.[5] The RSPO is also vulnerable to inequality in stakeholder representation and lack the capability to resolve conflicts (Schouten and Glasbergen, 2011). Its legitimacy and sustainable standard still need to be improved.

2.11 Can Malaysia Foster its Biofuel Industry?

Malaysia was targeted to become the largest biofuel producer in 2013 but the target was not achieved. The biofuel policy target is too ambitious given the current technological

[5] Friends of the Earth and Greenpeace are the two NGOs that have raised objections to the implementation of the RSPO certification. This is taken from Greenpeace website: “The certification of palm oil by the RSPO does not halt deforestation, it does not halt the expansion of damaging oil palm plantations, and it does not benefit local communities. Basically, it fails to deal with the causes of the palm oil problems.” Meanwhile, Torry Kuswardono, International Agrofuels Campaign Coordinator at Friends of the Earth, said “Small but rapid growing quantities of palm oil are being certified by the RSPO. The certification of palm oil is seen by many as a way to make the palm oil industry appear responsible or sustainable“.
(see http://www.foei.or/en/ media/archive/2009/certified-palm-oil-not-a-solution)

capabilities and progress of biofuel refineries in Malaysia (Chin, 2011). Dr Basiron does believe that this is achievable because palm oil prices are too high to justify investment in developing palm oil-based biofuel. Besides, the EU Directive and the US-EPA both declared that palm oil biodiesel does not qualify as a renewable energy source because it does not meet their GHG emission reduction standards. However, Basiron pointed out that many studies have refuted such claims. According to Kanter (2008), the European Commission and the European countries that import palm oil biofuel are preparing a ban on importing biofuel crops which are cultivated on certain types of land, including tropical forest. Dr Mahathir also disagreed with the Malaysia's goal to become the largest biofuel producer because he thinks that it is not economically viable. He said that the biofuel prices in the market are quite low compared to the high production costs of converting palm oil to biofuel.

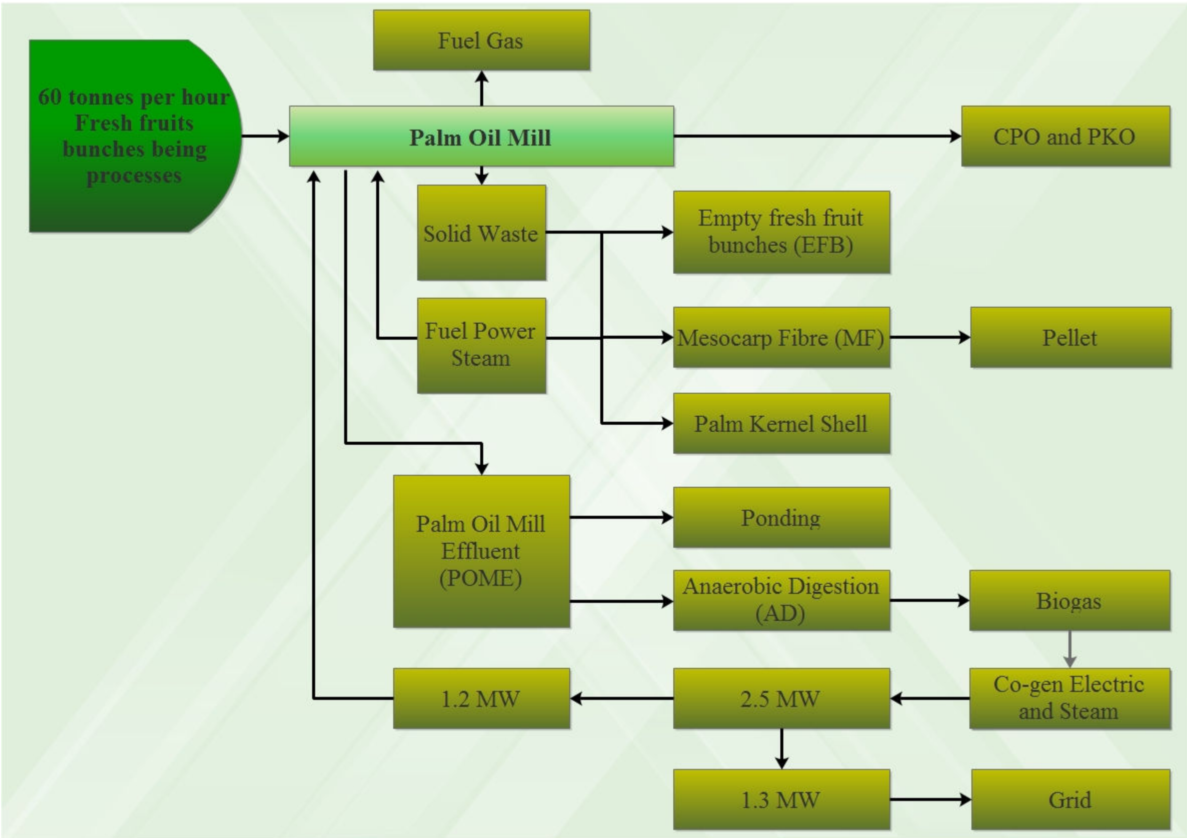
According to the National Biomass Strategy, Malaysia is targeting to produce 100 million dry tonnes of palm oil by-product biomass by 2020. Yet, doubts remain over strategy: do the existing production technology and the scale of palm oil mills have sufficient capacity to recycle oil palm wastes into bioenergy products? Can this target be achieved, or it is too ambitious? Shamsuddin, an expert in palm oil-derived renewable energy, mentioned that this target can only be achieved with proper policy planning, commitment from all parties, and policy options that are better and more pragmatic. He added that currently, the contracts available to biomass producers in Malaysia are too short term. A hypothetical scenario to illustrate the point: company A operates a palm oil extraction mill, and company B purchases biomass for biofuel production. Company A offers only a 5-year contract to company B for waste recycling services. A 5-year period is insufficient to put company B in a more secure position so that it can develop its biomass business. Policies need to be revised to foster the development of Malaysian companies that recycle palm oil biomass into biofuel (Shamsuddin, personal communication).

Biofuel pellets[6] can be exported to Europe, Japan, and Korea, thus increasing the potential market size for Malaysian palm pellets made from palm oil wastes. Shamsuddin opined that it is wiser to use biofuel pellets for domestic consumption than for exports. He also stated that the Malaysian palm oil industry can become more sustainable by adopting a zero-waste approach, which can be achieved by recycling palm oil waste into energy.[7] An extraction mill can process as much as 60 T of fresh fruit bunch per hour and produce 2.5 MW of energy by

[6] Fuel pellets based on oil palm fronds.
[7] The experts gave one case study scenario, which is summarised in Figure 2.1.

co-generating electricity and steam (Figure 2.1). Approximately 1.2 MW can used to power the operation of the palm oil mill, and the 1.3 MW of power left can be fed into the electrical grid.

Figure 2.1 Recycling Waste for Renewable Energy in Processing Mills



Note: CPO=Crude Palm Oil, PKO=Palm Kernel Oil.
Source: Shamsuddin, personal communication

The Malaysian palm oil industry has been continually improving its sustainability practices as new technologies and knowledge become available (Basiron, personal communication). For example, when the industry became aware through a life-cycle study commissioned by the MPOC that methane emission accounts for half of the total GHG emissions from the industry, palm oil extraction mills began trapping methane to prevent its release into the atmosphere. Currently, some of the mills in Malaysia capture methane and use it to generate renewable energy (Basiron, personal communication).

The Malaysian government and the palm oil industry are both actively working towards integrating these technological advancements. Palm oil is one of the National Key Economic Areas (NKEAs) that can raise the income level in Malaysia. Entry Point Project 5 (EPP 5) under NKEA palm oil and rubber aims to achieve the installation of biogas facilities in all palm oil mills so that, palm oil mills can achieve zero methane emission by 2020. Dr Basiron also stated that under the National Biomass Strategy, Malaysia already plans to use palm oil biomass as a renewable energy source. Palm oil, unlike many other seed oils, can be produced sustainably through minimal waste generation.

In addition, Dr Basiron also believes that the social benefits of the palm oil industry outweigh its social costs, particularly in reducing rural poverty. It drives development of rural areas and less-developed towns, so that the rural population receives important infrastructures that are commonplace in urban areas. Felda Global's listing on the Malaysian stock exchange is yet another example of social benefit. On a national scale, the Malaysian palm oil industry earned RM80 billion (USD 27 billion) in revenue for the Malaysian government in 2011 (Basiron, personal communication, MPOB, 2011).

2.12 Conclusion

This chapter describes the important developments in the history of the Malaysian palm oil industry and the current challenges that the industry is facing according to the industry experts. Palm oil originated from West Africa and was later introduced to Southeast Asia. Oil palm cultivation began in Malaysia at an experimental plantation in Kuala Lumpur established by the Department of Agriculture. After the experiment showed positive results, agricultural scientists became confident that oil palm has the potential to become one of the crops that serve the purpose of the Malaysian agricultural diversification policy. Besides, the demand for palm oil, used as cooking oil and ingredient in processed foods, increased in the 1960s due to population growth, especially in China. The decline in rubber prices became a driving factor in the development of oil palm as a second generation crop to substitute rubber plantations. The development of the Malaysian palm oil industry is the outcome of the strategic plan which was drafted by Tun Dr Mahathir Mohamed, former prime minister of Malaysia, after careful assessment of the palm oil industry in West Africa. It was predicted by Dr. Mahathir that plantations based on palm oil production in Malaysia could exceed the wild harvest based palm oil industry in Africa. Moreover, cultivated oil palms are able to produce a higher quantity of fruits with better quality than their wild counterparts.

Furthermore, the palm oil industry has contributed to Malaysia's economic growth and development. Oil palm plantations require a large amount of labour and have a multiplier effect on in rural economies. FELDA settlement programmes accelerated the development of the industry. Settler households are provided with four hectares of land to grow oil palms, and one acre for housing (these are provided as development loans from the government with zero interest). To date, FELDA has resettled 102,737 families through 278 settlement programmes, along with infrastructure development. The settlers are required to repay the development loans within 20 years. As of the year 2000, 47% of participating settlers have successfully repaid their outstanding development loans and have received their land titles (Malaysia, 2000; 276).

In addition, this chapter also discusses the current issues faced by the Malaysian palm oil industry, such as having a lower level of production than Indonesia. The industry experts offered different explanations for the current disparity in productivity. Dr Basiron believed that it is primarily due to the larger land area used for oil palm cultivation in Indonesia (6.5 million hectares in Indonesia compared to 5 million hectares in Malaysia); while Dr Mahathir opined that it is because of lower production costs and more available land in Indonesia.

In response to the negative perceptions of this industry on the issues of land degradation and deforestation, Dr Basiron said that usually degraded forests, instead of virgin forests, are cleared for oil palm plantations. Degraded forests, which have already been logged, have reduced carbon stocks and therefore unable to produce a timber volume that is economically significant.

This chapter also looked into the potential of the Malaysian palm oil industry to produce biofuels. According to Dr Mahathir and Dr Basiron, because the market prices of biofuels are low and production costs of palm oil biofuel are relatively high, converting palm oil into biofuel is not economical now. Furthermore, shifting the focus of the palm oil industry to biodiesel would be counterproductive because palm oil prices are high. Both experts are unanimous in their assessment that the goals set for the biofuel production in Malaysia are not realistic.

In the next chapter, the reporting tone makes way for an evidence-seeking approach. This chapter gives a general picture of the palm oil industry to briefly introduce the current issues surrounding the industry to the readers. In the later chapters, critical aspects of the industry are identified. Some of the claims made by the experts and policy makers on various subjects; including productivity, efficiency, and sustainability of oil palm plantation and processing mills were objectively and scientifically investigated.

Chapter 3 Global Value Chain and Gross Margin Analyses of the Palm Oil Industry in Malaysia

3.1 Introduction

When Malaysia gained independence in 1957, the national economy was highly dependent on rubber and tin, which together accounted for 70% of total export earnings, 28% of government revenue, and 36% of total employment. Compared with 1960, the export of goods and services occupied a much smaller percentage of the Gross National Product (GNP) in 1970, declining from 52.6% to 7.5%. Within that decade, the shares of rubber and tin in the total exports also fell by 17%. The year 1970 was a turning point in the Malaysian economic transformation. It was marked by "agricultural diversification", which saw timber and palm oil becoming pivotal export commodities. The palm oil industry also contributed to the rise in employment rate in Malaysia, and the agriculture sector constituted 11.4% of total employment (Economic Planning Unit, 2012).

In Malaysia, the current annual palm oil consumption per capita is 183 kg[8], while the global average is 17.9 kg. The national averages vary among different countries: 9.4 kg in Bangladesh, 10.6 kg in India, 17.7 kg in China, and 39.3 kg in the USA. The high per capita palm oil consumption in Malaysia is likely due to the extensive development of the palm oil industry and palm oil's integration into many other aspects of the national economy. Data from the USDA showed that the global demand for edible oil increases by 5 – 6 tonnes (T) (5,000 kg to 6,000 kg) annually (Corley, 2009).

For comparison, the production costs of selected oils are as follows: Malaysian palm oil (US$228/T), US soy bean oil (US$400/T), Canadian rapeseed oil (US$648/T), and European rapeseed oil (US$900/T). The water requirement of oil palm ranges from 1,800 mm/year to 2,500 mm/year. In a plantation, 150 oil palms are typically grown on each hectare of land, producing an average yield of up to 120,000 kg/ha (Lam et al., 2009). Oil palm, in contrast to annuals such as rapeseed and soy beans, is a perennial crop. It requires less solar energy (i.e. less exposure to sunlight) to produce a unit of oil than other oil seeds. However, more labourers are required to produce the same amount of palm oil (compared with other oil seeds) because establishing and managing a plantation and harvesting and processing oil

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[8] Corley (2009; 135) estimated per capita consumption of palm oil by using consumption data from 2006–2007 and population data from 2005. The data was provided from a USDA database. The consumption data came from fifteen countries.

palm fruits require large number of workers. (Mekhilafa et al., 2011; 1938). Harvesting oil palm fruit is also a physically demanding activity; a taller oil palm poses a greater physical challenge to fruit harvesters than a shorter one. Despite palm oil production having lower labour productivity, palm oil's higher crop yield (per hectare) has led to the rapid rise in the number of oil palm plantations in Malaysian and other countries.

Historically, there were three important phases in the development of the Malaysian palm oil industry. The first phase, strategic planning, occurred between 1960 and 1980 to create market opportunities. FELDA was a major contributor to the growth of oil palm production during this period. During this stage, the inefficient pooling marketing system was abolished and subsequently replaced by a liberal marketing system. Furthermore, since other developing countries, such as India, Pakistan, and Middle East countries, had insufficient capacity to refine crude palm oil from Malaysia, the federal government decided to encourage the establishment of refineries in the country (Basiron, 2007).

In second phase of development of the industry (between 1980 and 2000), scientific researches on the nutritional value of palm oil were carried out to investigate the health impacts of palm oil, which were propagated via anti-palm oil campaigns. These efforts continued for approximately fifteen years, during which 160 nutritional studies around the world were conducted. After the results of some of the nutritional studies were published (e.g. 50% palm oil blended with local soybean and canola oils improves cholesterol ratios), palm oil exports to countries like the USA and Iran increased sharply (Basiron, 2007). Furthermore, Malaysia invested in refineries located in major consumer countries to increase exports to these countries, and also to compensate for declining export due to competition from US soybean oil from the (Elam and Uko, 1977). Palm oil refineries were established in China, Vietnam, Pakistan, Egypt, the UK, the USA, and Mexico.

The third phase of development took place after the year 2000. There was a drop in demand for palm oil because of adverse market conditions in India. India, the largest importer of Malaysian palm oil, imposed a discriminatory import duty on Malaysian palm oil that made it more expensive than soybean oil. As a result, Malaysian palm oil suppliers lowered their prices to compete with their Indonesian counterparts in the Indian palm oil market. Consequently, the Malaysian government decided to develop its biodiesel industry, believing that this would lead to potentially unlimited demand for palm oil in the energy market. Even though palm oil producers can cater to the demand of the fuel and the automotive industries, palm oil will continue to be used mainly in food products as long as the cost of palm oil biodiesel is greater than that of petroleum-based fuels. Reducing the cost of biofuel will create a profit margin that will encourage the use of palm oil for biodiesel (Basiron, 2007).

3.2 Palm Oil as a Bioeconomy Product

In the Nigeria's tropical rainforests, where the oil palm originated, the oil palm is part of the lifestyle of Nigerians. Oil palms are indigenous to the Nigerian coastal plain and were later cultivated inland as a stable crop (Ekine and Onu, 2008). In the 1980s, Nigerians included oil palm into their cuisine; palm oil is also used for illumination, medicinal purposes, and as fuel to start fires. Furthermore, oil palm leaves were traditionally used as material for roofing, fences, floor mats, and brooms; while its stalks fibre is used to make ropes, baskets, and fish traps. Immature oil palm flowers are made into a refreshing drink, and can be fermented to make palm wine, vinegar, and a stronger alcoholic drink. Palm oil was brought to international attention by James Walshes in 1589 and was originally used internationally for making soaps (Henderson and Osborne, 2000). At present, a multitude of uses of oil palm has been discovered through scientific researches. Oil palm is considered as a bioeconomy crop since every part of the plant biomass may be reused and recycled (Tables 3.1 and 3.2). Table 3.1 shows the percentage of each biomass type which remains after processing in Malaysia. Mesocarp fibre constitutes 12% of the mass of a fresh fruit bunch (FFB). For instance, it takes up 9.5 million tonnes in 79 million tonnes of fresh fruit. When a palm oil mills processes a FFB, 10% of the total mesocarp fibre remains as biomass. The quantity (t) in Table 3.1 refers to the remaining mass of each biomass types after processing.

Table 3.1 Components of Biomass Derived from Oil Palm Fruit Processing in Malaysia: 2005

Total: 79 million tonnes of fruit[9]				
Biomass Type	**% to FFB[10]**	**Quantity (t)**	**Surplus %**	**Quantity (t)**
Mesocarp fibre	12%	9.5 million	10%	0.9 million
Wet Shell	2%	1.6 million	2%	1.6 million
Dry Shell	5%	4 million	1%	0.8 million
Empty fruit bunches	23%	18 million	23%	18 million
Decanter solids	0.5%	0.25 million	0.5%	0.25 million
Effluent solids	0.5%	0.25 million	0.5%	0.25 million
Boiler ash	0.5%	0.25 million	0.5%	0.25 million

Source: Menon, 2007.

Table 3.2 Utilisation of Oil Palm Biomass

Biomass components	Used as	In/For
Mesocarp fibre	a) Fuel	a) Biomass boilers
Wet Shell	a) Fuel b) Material	a) Biomass boilers b) Road fill
Dry Shell	a) Fuel b) Material	a) Biomass boilers b) Road fill
Empty fruit bunches	a) Fuel b) Raw Material c) Fertiliser d) Raw material	a) Biomass boiler b) Anti-erosion mats c) Mulch d) Activated carbon
Decanted solids	a) Fertiliser	a) Palm cultivation
Effluent solids	a) Fertiliser	a) Palm cultivation
Boiler Ash	a) Potassium source	a) Cultivation of palm seedlings

Source: Menon, 2007.

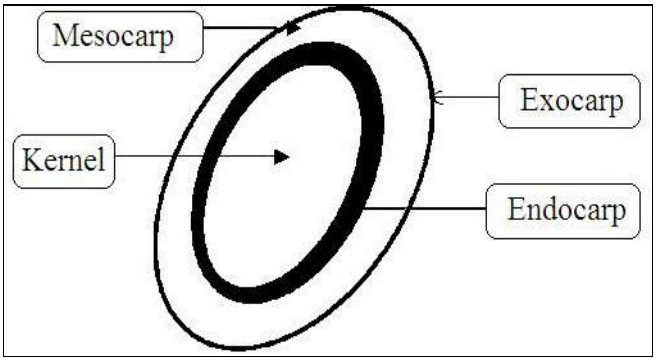
Palm oil and palm kernel oil are extracted from palm oil fruits. Palm oil is extracted from the outer layers (mesocarp) of the oil palm fruit and constitutes of 20% of the fruit mass. Palm kernel oil is derived from the oil palm seed and accounts for 5% of the fruit mass. Oil palm fruit bunches typically weigh between 23 and 27 kg, and have the following composition:

[9] 79 million tonnes is the total amount of fresh fruit bunches (FFB) delivered to mills in Malaysia from peninsular Malaysia, Sabah, and Sarawak in 2006.

[10] FFB composition can be broken down into three basic elements: solid (biomass), oil, and moisture. The percentages may not add up to 100% from solid biomass alone. Oil in FFBs constitutes 20 to 30% of the total mass; and the remaining mass consists of moisture in each type of biomass (Thamsiriroj, personal communication).

60–65% fruit, 21–23% oil, 5–7% kernel, and 44–46% mesocarp. An oil palm fruit is composed of: 71–76% mesocarp, 21–22% kernel, and 10–11% shell (FAO, 2006). Besides, oil palms typically have a commercial life cycle of around 25 years.

Figure 3.1 Basic Oil Palm Fruit Structure



Source: FAO, 2006.

In Malaysia, the average palm oil yield is 4.2 tonnes per hectare per year (Tan et al., 2007). In some instances, the yield may be as high as 20 to 28 tonnes per hectare per year (Ravi, 2007). The Malaysian palm oil industry uses oil palm clones produced by Applied Agro-ecological Research (AAR). Theses clones are capable of producing up to 10.6 tonnes of crude palm oil per hectare annually, which is 20–25% higher than the yield of conventional seedlings. Furthermore, newer varieties oil palm clones have a shorter maturity period of two years as opposed to the two-and-a-half years required by older varieties. The oil palm clones also grow to a shorter height to facilitate harvesting work. At present, two million oil palm clones are produced per year. However, the clones are costlier than conventional oil palm seeds (RM1.35/US$0.40) at RM20 (US$7) each (Lam et al., 2009).

Palm oil biodiesel has a huge potential to become a renewable energy source. If the expansion of oil palm plantations had been limited, the increasing trend in yield could meet the current demand and also increase future demand for biofuel in a global market (Edgar et al., 2011). According to FAO (2006), palm oil is primarily produced in Southeast Asia, West Africa, and Latin America. The Malaysian palm oil industry dominated the global palm oil supply chain for more than three decades and helped develop value added palm oil products (Craven, 2011). The value-added increased recently to 3%, exceeding industry expectations; the higher-than-expected growth is a result of improved performance of the industry. The industry saw an average annual growth rate of 13.9% during the period of the Eighth Malaysia Plan. The targeted growth rate was subsequently set at 7% in the Ninth Malaysia

Plan (Economic Planning Unit, 2006). The annual growth of agricultural value-added is 0.98%, and agriculture accounts for 10% of the Malaysian GDP (World Bank, 2014). Between 2000 and 2010, the total agricultural and non-agricultural export earnings also increased annually at an average rate of 9.5%.

3.3 Study Region

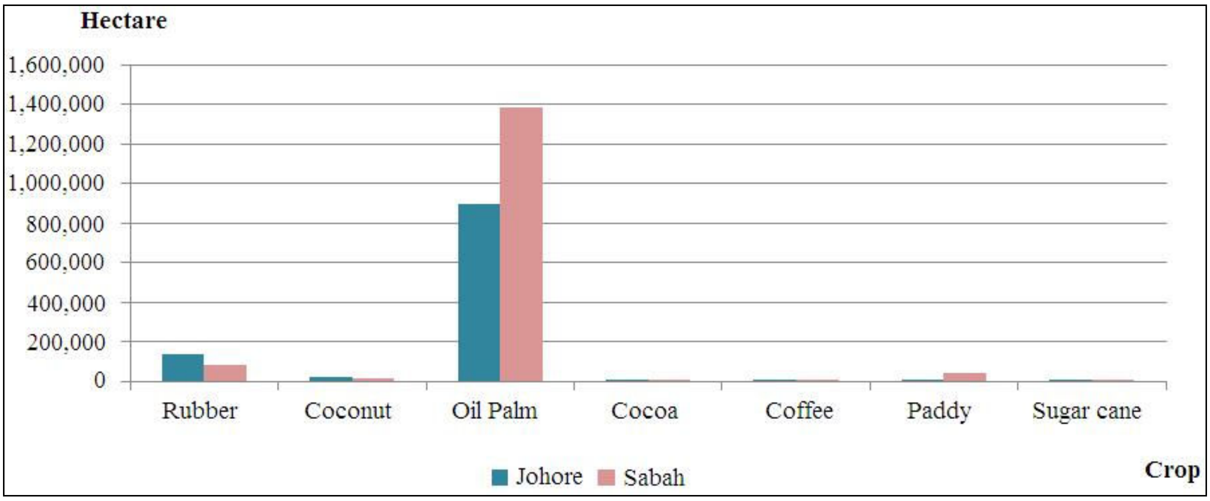
3.3.1 Johor in Peninsular Malaysia, and Sabah in Borneo

Johor has an area of 18,985 km^2, which constitute 5.7% of Malaysia's land. In 2010, the incidence of poverty in Johor was at 1.3, while extreme poverty was at 0.1; the average monthly income was RM3,835 (US$1,278) (Department of Statistics, 2012). Sabah has a larger land area at 73,623 km^2, or 22.3% of Malaysia's land. The incidence of poverty in Sabah was at 19.2%, while extreme poverty was at 4.7%; the mean monthly income was RM3,144 (US$1,048). Compared with Sabah, Johor has better developed infrastructure. For example, there is a primary school in Sabah that still relies on a generator in a palm oil mill generator for electricity. As for language, Johorians speak standard Malay, while Sabahans speak a different Malay dialect, which was incomprehensible to the researcher. Local research assistants were engaged for the interview process in order to bridge the language barrier.

According to the local farmers and an officer of a farmer's organisation, most of the land used for oil palm cultivation in Johor was converted from rubber plantations, but in Sabah, oil palm plantations were primarily converted from cocoa plantations. In both Johor and Sabah, there are also oil palm plantations that were established on previously forested land. In addition, oil palm plantations were also established on lands formerly used for other crops, such as coconut and rice, but these instances are infrequent. The total area planted with commercial crops is detailed in Figure 3.2. Oil palm is the dominant crop in the regions of Johor and Sabah , covering 6.4 times more land than rubber, the second most common crop in Johor. The lowlands in Sabah (Kota Kinabalu, Kudat, Sandakan, and Tawau) have an average temperature of 32°C, compared with 21°C in the highlands (Ranau, Kundasang, and Tambunan). The climate is equatorial and tropical, with unpredictable rainfall and generally sunny conditions with high temperatures throughout the year. In Sabah, oil palms crops cover 17.3 times more land than rubber (also the second most common crop in Sabah).

Based on agricultural data, the Sabah gross agricultural output amounts to 24.7% of the national total in 2010, whereas Johor contributed 12.7% (Department of Statistics, 2012). A total of 50,160 workers are employed in the agricultural sector in Johor, and 139, 240 in Sabah. The mean monthly income of a worker in the agricultural sector is RM1,120 (US$373) in Johor, and RM868 (US$289) in Sabah (Malaysian Department of Statistics, 2012). Amongst the Malaysian states, Sabah has the highest number of sub-sector entities in the palm oil industry at 1,148 (18.1% of the national total), followed by Johor at 962 (15.2 %) (Malaysian Department of Statistics, 2011). Furthermore, in 2010, Sabah had the highest value-added across Malaysia at RM8,387.9 million (US$2,796 million); Johor was ranked fourth at RM3,315.8 million (US$1,105 million), behind Sarawak and Pahang (Malaysian Department of Statistics, 2012). Henson (2005) also found similar results during an evaluation of carbon sequestration in Peninsular Malaysia and Sabah between 1981 and 2000.

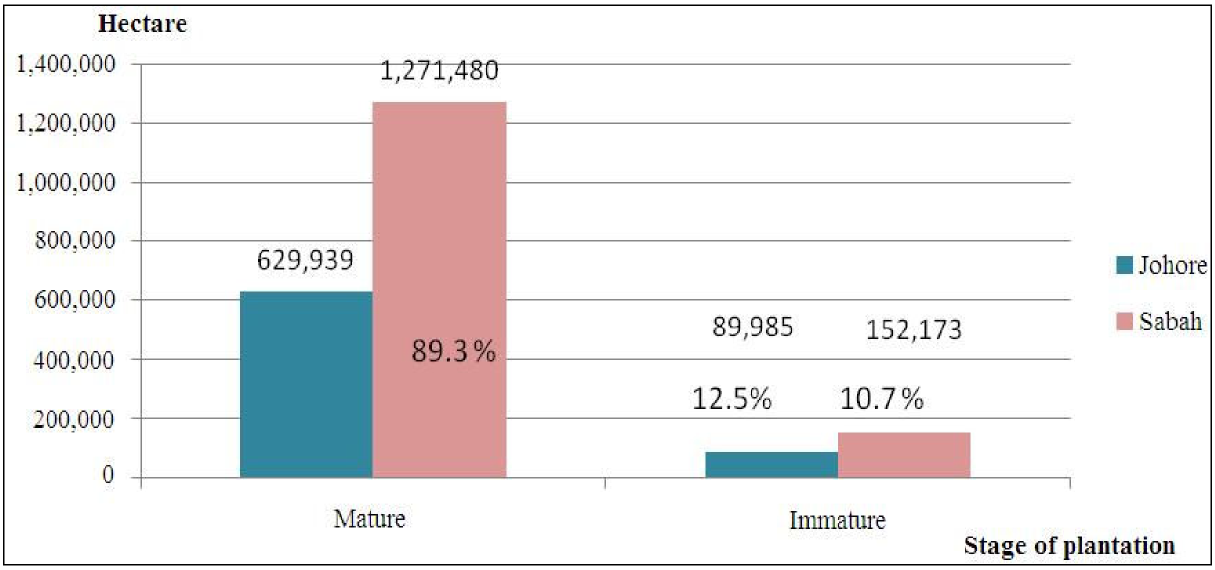
Figure 3.2 Total Area of Commercial Crops in Johor and Sabah, Malaysia: 2009 (in hectares)



Source: Department of Plantation, Johor (2010).

As depicted in Figure 3.3, Sabah uses more land area than Johor for both mature and immature oil palms. The oil palm industry in Sabah experienced a rapid expansion in the 1980s. Therefore through the expansion, even though the palm oil industry in Johor has a longer history, the industry in Sabah still has a larger area of mature oil palms.

Figure 3.3 Oil Palm Production Areas in Malaysia as of September 2009 (in hectares and percentages)



Source: Department of Plantation, Sabah (2010).

3.4 Literature Review

3.4.1 Studies Related to Issues of Palm Oil

Selected previous palm oil-related studies, including information on their scope, findings, learnt lessons, and research gaps are summarised in Table 3.3. These studies focused on palm oil demand; palm oil products; palm oil in the international market; and the economy, social, and environmental impacts of palm oil. A previous study asserted that the expansion of land used for oil palm plantation in Malaysia will most likely be due to the biofuel industry. However, according to policymakers who were interviewed (discussed in the previous chapter), Malaysia's biofuel policy is heading in a different direction. Some of the studies also discussed the topic of oil product diversification; as an extension to these previous studies on palm oil, the potential of palm oil as a bioeconomy product and the industry's move towards zero waste industry are also discussed in this thesis.

Table 3.3 Selected Studies on Palm Oil Issues

Author(s)	Scope of study	Findings	Lessons learnt from this study/research gaps
Corley (2009)	Expansion of oil palm in Malaysia	- Estimation of future demand of palm oil for edible purposes using world population projections and per capita vegetable oil consumption. - Demand would likely be around 240 tonnes per head in 2050, whereas biofuel demand might exceed this amount significantly and drive the continual expansion of the oil palm industry.	- Corley's findings reflected the reasons oil palm has become the second generation crop and the causes of its rapid expansion in Malaysia. - There are different opinions on the prospects of biofuel industry in Malaysia. Based on the interviews with Malaysian policy makers and NGOs, palm-based biofuel is merely a backup option for the industry. - Malaysian palm oil is prioritised for food production, which may contradict the biofuel demand projections made by Corley (2009), in which palm oil biofuel will drive the continual expansion of Malaysian palm oil industry. - This present study brings a different perspective on the topic of oil palm expansion in Malaysia.
Nieves et al. (2011)	Palm oil product diversification	- Investigated the use of empty oil palm fruit bunches for biogas production.	- In this present study, the researcher investigated the potential of palm oil products as part of bioeconomy programmes and the potential of palm oil production to generate zero waste through various methods, for instance, using palm oil waste (empty fruit brunches) to produce renewable energy (pellet biofuel) and other potential bioeconomy products. - This present study also identified and discussed one of the market barriers, namely the external governance of the value chain. This is because the palm oil industry requires innovation to ensure that its value chain is sustainable and fulfils the rules of governance.
Mekhilaf et al. (2011)	Palm oil product and access to international market	- Technological aspects of palm oil biodiesel production were looked into to meet the international market standards.	- In this current study, the rule of governance in the palm oil value chain is also identified, this includes the biodiesel product certification schemes required to enter the European Union market.

		- This study also explored access to international markets for palm oil products, many of which now impose restrictions on palm oil import.	- In Chapter 5, the issues surrounding the Malaysian palm oil biodiesel is discussed, and international policies of other biodiesel industries (German Rapeseed Biodiesel and US Corn Ethanol) are compared. By learning from these two industrial clusters, the Malaysian palm oil industry can make improvements to its sustainability practices, thereby raising the potential to penetrate international markets.
Fold (2000)	The institutional aspect in FELDA	- The FELDA resettlement programme in Malaysia has gained international recognition as an example of success in increasing the area used for agriculture and the great extent of vertical integration in the Malaysian palm oil industry.	- Fold (2000) only studied FELDA, but this present study also investigates FELDA and other programmes, including FELCRA, RISDA, independent smallholders, and private estates. - Fold (2000) merely looked at the organisational structure of FELDA, but this study further identified the economic factors, such as oil palm fruits bunch pricing, and compared the factors with those of independent smallholders and other land settlement schemes. - This present research also identified the internal regulations set by FELDA for FELDA settlers, including the monthly fixed income earned by unproductive FELDA settlers compared to the income of productive FELDA settlers.
Wan Teng (2011)	Social impact or externalities	- There was a progressive change to the livelihoods of the indigenous group. - Local labourers (on large-scale oil palm plantations) felt that their livelihood was threatened[11] by Indonesian migrant workers, and thus, some of them decided to develop their own small-scale oil palm plantations.	- This present study reviewed the wage differences and cost of production in the two study regions, which differs in the composition of their labour forces. The palm oil industry in Johor predominantly hires local labourers, while there is a higher percentage of migrant workers in Sabah's palm oil industry. - Wan Teng (2011) conducted a survey on the wages among oil palm fruit bunch harvesters. Similarly, for this research, wage data were also gathered from collectors of oil palm fruit bunch in Johor and Sabah, and compared with those from Wan Teng's study.

[11] Individual workers, who are dependent on forest resources, felt the need to make adjustments to their lifestyle to compete with migrant workers, who dominate the Malaysian palm oil labour market.

			- Wan Teng (2011) also discussed the social cost of converting forests into oil palm plantation, while this research discussed the environmental externality of converting forest or previous crop into oil palm. - Wan Teng (2011) discussed acre oil palm plantation earned by households and monthly income. In this present study, similar type of data were obtained from oil palm smallholders and compared with other data from other scale of operation.
Sayer et al. (2012)	The impact of oil palm expansion	- The need of yield productivity in minimising the area of expansion. - Better organisation and management of smallholders.	- In this present study, gross margin analysis was conducted to identify the yield productivity and profitability of Malaysian oil palm plantations (in terms of profit per hectare, per labour, and per tonne). - The value chain of the Malaysian palm oil industry as well as the critical aspects among independent smallholders are also identified in this research.

3.4.2 Theoretical Background and Researches on Value Chains

Value chain refers to a chain of activities that is performed to bring a product to the market; this includes product design, production, and marketing. GVC focuses on the relationships between buyers and suppliers, as well as the flow of goods or services from sellers to buyers. The relationship between sellers and buyers are complementary to the resource material, finances, knowledge, and information (Ponte and Gibbon, 2005; 4) in terms of the physical flows of particular product and their accompanying monetary terms (FAO, 2006a). The value chain theory explains the power and the dynamics of a value chain. This framework was developed by Michael Porter in 1990; he defined the value chain as a set of interlinked 'complete firms' that possess all typical business functions. The value chain also describes the successive operations of up- and downstream agents after several stages and value added initiatives.

There are two types of value chains: the buyer-driven and producer-driven chains. The fundamental concept of the value chain is how 'value' itself is conceptualised and measured (Gereffi et al., 2001). The level of integration of an actor in a value chain (which creates transactions and value-added) determines the extent to which the actor benefits from growth. Developing countries are increasing their economic activities considerably in order to achieve the "developed country" status. However, not all actors on a supply chain benefit equally – some are excluded from the benefits of growth. There has been a growing asymmetry in most supply chains as the benefits of growth tend to accumulate at downstream operations, where procurement and retail occur.

Kaplinsky and Morris (2000) stated that value chain analysis differs from statistical analysis, which only partially considers the insights of the phenomena of particular industry. The concept of value chain is described in greater detail than input-output relationships (Kaplinsky, 2004). Value chain analysis is also capable of overcoming some of the critical weaknesses of traditional sectoral analysis; in particular, it is able to analyse data beyond the firm-specific level. For example, trade statistics do not provide data on net earnings cutting across agriculture, industry and services. However, value chain analysis observes the way in which particular firms, regions, and countries are linked in the global economy. It is a useful tool to help new producers achieve sustainable income growth, and facilitate their entrance into the global market. Through value chain analysis, actors in economy can know how they can gain access to the skills, competencies, and supporting services required to participate in global value chains; and receive suggestions on which aspects of producer firms, industries, and societies of developing countries they should upgrade. Besides, value chain analysis can identify the impacts of globalisation on income distribution (Kaplinsky and Morris, 2000). Product flow is, therefore, one of the crucial aspects of value chain analysis. After analysing agricultural value chains in developing countries, Trienekens (2011) noted the important components in a value chain framework, namely value addition, horizontal and vertical integration structures of chain network, and the rules of governance. He also found that asymmetrical power relationships pose a significant constraint to developing countries as the global power held by Western retailers and industries is become greater.

However, value chain does not address space-related production issues, global aspects of production, or socio-economic issues. It merely focuses on upgrading value chains at firm-level instead of global level. Several researchers like Peters (2000) and Vazquez Barquero (1999) have discussed the topic of 'territorial endogeneity', while Storper (1997) argued for the need to address issues surrounding industrial development, intra- and inter-firm networks, and the global market integration of particular industries, which takes into consideration the locational aspects of production. In addition, Humprey and Schmitz (2000), and Messner (2002) argued that the integration of commodity chains is dependent on the structure of governance in the chain design.

3.4.3 Global Value Chain

The global value chain framework uses the concepts of governance, transaction costs, and upgrading. Fundamentally, the global value chain comprises the commodity chain, the global commodity chain, and the world economic triangle, in which the objective is to understand governance and regulation systems, and linkages of horizontal and vertical approaches of the chain network.

Meanwhile, Kaplinsky (2004) and Gereffi et al. (2005) have used the value chain analytical framework to identify the key actors that drive the production of goods within value chains. It is an inevitable step to identify the existence of anti-competitive practices, the role of each actor, the required standards, how the chain upgrading process is coordinated, and how chain upgrading influences the distribution of returns among the actors in a value chain. Gereffi et al. (2005) also found that historical institutions, geography, social contexts, and the rules of engagement are amongst the factors that influence how firms and actors in value chains are linked to the global economy.

Humphrey and Schmitz (2000) noted that governance in value chains is a requisite for market access, fast track to the acquisition of production capabilities, income distribution, leverage points for policy initiatives, and funnelling technical assistance. In global palm oil production, chain governance is crucial to ensure the flow of the goods and the intangible assets such as knowledge and information (Boons and Mendoza, 2010).

This study observed that the supply chains in the Malaysian palm oil industry are consumer driven. The industry is under pressure from NGOs, which have an influence on consumer choices and on the level of awareness of sustainability issues in the palm oil industry. As a result, some food and consumer product manufacturers, such as Nestle and Unilever, prefer using certified palm in their products. Otherwise, their brand names could be tarnished among consumers by NGOs. Sayer et al. (2012) also expressed the same opinion, they asserted that social and environmental awareness in the palm oil industry is driven by consumers.

The latest conceptual framework for value chain analysis, namely global value chain analysis, was used for this study. This framework was chosen because the value chain production of the Malaysian palm oil industry is global. The chain governance along its regulatory system is the crucial factors to be investigated for the purpose of chain upgrading. Furthermore, rules of governance, policies, and regulatory enforcement are the critical factors in ensuring the sustainability of the value chain. In this study, value chain analysis was used to investigate the governance and regulatory systems, and transaction costs. Table 3.4 summarises selected previous researches which adopted value chain analysis to study the palm oil and oilseed industries.

Table 3.4 Researches related to Palm Oil and other oil Seeds on Value Chain Analysis

Author(s)	**Research**	**Main Findings or scope of previous studies**	**Argument and Gap filled by the present study**
Mather (2008)	- Palm oil industry and its sustainability issues in general (in Malaysia, Indonesia, and African countries)	- The study showed a simple product flow in the palm oil value chain. - The factors found for flow of fresh fruit bunches production were: **plantation, mills, and refineries.**	- The present study describe the product flow from the inputs sources, such as nurseries, growers, collection centres, millers, refineries, and palm oil dealers, to exporters or domestic market. - This current study presents more detailed information on product flow, financial flow, and governance in the value chain.
Vermulen and Goad (2006)	- Smallholders in the palm oil industry (in Malaysia, Indonesia, and African countries)	- This study describes the product flow in the Malaysian palm oil industry. - The actors in the supply chain are identified to be: Plantation, **middle man, mills, refineries,** local manufacturers, and exporters.	- The current study analyses the value chain at various scales of operation. The actors in the value chain are nurseries, growers, collection centres, millers, refineries, and palm oil dealers, exporters and domestic market. - This research also identified more actors in the palm oil value chain than Vermulen and Goad's (2006) study (The additional actors are: nurseries and dealers of oil palm fruit bunches and palm oil).
Duijn (2013)	- Traceability of the palm oil supply chain	- Only smallholders were considered in Duijn's (2013) study. Actors along the supply chain are identified to be: **small holders, mills, refinery, storage for shipping, refining, post-refining**, and manufacturer of consumer goods.	- Duijn's (2013) product flow did not consider nurseries, and palm oil and oil palm fruit bunch dealers. - The current study includes financial information and important characteristics of the actors in the value chain, such as land size, production volume,

		- This study mainly discussed the storage of palm oil products for export.	and the products in the respective segments.
United Nations (2013)	- Edible Oil Value Chain Enhancement Joint programme (JP) in Ethiopia - Oil crops: sesame, niger seed, and linseed	- The samples collected were not as targeted (this present study experienced the same issue). - This study found that the domestic and international markets have become more accessible for edible oil producers in Ethiopia. - Many intermediaries add value to the final product, leading to high transaction costs. - Government leadership is identified as the most important element in value chain.	- The United Nation (2013) compared the condition before, and after, the implementation of the JP, whereas detailed analysis was conducted on the Malaysian palm oil industry in this study. - This study identified the transaction costs in the respective segments and the rules of governance in the value chain. - This study identified the value-added per hectare, and per tonne, by growers.
Yee et al (2009)	- Life cycle assessment was employed to investigate palm oil biodiesel	- Agricultural activities in the palm oil industry (**nurseries, plantations, palm oil processing mills, and transesterification process)** (energy assessment). - The findings were compared with rapeseed biodiesel. - Using palm oil as a biodiesel feedstock was found to be more sustainable than using rapeseed.	- Yee et al. (2009) only showed life cycle inventory and GHG emission produced by plantations, processing mills, and biodiesel refinery. They did not consider the historical aspects of plantation unlike this present study (the externalities and land-use change caused by the conversion of rubber, cocoa, and forest to oil palm plantations). - Yee et al. (2009) did not evaluate externality (GHG/carbon emission) in monetary terms unlike this study. They also excluded some segments in the palm oil industry, such as oil palm fruit bunch dealers, collection centres, and refineries. It is important to evaluate the aforementioned

			segments because energy plays a crucial role in these segments.
Iliopoulos and Rozakis (2010)	- Biodiesel production in Greece (energy crops oil, namely soybean oil, sunflower oil, and cotton oil)	- Biodiesel supply chain is comprised of **farmers, cooperatives, oil crushing entrepreneurs, biodiesel producers, and refineries**. - High transaction costs are associated with vaguely defined evaluation procedure. - The opportunity cost of producing energy crops was evaluated.	- Iliopoulos and Rozakis (2010) did not describe product flow in detail; they merely highlighted the list of actors along the chain. - Iliopoulos and Rozakis' (2010) research outcomes were only based on 3 biodiesel companies. - Policies and rules of governance for palm oil-based biodiesel industry were only briefly discussed in their study. This topic is addressed in greater detail in this study. - This present study identified the transaction costs in the value chain segments and rules of governance. This research also assessed the opportunity cost of producing palm oil biodiesel (to an oil palm plantation), constraint on the palm based biodiesel development and biodiesel-related issues in the industry.
Ludin et al. (2014)	- Malaysian oil palm plantation sector (the use of renewable energy in oil palm plantations)	- This study looked into the Malaysian palm oil supply chain. - **Upstream:** plantation and milling - **Midstream:** refinery - **Downstream:** Food and non-food processing, and distribution	- Ludin et al. (2014) only identified those four actors in the supply chain, while in this present study, more actors in the Malaysian palm oil value chain were identified. - Ludin et al. (2014) classified some technical facilities, such as refinery, as a midstream actor in the value chain. - Some segments were missing from the analysis, including nurseries, and collection centres/dealers of oil palm fruit bunches and palm oil.

European Union (2012)	- The Malaysian palm oil sector, flow of palm oil and palm kernel oil products.	- This study gave an overview of the Malaysian palm oil sector. - The study compared the production costs in Malaysia with those in Indonesia. - The palm oil product flow was discussed, but only for the segment of mills.	- The study conducted by EU did not show the product flow from nurseries (upstream) to the downstream of the value chain. This topic is addressed in this study. - The study discussed the governance and actors in the value chain without thoroughly analysing some important aspects, such as the transaction cost, and critical issues in the chain segments. This present study fills those gaps. - The study conducted by EU did not comprehensively describe the product flow in the Malaysian palm oil value chain.
Geibler (2012)	- Sustainability in Palm oil value chains - Observations were made at Indonesian oil palm plantations and processing mills	- This study adopted the framework proposed by Wakker et al. (2005) to identify the actors along the value chain. - No fieldwork was conducted to identify the actors in the palm oil value chain. - In general, the actors identified were: **Plantations, mills, refineries, and Industries, such as food, chemical, livestock, and products.** - Geibler (2012) also discussed the establishment of sustainability standards for the palm oil value chain.	- The study did not investigate the flow of the value chain in detail. - The study did not identify input sources and overall chain segments in the value chain. - Geibler (2012) only observed the activities in plantations and mills, but this present study observed activities in other parts of the value chain, such as nurseries, plantations, mills, collection centres, retailers and so forth. - Geibler (2012) did not discuss the critical points in palm oil value chain for its chain upgrading. - This study investigated the overall actors, the segments in the value chain, and critical points for value chain upgrading.

McCarthy (2012)	- Production Network in Globalized Palm Oil, and Production in Indonesia	- McCarthy (2012) compared three case studies:- 1) Minimal state involvement in smallholder agriculture 2) Government-facilitated development of oil palm industry 3) Poor policy laid down by state government. - This study adopted the global value chain framework.	- The present study compared cases involving independent smallholders, medium-sized growers, and large estates. - The research also identifies government policy and describes the product flow in smallholders under land settlement schemes, which include FELDA, FELCRA, and RISDA. - The current research reviewed the policy laid down by the Malaysian Palm Oil Board (Registration of actors in the value chain and the actors' transaction cost).

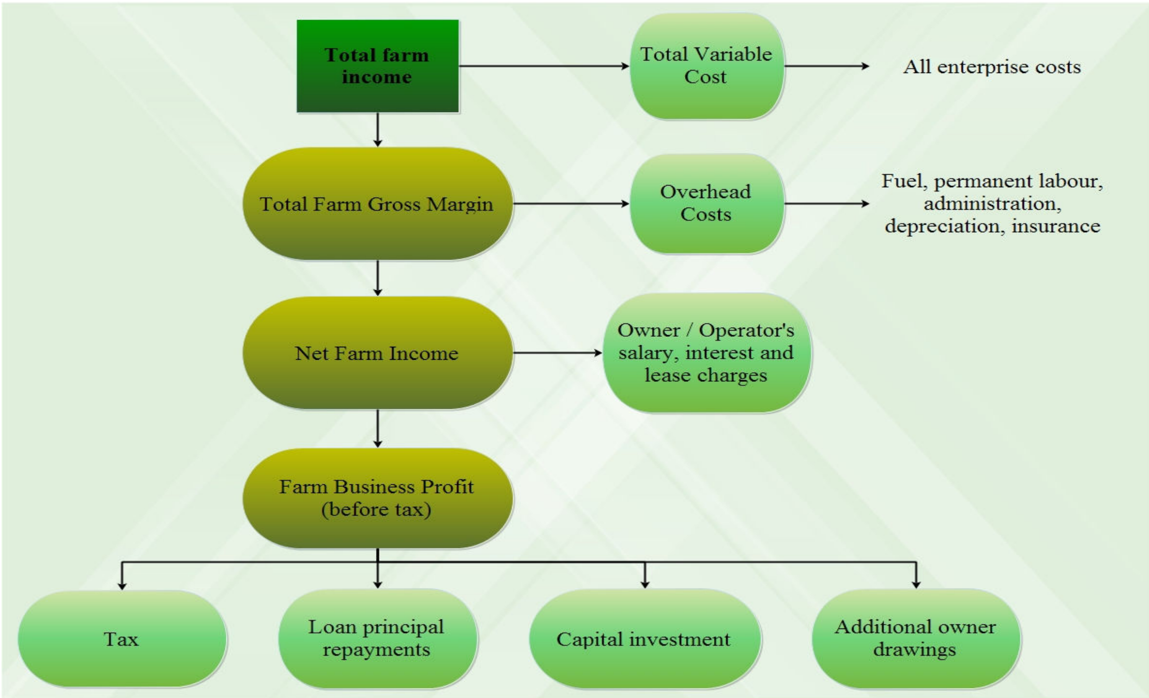
3.4.4 Gross Margin Analysis

Gross margin analysis has been used extensively by government agencies such as the Directorate-General for Agricultural and Rural Development of the European Commission, and the Department of Environment and Primary Industries (State of Victoria, Australia); and was also widely used in the UK in the 1960s (Barnard and Nix, 1979; Powell et al. 2002; Australian Department of Environment and Primary Industries, 2010; Rural and Environment Science and Analytical Services Agriculture Statistics, 2012). Farm gross margin has been recommended by these agencies as a way to help farmers improve their farm management practices and performance. In gross margin analysis, fixed costs are excluded as gross margin determines the threshold of sales to attain profitability. Farms or enterprises with similar characteristics, defined according to their predominant inputs (i.e. capital- or labour-intensive), can be compared using this analysis. The gross margins can also be compared on a per hectare, or per head, basis; therefore, gross margin analysis is applicable to both crops and livestock. A farm with a certain inputs can then be measured against standard values (typical gross margin) determined for typical cases. As a result, the efficiency of the farm can be evaluated and verified (Powell et al., 2002). Gross margin (per unit of output) may reflect the capability of producers to secure their selling price compared to its production costs (Rural and Environment Science and Analytical Services Agriculture Statistics, 2012).

3.4.5 The Limitation of Farm Gross Margin Analysis

Farm gross margin analysis is unable to determine the profit of an enterprise as this method excludes capital costs (e.g. land, buildings, machinery, irrigation, and equipment) and fixed costs (e.g. machinery depreciation, administration, insurance, and taxes) (Australian Department of Environment and Primary Industries, 2010). According to Powell et al. (2002), another limitation is exemplified by applying the analysis to organic farming. When the use of herbicides is replaced by modern/mechanical weeding systems, variable costs are offset by fixed costs; however, gross margin analysis does not consider conventional variable costs. Crop rotation highlights yet another drawback of gross margin analysis. Crops covering the soil are needed to build soil fertility. As some inputs are needed for crops rotation, these inputs may leave “residual effects” on subsequent crops. Crops planted in rotational breaks, such as peas, rest the land and improve the structure and the fertility of the soil (Powell et al. 2002). Nonetheless, it is impractical to consider these costs as they are already accounted for in the initial costs, which have already been omitted in gross margin analysis.

Figure 3.4 Gross Margin Analysis, Net Farm Income, and Farm Business Profit Framework



Source: Adapted from Northern Victoria Irrigated Cropping Gross Margins (2009–2010).

This study adopted the framework published in Northern Victoria Irrigated Cropping Gross Margins (2009–2010), which was jointly prepared by the Australian Department of Sustainability and Environment, and the Australian Department of Primary Industries. The framework was chosen because it is systematic and well structured, and simplifies the complexity of farm enterprises (Figure 3.4). This framework is useful for comparing the performance of growers with similar capitals and labour requirements.

Total farm gross margin can be obtained by subtracting total variable costs (enterprise costs) from total farm income (Figure 3.4). Most of the palm oil-related researches which use the gross margin methodology are conducted on palm oil processing mills outside of Malaysia. No existing study has applied the gross margin analysis to Malaysian oil palm growers or compared their gross margin per hectare, per labour, and per tonne. The literatures reviewed for this study contributed to the design of the gross margin analysis applied to oil palm growers (see Table 3.5).

Table 3.5 Studies of Oil Seed Using Gross Margin Methodology

Author(s)	Study Segments	Study Region	Findings/ gross margin design	Similar elements incorporated in the current research
Ekin and Onu (2008)	Palm oil processing among smallholders.	Ikwere and Etche, River State, Nigeria	- 100 small-scale palm oil processors were selected for gross margin analysis. - The average cost of gross margin was determined. - The palm oil processors showed positive gross margin (the enterprises were efficient). - The two study regions were compared. - The minimum cost of production was identified. - Ekin and Onu faced difficulties in determining the gross margin due to the producers' different objectives. - The revenue was underestimated due to poor data quality.	- This study adopted gross margin analysis to study Malaysian palm oil growers. - The gross margin analysis was used to study smallholders, medium-sized growers, and large estates. - The average cost of gross margin was used for cost structure analysis. - The palm oil industries in Johor and Sabah were compared. - This study also might underestimate revenue and cost due to limited data quality.
Quinlan (2004)	Macadamia growers	Northern Rivers region of New South Wales, Australia	- The gross margins of the macadamia trees in three age groups were compared: 1) three years, 2) seven years, and 3) fifteen years old. - Sensitivity analysis was carried out to calculate price range and yields.	- The gross margin analysis was used to study Malaysian palm oil growers. - In the current study, the oil palm trees were not disaggregated or grouped according to their age, but according to scale of plantation.

			- In the analysis, farm size was assumed to be 20 ha, with 312 trees per hectare.	- Based on available data, an assumption was made for the average number of trees (138) per hectare.
Rural and Environment Science and Analytical Services Agriculture Statistics (2012)	Crop enterprises that grow winter oilseed rape	Scotland	- The unweighted group averages of each enterprise were determined. - A comparison was drawn between high-performing (top 25%), the average-performing, and low-performing (bottom 25%) enterprises. - Factors not determined in this study include: natural constraints (land quality, weather, etc.), reasons for farming (financial, personal satisfaction, etc.), and farming methods (organic versus conventional production methods).	- A research related to the Malaysian palm oil growers was conducted as a case study. - Only smallholders, medium-sized growers, and large estates were investigated to find out the gross margin per hectare, per labourer, and per tonne. - The cases studied were classified based on their performance (high, average, low). - Natural constraints, such as land quality, and farming methods, were not taken into account for the current analysis.
Patrick et al. (2013)	Palm oil processing mills	Southern Nigeria	- The concept of gross margin was identified and integrated into OLS. - Gross margin formula was employed (Adegeye and Dittoh, 1985). - Gross margin was computed for both on- and off-season operations. - The determinants of gross margin were identified.	- A study on Malaysian palm oil growers was conducted. - The gross margin analysis was integrated with value chain analysis and cost benefit analysis.

Umar and Ibrahim (2012)	Sesame seed producers/growers	Nigeria	- The gross margin per hectare of growers who used organic fertiliser was 5% lower than that of growers who used inorganic fertiliser. - Average size of plantations studied – 556 ha (large scale)	- In this study, the researcher did not investigate the difference in gross margin between organic and inorganic farming. - Three scales (smallholders, medium-sized growers, and large estates) were compared. - The average size of smallholders, medium-sized growers, and large estates were identified.

3.5 Method

3.5.1 A Generic Framework for Global Value Chain Analysis

The general product and financial flows between actors in supply chains were reviewed. A product's physical flow along a supply chains is divided into three parts: input sources, upstream, and downstream actors in a value chain. Crucial pieces of information about growers, such as inputs sources, size (in hectares), average production (in tonnes per month), and average selling price (in RM per tonne), were included in the assessment. The transaction costs in the respective segments were also identified. The quality of output was assessed when considering the average selling price of oil palm fruit prices. The MPOB has established a benchmark (according to production zone) which growers can consult when pricing their products. Data on the GVC were obtained through interviews (primary) and from the MPOB (secondary).

The concept of value chain is multidimensional. The first dimension is flow (also termed as input-output structure), while the second dimension is geographical. Some chains are truly global, with activities taking place in many countries in different continents, whereas others are more limited, involving only a few locations in different parts of the world. The third dimension is the rule that each actor has to obey for conducting the activities that construct the chain. Since the GVC framework uses a global and holistic approach, a combination of the frameworks, adapted from those used by Kaplinsky and Morris (2000) and by FAO (2006a), are employed in this study for the GVC analysis. The framework used by Kaplinsky and Morris is well established, and relevant to descriptive and qualitative research. It highlights the product flow along a value chain, from production to consumption. The geospatial aspect is integrated as the production activities are carried out globally. This concept is applicable to the Malaysian palm oil industry, which also operates globally. The framework used by FAO is a good reference for value chain mapping, and policy analysis and design. It provides step-by-step guide to chain mapping and value-added computation. This framework has been widely used in policymaking for the value chains in the agriculture sector. Thus, both frameworks are used in this research to study the Malaysian Palm Oil industry.

3.5.2 Data Acquisition and Collection

An initial field research was conducted during an eight-month period between July 2010 and March 2011. The three key objectives of this field research are: 1) to gather information that illustrate the product flow along the value chain, 2) to describe the cost structures of actors in the value chain, and 3) to interview industry experts and policymakers who have contributed to the policies governing the Malaysian palm oil industry. A second field research was carried out over a two-month period, from April 2013 until June 2013, to identify the current issues in the Malaysian palm oil industry as well as the current state of the biofuel and biodiesel programmes in Malaysia. The second field research only involved in-depth interviews with policy makers, NGOs, and fertiliser retailers. Some of the findings and policy implications that emerged from this study were presented to the policymakers in the course of the second field research.[12] Hence, the findings about the reliability of the bioeconomy industries and constraints hindering the adoption of some particular policies were also discussed during the interviews.

Prior to conducting the initial field research, the researcher sought a formal letter of support from the MPOB at the request of the industry actors who were contacted for interview, as they consider data about the palm oil industry to be ‘private and confidential.’ There were bureaucratic issues that had to be overcome to obtain the necessary approval from the MPOB. An appointment was schedule with the director general of the MPOB in 2010, but it was delayed because of a change of director (who had not yet been appointed then) and other bureaucratic issues. The researcher also contacted and met with four other head of division at the MPOB; however, none of them were willing to write a letter of support for this research. As time was limited, the researcher proceeded to work independently with subjects who were willing to be interviewed, without official support from the MPOB.

Data collection during both field researches was conducted independently, without any collaboration with, or support from, other agencies. The list of actual interviewees is different from the intended one because of the difficulties faced at the start of the field research. The interview subjects were protected to conceal information due to public campaigns against the

[12] The fourth prime minister of Malaysia, Tun Dr Mahathir Mohamed, is one of the veteran policymakers who helped develop the palm oil industry in Malaysia. The Malaysian palm oil industry experienced its greatest growth during his tenure. His comments and feedback were integrated into this study.

oil palm industry, including NGO-led boycotts, and palm oil import bans in the US and EU. The interview participants were suspicious of the research work as the researcher was based in Europe. Some members of the EU have claimed that palm oil is unsustainable and responsible for high level of GHG emissions. Thus, the industrial actors were worried that revealing confidential data about the industry to a Europe-based researcher would further damage the image of the Malaysian palm oil industry. News about anti-palm oil campaigns led by NGOs or foreign organisations frequently appear in Malaysian media, causing the actors in the value chain to be more reluctant to provide their data.[13]

The questionnaires used for this study were designed in Bonn in 2010, prior to the field research efforts. The questionnaire was pilot tested in Johor in August 2010. Preliminary findings from the pilot study were presented at an academic conference in Sabah, Borneo. There were some missing values related to production costs and revenues among the data that were successfully gathered from the case study interviews. According to some of the respondents, answers to some questions are considered sensitive information, for instance, income, revenues, utility costs, and fixed and current assets. Most respondents also did not estimate the depreciation of fixed assets, and therefore, depreciation was assumed to be zero. This is, however, inadequate because asset depreciation is non-trivial and should be given a value. Depreciation data were not used for gross margin analysis, but they were used to calculate value-added. In order to fill up the data gaps, the missing values were estimated using the methods described below:

Deriving information from existing data to fill data gaps

If a missing value was related to a nursery in Johor, the value was estimated using the response from another nursery in Johor; this is likewise so for a missing value from an actor in Sabah. If data from an actor in the same state could not be found, the data from similar actors in a different state was used.

Information used to fill data gaps was based on similar or identical indicators

In order to fill in the missing values, various parameters, such as scale of operation (large-, medium-, and small-scale growers), number of workers, and monthly production, were used as indicators to approximate the missing values. Please refer to http://goo.gl/Bjh8bs (in cells

[13] Examples of articles about the anti-palm oil campaigns in Malaysian media that contributed to a general reluctance among industry actors to offer data for public scrutiny (http://www.ceopalmoil.com/2010/04/sen; http://ngos/http://www.thestar.com.my).

with red shades) for more information about the use of available data to estimate missing values. In addition, other missing values were estimated based on policy or base scenario constructed by the land settlement schemes: FELDA, FELCRA, and RISDA. Each of these actors has their own indicators and approach to managing plantations. But they usually share similar size of production areas, quantity of farm labourers, and production costs (facilities, safety equipment, tools, and fixed assets).

Respondents with too many missing values were excluded from the analyses

Respondents whose response contains too much missing data were excluded from the assessment to avoid complicating the analysis. However, if the missing values could be reasonably estimated, the respondent was included. All data provided by the respondents are considered valuable.

If the information could not be derived from the existing data, the gap was filled using secondary sources

Some respondents did not provide the costs of their machinery, such as tractors, vehicles, and tools, and therefore, secondary sources were consulted to obtain machinery prices in the Malaysian market. Please refer to http://goo.gl/kedVKP for an example about how machinery and tools were valued.

Labelling

All the estimated values were labelled for future reference. If the data was obtained from secondary sources, the corresponding URL of the web page is also included. An example can be found here: http://goo.gl/kedVKP.

3.5.3 Summary of Data

Consistent methodology was used to fill the data gaps for all actors in the value chain. A few formulas were needed to evaluate the missing values, These formulas were consistently applied for all cases of missing values. More information about the methods and formulas used can be found in the annex. Please refer to the description of the annex using this link: http://goo.gl/Owucui.

During the course of the field research, data were collected from 238 actors in the palm oil value chain in the two study region (Table 3.6). Secondary data were also gathered, they include financial data for 2009 retrieved from the Bursa Malaysia database (formerly known as KL Stock Exchange) the FOA annual report 2009, and financial reports of various industry actors that are available online. However, the total figure of small, medium, and large growers could not be obtained as it was unavailable in the MPOB directory. The directory is the important reference for any research on the palm oil industry in Malaysia. The collected data may not be representative as the sample size is small relative to size of each stratum. Each piece of data may nonetheless provide insight into the current state of affairs and critical changes in the industry.

Table 3.6 Summary of Malaysian Palm Oil Data Collection from Samples by Category

Actors	Sample/Population	
	Johor	Sabah
Nurseries	3/88	3/59
Estates/growers	54/575	16/317
Small holders	27	6
Medium holders	3	3
Large holders	24	7
Dealers of Oil Palm Fruit Bunches	27/69	9/82
Mills	5/66	14/na
Refineries	1/18	4/4
Dealers of Palm Oil	1/184	13/30
Retailers	34/na	54/na

Source: Field Research (2010).

3.5.4 Descriptions of Data

A list of variables and further explanation for the gross margin analysis are shown in Table 3.7. These variables were used in the gross margin analysis to study the three scales of plantations, namely small, medium, and large, in the two study regions (Johor and Sabah). An explanation is provided for each variable on the list.

Table 3.7 Variables Used in the Gross Margin Analysis to Study Oil Palm Plantations in Johor and Sabah, Malaysia (RM): 2010

Financial data for plantations in Johor and Sabah	Further explanation
Total revenue per year per holder (RM)	Primary data: average selling price (per tonne) X average quantity of production per year
Gross margin analysis	
Variable cost	
Annual salary costs per holder (RM)	Wages were paid according to the production of oil palm fruit bunches (tonnes). Salary = wages per tonne multiplied by the quantity of production per year. Wages are a fixed sum determined by the respective holders. It differs between regions, especially between Peninsular Malaysia and Borneo (Sabah and Sarawak).
Annual water costs per holder (RM)	Average water paid (monthly usage multiplied by twelve months). It was determined by the respective holders. Some growers consumed a fixed amount of water, but some used watersheds as a source of water.
Annual pesticide costs per holder (RM)	Cost of pesticide used per acre multiplied by total acreage and usage per year (Private plantations applied pesticides four times per year, while frequency varies among smallholders). It was determined by the respective holders. Usually, large estates use fixed rates, but rates vary among smallholders.
Annual fertiliser costs per holder (RM)	Total acreage multiplied by 0.5, then multiplied by cost per bag of fertiliser (Respondents used half a bag of fertiliser per acre).
Annual transportation costs per holder (RM)	Cost per tonne multiplied by production per month, then multiplied by twelve months. As the distances between collection centres and plantations vary in different regions (between 4-8 km in Peninsular Malaysia and 8-9 km in Borneo), the rates were calculated on a per tonne basis (rather than distance). The costs are subjected to the contracts between the respective collection centres and growers.

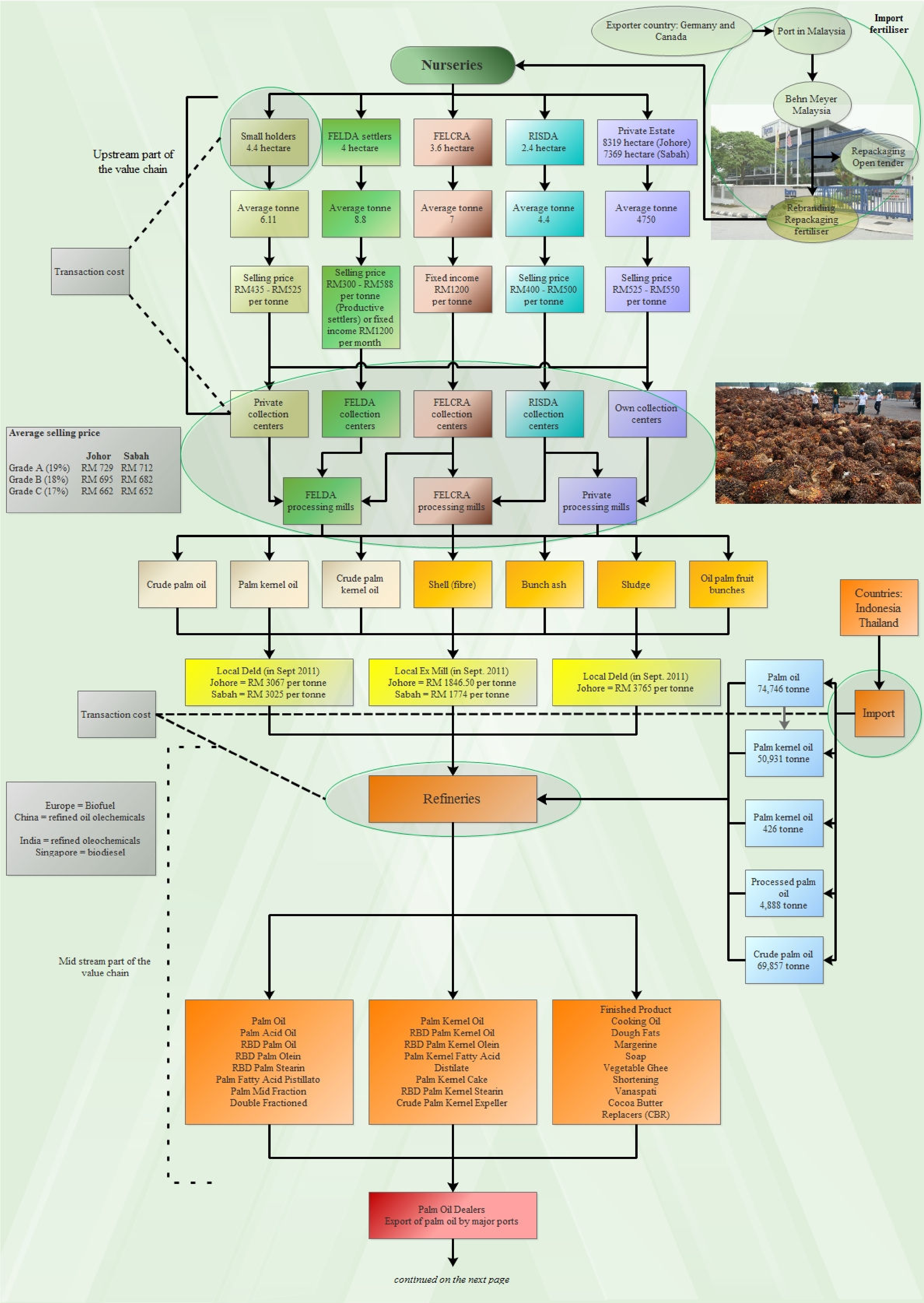
Source: Field Research (2010)

3.6 Results

3.6.1 Global Value Chain Analysis - Product Flow

Figure 3.5 shows the chain flow and actors in the value chain, the financial flow, the vertical and horizontal relationships, the transaction costs, and the critical points in the global value chain analysis. The production of each segment, either domestically or internationally, is also noted in the flow diagram. The numbers found in each of the boxes represent the average value among the identified actors. The average selling prices were derived based on the sample data. This figure is discussed further in the later sections.

Figure 3.5 Malaysian Palm Oil Industry Global Value Chain



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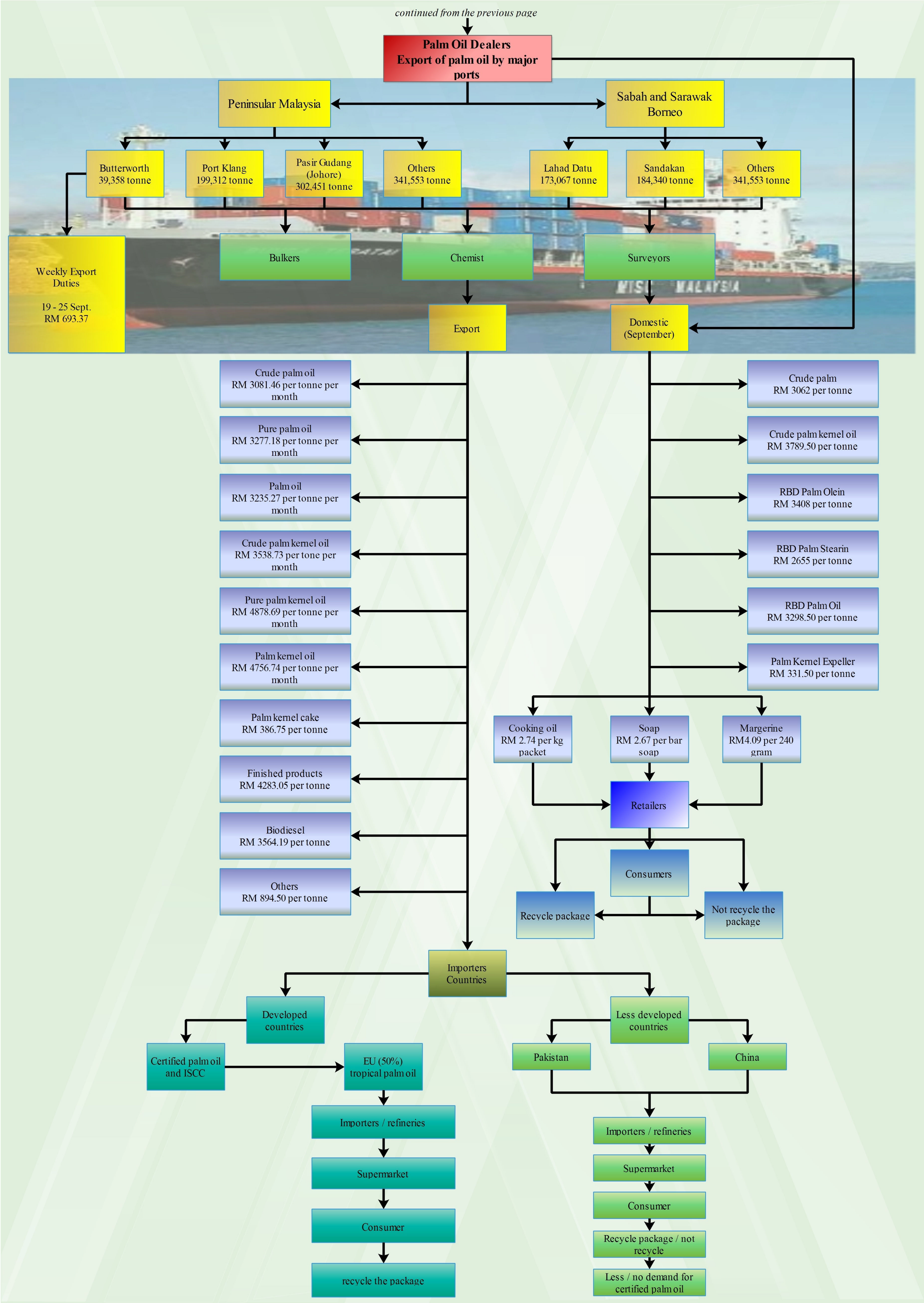

Source: Own Illustration.
Note:*Palm oil = Crude palm oil + Processed palm oil; ISCC = International Sustainability and Carbon Certification

3.6.2 Source of Inputs for Malaysian Palm Oil Industry - Fertilisers

Germany is one of the main producers and exporters of fertilisers used in the Malaysian palm oil industry (Figure 3.5). The most popular high-quality fertiliser is Nithrophoska/NPK, which has been used in the Malaysian palm oil industry for more than ten years (FAO Officer, personal communication). The central headquarters of Behn Meyer, manufacturer of NPK is located in Hamburg, Germany. The Behn Meyer Agricare division has formulated fertilisers that are cost effective and nutrient rich exclusively for oil palm. These fertilisers have helped farmers balance nutritional profiles of palm oil products with the need to lower labour costs (Behn Meyer, 2012). Behn Meyer produces special fertilisers for oil palm and ships them to Malaysia. The fertilisers are exported to Malaysia using container ships. Upon arrival in Malaysia, the Malaysian subsidiary of Behn Meyer (located in almost all Malaysian states) repackages the fertilisers into smaller bags and markets them as part of its product range. Behn Meyer Group Malaysia also licenses their products to growers and fertiliser trader.

Oil palm fruit bunches (OPFB) and palm oil mill effluent (POME) can also be made into bio-fertiliser, an alternative to chemical fertilisers, for oil palms. A Malaysian small and medium enterprise (SME) produces bio-fertiliser under the brand name Vermicast. The company imports worms from overseas and uses the worms to compost OPFB for commercial bio-fertiliser production in a process called vermicomposting[14]. Vermicast sells its fertilisers to smallholders or any growers who are interested in using bio-fertilisers. However, none of the growers sampled used bio-fertilisers in their productions.

Based on information gathered from field research, fertilisers do not need to be certified. Fertiliser certification is a voluntary process; if a company or producer wishes to obtain certification for their fertilisers, they may send their request either to SIRIM[15] or MPOB. A

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[14] Vermicomposting is the process of recycling organic matters, including oil palm fruit bunches (opfb) by using various kinds of worms.

[15]Standards & Industrial Research Institute of Malaysia is the leading certification, inspection, and testing body in Malaysia. Products and companies are certified under the Quality Management System Certification Scheme, Environmental Management System Certification Scheme, Product Certification Scheme, Product Listing Scheme, Eco-Label Scheme, and Occupational Health and Safety Management System Certification Scheme (food, nutraceuticals, oleochemicals, biofuel, and a certification scheme on supply chain of the RSPO). "SIRIM QAS International is an accredited certification, inspection, and

massive amount of bio-fertilisers is needed in an oil palm plantation as it has less nutrients than chemical fertilisers. The inputs to oil palm plantations are critical considerations when aiming to improve the sustainability of the value chain. This is because in previous studies, nitrogen fertilisers were found to emit the most GHG within the industry (Yusoff and Hanson, 2007). Making certification compulsory for inputs to the palm oil value chain is a way to improve the sustainability of the palm oil industry. The external costs of these inputs are discussed in detail in chapter 4 (Social Cost Benefit Analysis for the Malaysian Palm Oil Industry). A discussion about the actors in the various segments of the palm oil value chain can be found in the following section.

3.6.3 Actors along the Value Chain

In the upstream segment of the value chain, **nurseries** sold individual seeds at RM1.25 (US$0.42) each and 3.5-month-old oil palm seedlings at RM3.50 (US$1.2) each (Figure 3.5). Independent smallholders could purchase seedlings from private nurseries. Large-scale plantations may have their own nurseries or buy young oil palms through the procurement department of their parent companies.

The second category of upstream actors is **growers**. Based on the data gathered from the field research, there were five types of growers in the palm oil value chain: independent smallholders, smallholders under FELDA scheme, smallholders under FELCRA scheme, smallholders under RISDA scheme, and large estates (see Figure 3.5). The average size of plantations owned by independent smallholders is 4.4 hectares; the figures for smallholders under FELDA were 4 hectares, FELCRA 3.6 hectares, and RISDA 2.4 hectares. The average sizes of private estates were 8,319 hectares and 7,368 hectares in Johor and Sabah respectively. The average total production was highest among large estates (125,642 t in Johor, and 98,388 t in Sabah), followed by smallholders under FELDA (8.8 t), FELCRA (7 t), independent (6.4 t), and RISDA (4.4 t) (Figure 3.5).

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testing services provider under numerous bodies, including the National Accreditation Body, the Department of Standards Malaysia (STANDARDS MALAYSIA), and the United Kingdom Accreditation Service (UKAS)" (SIRIM, 2013).

The next group of actors are **oil palm fruits dealers**. Oil palm fruit dealers purchase oil palm fruits from growers at the collection centres. Usually, these dealers would transport the OPFBs using lorries or the smallholders would send the OPFBs to the collection centres. **Oil palm fruits have to be processed within 24 hours** to minimise the build-up of fatty acids, which adversely affects the quality of oil palm fruits. More oil can be extracted from high-quality fruits during processing. The average selling price of OPFB to collection centres was between RM435 and RM525 (US$145–US$175) per tonne, RM300 and RM558 (US$100–US$186) per tonne for FELDA, RM400 and RM500 (US$133–US$167) per tonne for RISDA, and RM525 and RM550 (US$175–US$183) per tonne for large estates (Figure 3.5).

Governmental settlement schemes are the pivotal actor and the resettlers are price takers, resulting in an asymmetrical power relationship between the authorities and the resettlers. Smallholders under one of the resettlement schemes (FELDA, FELCRA, or RISDA) are necessitated to sell their harvest to the collection centres at which they are registered. FELDA provides loans to the farmers to cover the initial cost of establishing a plantation; smallholders will subsequently be required to repay the loans in instalments at zero interest rates. A part of the income from the sales of OPFB is deducted as repayment for the investment loans. FELDA settlers have two choices: 1) manage their own plantations, but are required to sell their oil palm fruits to FELDA collection centres or 2) let FELDA manage their plantations and receive a fixed monthly income of RM1200 (US$400). FELCRA settlers, on the other hand, have no choice, they retain a monthly income of RM1,200 (US$400) and FELCRA manages their farms (Figure 3.5).

Oil palm fruit pricing is a critical topic in Malaysia as there have been many complaints about the price range of oil palm fruits. Until now, neither government nor the respective land settlement programmes have given any official feedback. The prices offered to growers differ, depending on the quality of oil palm fruits, and the prices set by individual collection centres and programmes. FELDA and RISDA operate their own collection centres and lay down pricing policies for their settlers. Most FELDA growers claimed that independent smallholders are more profitable than FELDA settlers, yet the independent smallholders claimed the opposite (FELDA settlers, independent small holders, personal communication).

Prices of inputs to the value chain vary occasionally. The situation has changed over the past 50 years; this change is critical and therefore needs to be carefully considered. The prices of inputs, factors of production, and technology and transaction costs may have changed. FELDA is a well-known pivotal actor in reducing poverty among smallholders for the past 50 years (as discussed by policymakers in the previous chapter; Chapter 2). However, FELDA offers the lowest minimum price for OPFB to its settlers amongst all the land settlement schemes (Figure 3.5). FELDA settlers claimed that they offered higher selling prices when they sell their fruits illegally to non-FELDA collection centres. In order to improve the lives of peasant farmers, FELDA may need to revise and improve its policy. This issue is further discussed in Chapter 5 (Policy Assessment of the Federal Land Development Authority [FELDA]). Conversely, independent smallholders can determine to which collection centre they would prefer to sell their oil palm fruits. Thus, the smallholders exchange information on the OPFB prices offered by the collection centres. They had to be aware of the prices to maximise profit. This information exchange has been identified as a transaction cost[16] for independent small holders. The transaction costs are the grey shaded ellipses in Figure 3.5.

Each scale of growers has their own labour issues. Based on an interview with Sime Darby plantation manager, in Malaysia, large plantations are highly dependent on migrants for labour. As noted by Daud (2006), oil palm plantations can legally hire labourers from Indonesia, Thailand, Cambodia, Myanmar, Nepal, Laos, Vietnam, Philippines, and India. The duration of their employment is restricted to 3+1+1 years. At Sime Darby plantations, the local and foreign labourers are trained to maintain high labour productivity. Plantation companies, however, are increasingly keen to hire Malaysians as farm workers (Malek, personal communication).

Transportation is another issue that affects the quality of oil palm fruits. Private collection centres deliver their OPFB to any palm oil processing mills, whereas the collection centres of FELDA and FELCRA send their OPFB only to their own extraction mills. Some mills have their own collection centres (Figure 3.5). This simplifies the selling process and increases added value for oil palm growers as the OPFB are directly transported to the mills (lower transportation cost

[16] Transaction costs are incurred when producers organize, coordinate, and execute exchanges, such as searching information costs, dealing, trading, agreement or arrangement cost, and procecution and administration costs (Ortmann and King, 2007).

and time consumption). The fruit bunches are priced according to their quality grades: A (high), B (standard), and C (low). The average fruit prices are different between Peninsular Malaysia and Borneo. Grade A fruit with a 19% oil extraction rate (OER) was worth RM729 (US$243) per tonne in Johor (Peninsular Malaysia), but only RM712 (US$237) per tonne in Sabah. Grade B fruit with an 18% OER was worth RM695 (US$232) per tonne in Johor, but only RM682 (US$227) per tonne in Sabah, while Grade C fruit with a 17% OER was worth RM662 (US$221) per tonne in Johor and RM652 (US$217) per tonne in Sabah. The criteria for determining the quality of OPFB are ripeness, colour, attached fruitlets, detached fruitlets, surface, and condition (FOA officer, personal communication; Nureize and Watada, 2009). The prices paid to collection centres may change daily. Therefore, collection centres have to gather daily updates on the OPFB prices set by the MPOB, and transaction costs may also be incurred.

RISDA settlers are the minorities in oil palm industry as they mainly produce rubber. However, in suitable areas, RISDA allows some of its settlers to also grow oil palms. As the RISDA plantations do not have any issue pertaining to oil palm fruits price setting, the discussions are not focused on RISDA settlers.

In the midstream segment of the value chain, extraction mills process OPFB into crude palm oil, palm kernel oil, shell (fibre), bunch ash, and sludge. The MPOB set the prices of crude palm oil for local delivery at RM3,067 (US$1,016) per t in Johor and RM3,025 (US$1008) in Sabah for September 2011 (Figure 3.5). At the local mills, palm kernel oil was priced at RM1,846.5 (US$615.5) per t in Johor and RM1,774 (US$591.3) in Sabah. Crude palm oil delivered locally in Johor cost RM3765 per t. In figure 3.5, “Sept.” in the yellow boxes indicates that the price information were obtained from data for September 2011. The prices for OPFB and palm oil products are set by the MPOB (there are also transaction costs at these stages). The Malaysian Department of the Environment (DOE) also conducts inspections at palm oil mills to ensure conformity to the environmental regulations.

Crude palm oil and palm kernel oil are sent to palm oil **refineries**, where they are processed into various products. Basiron and Kook Weng (2004) said that about 80% of the palm oil produced is typically used for edible products, and 20% for non-edible products (oleochemical derivates). Palm oil extracted from the pulp of oil palm fruits is used in food production, while palm kernel oil, which is extracted from the kernel, is used in cosmetics products. Several products can be made by refining palm oil: palm acid oil, Refined Bleached Deodorised (*RBD)* palm oil, RBD palm olein (liquid), RBD palm stearin (solid), palm fatty acid distillate, palm mid-fraction, and double-fractionated olein (Figure 3.5). Palm kernel oil can be refined into RBD palm kernel oil, RBD palm kernel olein, palm kernel fatty acid distillate, palm kernel cake, RBD palm stearin, and crude palm kernel expeller. Palm oil is also made into other products, such as cooking oil, dough fat, margarine, soap, vegetable ghee, shortening, vanaspati[17], and as cocoa butter and replacers (CBR). These products are used by palm oil dealers to manufacture end products. Some international brands and retailers that use palm oil in their products are McDonald (USA), Burger King (USA), Ferrero (Italy), Nestle (Switzerland), Body shop, Tesco (UK), Aldi, REWE, Haribo, BASF, Metro Group (Germany) (for a comprehensive list of companies, please refer to Palm Oil Buyers Score Card, WWF, 2013). Most palm oil dealers use palm oil derivatives as ingredients in their commercial products and export those products to other countries. The tonnes shown in the light blue boxes (in the refineries segment, figure 3.5) solely indicate tonnes of palm oil imported into Malaysian refineries.

Palm oil is exported through major ports, such as Butterworth (average of 39,358 t), Port Klang (199,312 t), and Pasir Gudang, Johor (302,451 t), and the rest of the ports receive a total of 341,553 t. In Sabah and Sarawak, the major ports are Lahad Datu (173,067 t), and Sandakan (184,340 t), and the other ports receive a total of 341,553 t (Figure 3.5). These figures were obtained from MPOB data for the month of September 2011.

The exports figures for each of the ports are reported on a monthly basis. Dealers or exporters need to pay export duties, which are set by customs on a weekly basis, when exporting palm oil products. At respective ports, **bulkers, chemists, and surveyors** are responsible for the quality control of palm oil products prior to export. The palm oil products are exported as partially finished or end products. Some Malaysian large-scale producers have taken over palm oil mills in Europe. For instance, Golden Hope (Completed a merger with Sime Darby) purchased

[17] Vanaspati is a substitute product for ghee or butter, which is usually used by the Indians in preparing their food. It is partially-hydrogenated and an ingredient for bakery products, sweets, and snacks (www. tarladalal.com, 2014).

Unimills as well as other palm oil mills from Unilever and Cognis. The company also became the biggest oleochemical companies in the world (Golden Hope Plantations Berhad, 2007).

In the domestic market, end products of palm oil, such as cooking oil and margarine, are controlled by the Ministry of Domestic Trade, Co-operatives, and Consumerism; and the Malaysian government. The wholesale prices were RM2.74 (US$0.91) per kg of cooking oil, RM2.67 (US$0.89) for a bar of soap, and RM4.09 (US$1.36) for 240 g of margarine. Meanwhile, the retail prices were RM2.94 (US$0.98) per kg of cooking oil, RM3.14 (US$1.05) for a bar soap, and RM4.72 (US$1.57) for 240 g margarine (This figure were obtained in 2010)(Figure 3.5). The products that are exported to certain developed countries need to meet certification standards. For instance, biofuel products need to undergo the International Sustainability and Carbon Certification (ISCC). Palm oil plantations that would like to achieve RSPO certification standard may apply for environmental verification and certification schemes, ISO 14001 environmental management system certification, Roundtable Sustainable Palm Oil (RSPO) certification, and SIRIM ecolabeling scheme (SIRIM, 2013). SIRIM also conducts validation, verification and certification of palm oil project related to Clean Development Mechanism (CDM).

The EU imports approximately 50% of its palm oil supply from tropical countries. Palm oil-based oleochemicals and non-edible palm oil are processed in the importing countries and sold to retailers as end products. NGOs from developed countries have claimed that most palm oil products are incorrectly labelled as "vegetable oils" in the EU and Australia as palm oil has distinct nutritional qualities and environmental impacts (Sheargold and Mitchell, 2011)[18]. However, in the EU, food manufacturers are required to label specific ingredients, including palm oil, on their packaging from 2013 onwards (USDA, 2012). Developed countries seem to be more concerned about the sustainability of palm oil production (Figure 3.5) than developing

[18] "The Bill identifies targeting the health impacts of saturated fats contained in palm oil as one of the reason for the proposed labelling requirement (the 'health purpose'). The primary justification for the Bill is to address the environmental impacts of palm oil production in Malaysia and Indonesia (the 'environmental purpose'). The explanatory memorandum that accompanies the Bill states: 'Palm oil production results in extensive deforestation. As the major producers are Malaysia and Indonesia, this has led to the removal of wildlife habitat and has placed many species, including the endangered orang-utan, at risk.'' More information about palm oil labelling and the WTO can be found at http://www.law.unimelb.edu.au/files/dmfile/downloadbac51.pdf

countries. Developing countries such as Pakistan and China import palm oil products regardless of the product's certification status (MPOB, 2011).

The MPOB is a key to the governance of Malaysian palm oil value chain. The board enforces regulations and controls critical points in the value chain: seed producers, oil palm nurseries operator, production and processing of crude palm oil material, storage, handling, point of exportation, and tank ships. According to MPOB (licensing) Regulations 2005, all actors in the value chain are required to obtain licence from MPOB. The licences are required for a range of activities: production, sale, purchase, movement, storage, commencement of construction of oil palm mill, milling, commencement of construction of bulking facilities, survey, test, and import and export of oil palm products. Regulation 5(1) states 'No persons shall involve in those activities unless he is a holder of an appropriate license issued under these Regulations'. According to Regulation 5(3) of the MPOB (Licensing) Regulations 2005, 'Any person who contravenes Regulation 5(1) commits an offence and shall be liable on conviction to a fine not exceeding two hundred thousand ringgit (US$66,666; RM22,222) or to a term of imprisonment not exceeding three years or to both' (MPOB, 2014). Activities that require licence from MPOB are shown in Table 3.8.

Table 3.8 Activities in the Supply Chain that Require MPOB Licensing

1	Produce oil palm planting material
2	Sell or move oil palm planting material, oil palm fruit, palm oil, palm kernel, palm fatty acids or palm oleochemicals
3	Purchase oil palm fruit, palm oil, palm kernel or palm fatty acids
4	Store oil palm planting material, palm oil, palm kernel, palm kernel cake, palm fatty acids or palm oleochemicals
5	Commence construction of oil palm mill
6	Mill oil palm fruit
7	Commence construction of bulking facilities for oil palm products
8	Survey or test oil palm planting material, oil palm fruit, palm oil, palm kernel, palm kernel cake, palm fatty acids or palm oleochemicals
9	Export or import of oil palm planting material, oil palm fruit, palm oil, palm kernel, palm kernel cake, palm fatty acid or palm oleochemicals

Source: MPOB (2014)

Application for the aforementioned licences has to be submitted to the MPOB either manually (hard copy) or through the online portal e-Pelesenan (e-licence). Some documents are needed for the licence application, and thus, incurring transaction costs. All segments in the value chain are generally well integrated in the production chain. Every actor in the value chain is required to be registered with the MPOB; and cess is paid to the MPOB. As a way to upgrade the value chain, a systematic "tracing of palm oil products", from the end users to nurseries, is a requisite. Albeit all the OPFB are mixed up in the processing mills, the upstream producers in the palm oil value chain, especially growers who are classified into the "dirty segments", need to be traced. With a tracing system in place, sustainable and unsustainable palm oil can be differentiated. A tracing system may increase the transaction cost in the palm oil value chain, but the transparency it provides encourages sustainable practices in the palm oil industry.

3.6.4 Gross Margin Analysis among Oil Palm Growers

Data for calculating gross margins were disaggregated into three groups: small-, medium-, and large-scale producers. Small and medium producers only differed slightly in terms of the usage of inputs and pesticides, but the medium-sized growers used larger amount of inputs per hectare than the smallholders. The farmers gave initial data, such as farming inputs, in many different ways. For instance, some gave their inputs on a per plantation basis, while others on a per acre basis or total inputs per year. Thus, all data had to be standardized on a per hectare per year basis. All calculations and assumptions used for observations or calculating missing values are shown in the online annex (refer to the online annex: http://goo.gl/TEhz7u). Small-scale operations are usually family-owned and operated, while medium-scale growers usually hire labourers; large-scale growers have the greatest production areas, labour needs, and other production costs.

In Johor, large farms typically make effective use full-time labourers for multiple activities. This farm management strategy may influence their farm gross margins (Table 3.9). The full-time labourers in large estates are involved in a wide range of production activities, ranging from the establishment of plantation to the end of production activities. The spectrum of activities includes plantation establishment, fertilising, pruning, weeding, harvesting, and transportation. In contrast, small and medium producers tend to employ different part-time/day labourers for these different tasks. Additionally, large producers typically have greater knowledge of and experience in input methods. This aspect has been highlighted through the pilot study, which found that 29.6% of the smallholders reported being uncertain about the use of pesticides; this is higher than the percentage of smallholders that reported using pesticides as often as every two months

(25.9%), and data on the use of fertilisers also showed similar findings (Rahmat, 2010). Large estates, however, use nearly double the amount of fertilisers; budget constraints representing a key factor in the different levels of pesticide and fertilisers usage among the different scales of plantation.

Oil palm fruits can only be harvested after the oil palm tree reaches the ages of three years. The oil palm tree reaches maximum production rates between the age of eight and fourteen. After the age of fourteen, the production of oil palm fruits slows down and then declines after 25 years. Therefore, in the first three years, growers need to have other sources of income. Large growers rotate the planting of different sections in their plantations to avoid interruptions to harvest because of immature plantations. In contrast, smallholder plantations are typically planted with oil palms of similar age oil palms; some respondents had just replanted when the field research was conducted (between three to four years old). Gross margin figures can be significantly affected by the maturity of the oil palms. In this analysis, the results were not scaled or weighted according to the maturity of the plantations. The plantations used as samples were matured, but at varying age in this study. As previously mentioned, the age of the oil palm is a factor in the production of oil palm fruits, the oil palm produces more fruits between the age of eight and fourteen. As a result, oil palm trees younger than 8 years old or older than 12 years are unable to generate high returns. Smallholders also incur higher transportation costs as the costs are calculated on a mass basis, but transportation costs for large estates are calculated on a lump-sum basis, and therefore, are usually charged to the logistic division of their parent company. The gross margins of outcomes for growers in Johor are shown in Table 3.9.

Table 3.9 Farm Gross Margins for Growers in Johor, Malaysia: 2010

Description of Plantation	Types of Growers		
	Small holders (n=27)	Medium holders (n=3)	Large holders (n=24)
Average Size per Holders (hectares)	3	10	8319
Average Labourers per Holders per year	1	3	295
Average Quantity per Holders per year (tonne)	*58	*180	*125, 642
Gross Margin per Hectare per year (RM)	6,684.00	6,314.00	11,940.00
Gross Margin per Labourers per year (RM)	7,676.00	23,302.00	281,293.00
Gross Margin per Tonne per year (RM)	349.00	331.00	1,178.00

Source: Field research data (2010).
Note: * Average quantity tonnes per year, (e.g., a 4 ha plantation produces 4.8 t per month x twelve months = 58 t per year.
Note: * The step-by-step calculation and data can be retrieved at http://goo.gl/BkNp3l

In Sabah, the opposite is evident in the data: small enterprises earn an average gross margin of RM7,337 (US$2389) per ha per year, the highest among the different scales of plantations and also higher than those of their Johor counterparts (RM6,684 [US$2177.2]) (Table 3.10). Most farm labourers are immigrants from Indonesia, Philippines, and Myanmar; and the harvest workers were paid less on average (RM35.00 or US$11/t) than those in Johor (RM40.00 or US$13/t). Despite the higher costs of pesticides and fertilisers on a per holder per year basis, the small enterprises in Sabah enjoy better gross margin.

On a per tonne basis, large estates in Sabah earned the highest gross margins, small-scale enterprises were the least efficient, while medium-sized plantations were generally more efficient on the per labourer basis (Table 3.10). According to Meredith (1984), when prices decrease, small-scale production becomes more economically viable. In Sabah, most smallholders do not hire labourers and have lower establishment costs compared with large estates. It is easier for small producers to make reasonable adjustments to costs and production factors when market prices decrease. Large plantations in Sabah hire more labourers (916) than their Johor counterparts (295). Therefore, they bear higher transaction costs than estates of similar scale in Johor because of the difficulties in managing a larger number of farm labourers. The large plantations in Sabah have smaller area than those in Johor on average (7368 and 8319 hectares respectively), but they hire more labourers. In addition, educating migrant labours poses a greater challenge because of cultural and language barriers. Unfortunately, the migrant workers also produce less tonne per hectare. The estates in Peninsular Malaysia are also more technologically advanced than in those in Borneo because they are industry pioneers.

Table 3.10 Farm Gross Margins for growers in Sabah, Malaysia: 2010

Description of Plantation	Types of Growers		
	Small holders (n=6)	Medium holders (n=3)	Large holders (n=7)
Average Size per Holders (hectares)	3	46	7368
Average Labourers per Holders per year	1	5	916
Average Quantity per Holders per year (tonne)	*73	*1288	*98388
Gross Margin per Hectare per year (RM)	7,337.00	7,127.00	4,604.00
Gross Margin per Labourers per year (RM)	12,982.00	70,727.00	69,363.00
Gross Margin per Tonne per year (RM)	320.00	374.00	2,147.00

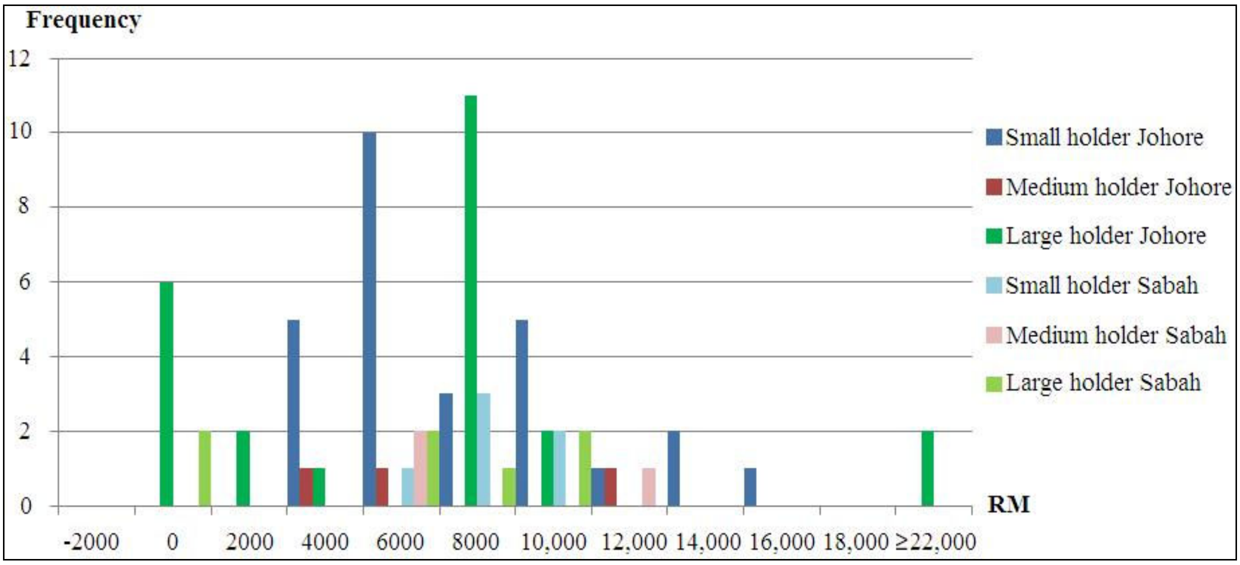
Source: Own findings from field research data (2010)
Notes: *Average number of tonnes per year, (e.g., a 4 hectare plantation produces 4.8 tonnes per month x twelve months = 58 tonnes per year

Note: * The step-by-step calculation and data can be retrieved at http://goo.gl/BkNp3l

3.6.5 Competitiveness of Enterprises in Sabah and Johor

Smallholders, medium-, and large-scale plantations were found to be potential equally competitive, with some small holders achieving higher gross margin on the basis of hectare, labourer, and tonne than other holders. Smallholders in Johor earned higher gross margin than medium-sized growers on the basis of hectare, and also tonne, whereas smallholders in Sabah earned higher gross margin than medium and large estates on a per hectare basis (Figures 3.6, 3.7, and 3.8). There may be some caveats concerning the findings in the analysis. The assumption that the average planting density in Johor and Sabah (regardless of plantation size) is 138 palms per hectare may have influenced the results. The planting density influences the profit of holders. As mentioned by Jusoh et al. (2003), profit levels are influenced by planting density, yields, and market prices. He also found that increasing planting density, up to 200 palms per hectare, positively influences yields (although in practice, typical planting densities are 140 – 160 palms per hectare). Based on the field interviews, it appeared that higher planting densities led to increased competition for soil nutrients and sunlight among oil palms, thus resulting in decreased growth and productivity (Smallholders, personal communication; FAO officer, personal communication). In addition, yield can be influenced by incidence of pests, drought, heavy rain, and haze (Noormahayu et al, 2009).

Figure 3.6 Gross Margins in the Malaysian Palm Oil Industry per Hectare : 2010 (in RM)



Source: Own findings from field research data (2010).
Note: * Data can be retrieved at http://goo.gl/BkNp3l

In both regions, 62 farms had gross margins of less than RM10,000 (US$3,333) per ha per year (Table 3.11). This figure is gathered from 29 smallholders, 4 medium-sized producers, and 29 large-scale holders. Only 12 farms managed to earn a gross margin per hectare per year of between RM10,001 and 40,000 (US$3,333.67-13,333.33), both in Johor and Sabah.[19] Only large

[19] Fisher's exact test was used as a justification because it showed the significance of the results regardless of the sample size (UCLA, 2011). It was significant at 5% on a per ha basis. Overall, the farmers in Johor and Sabah appeared to be almost equally competitive regardless of their farm size. The Fisher's exact test value of Johor was 15.120, with N=54 valid cases and exact sig. (2-sided) of 0.001, while the Fisher's exact test value for Sabah was 2.172, with N=16 valid cases, and exact sig. (2-sided) of 0.650. The combined total Fisher's exact test value was 17.540, with N=70 valid cases and an exact sig (2-sided) of 0.00.

scale plantations in Johor earned a gross margin per hectare per year of greater than RM40,001 (US$13,333.67) (4 plantations).

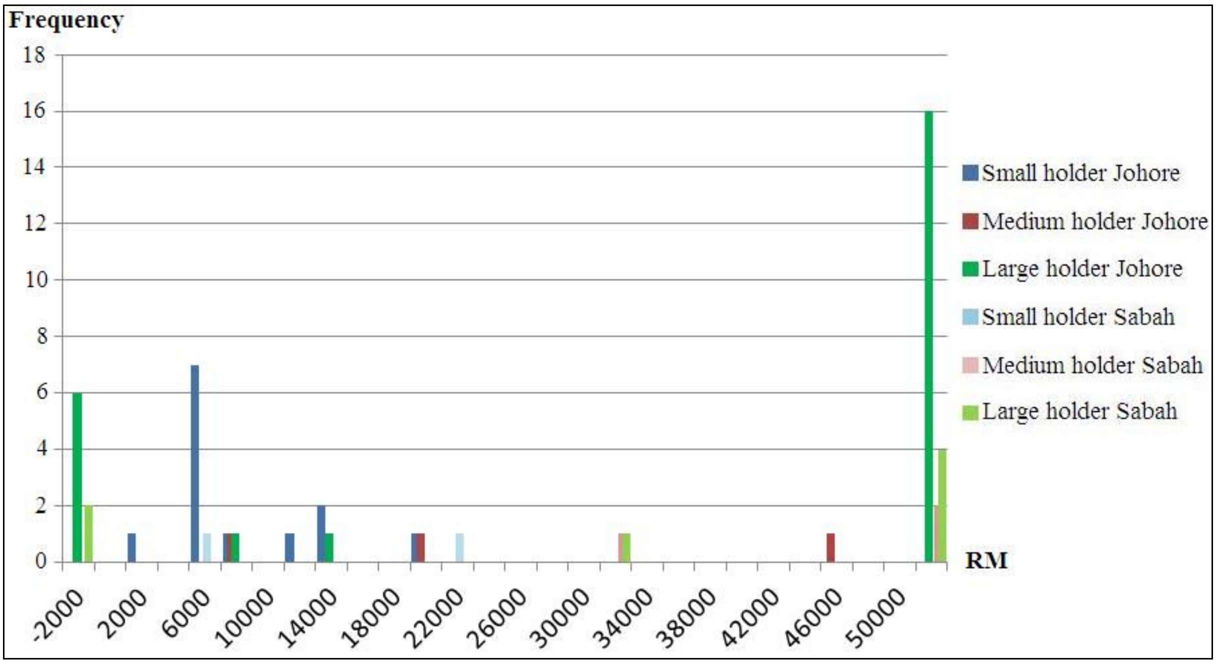
Table 3.11 Gross Margins in the Malaysian Palm Oil Industry per Hectare: 2010 (in RM)

Region	Scales		Gross Margin per hectare ≤RM10,000	RM10,001-40,000	≥ RM40, 001	Total
Johor	Small holder	Count	23	4	0	27
		% of Total	42.6%	7.4%	.0%	50.0%
	Medium holder	Count	2	1	0	3
		% of Total	3.7%	1.9%	.0%	5.6%
	Large holder	Count	22	0	2	24
		% of Total	40.7%	.0%	3.7%	44.4%
	Total	**Count**	**47**	**5**	**2**	**54**
		% of Total	**87.0%**	**9.3%**	**3.7%**	**100.0%**
Sabah	Small holder	Count	6	0		6
		% of Total	37.5%	.0%		37.5%
	Medium holder	Count	2	1		3
		% of Total	12.5%	6.3%		18.8%
	Large holder	Count	7	0		7
		% of Total	43.8%	.0%		43.8%
	Total	**Count**	**15**	**1**		**16**
		% of Total	**93.8%**	**6.3%**		**100.0%**

Source: Own findings from field research data (2010).

On a per labourer per year basis, large holders in both Johor and Sabah had the highest gross margins (Figure 3.7). On the other hand, smallholders were the least efficient on a per labourer per year basis as the majority earned a gross margin per labourer per year of less than RM10,000 (US$3,333).

Figure 3.7 Gross Margins in the Malaysian Palm Oil Industry per Labourer: 2010 (in RM)



Source: Own findings from field research data (2010).
Note: * Data can be retrieved at http://goo.gl/BkNp3l

The labour efficiency analysis showed that large producers in Sabah had the highest gross margins per labourer per year. However, there are more large estates with gross margins per labourer per year greater than RM40,000 in Johor (16 estates) than in Sabah. There were seven farms that earned less than RM10,000 (US$3,333) and one farm with gross margin per labourer per year between RM10,001 and 40,000 (US$3,333.67-13,333) in Johor (Table 3.12). Only 4 large estates in Sabah had a gross margin per labourer per year higher than RM40,000. This may be due to lower labour costs per tonne (in terms of wages) in Sabah despite the estates in Sabah having similar capabilities and efficiency as the estates in Johor. In contrast to the estates in Sabah, the findings revealed that 16 large estates in Johor had gross margin per labourer per year higher than RM40,001. The Fisher's exact test results indicated the statistical significance of the data.[20]

[20]The Fisher's exact test value for Johor was 10.607 with N=54 valid cases and an exact sig. (2-sided) of 0.012. The Fisher's exact test value for Sabah was 2.172 with N=16 valid cases and an exact sig. (2-sided) of 0.650. The combined total Fisher's exact test value was 12.969 with N=70 valid cases and an exact sig. (2-sided) of 0.004.

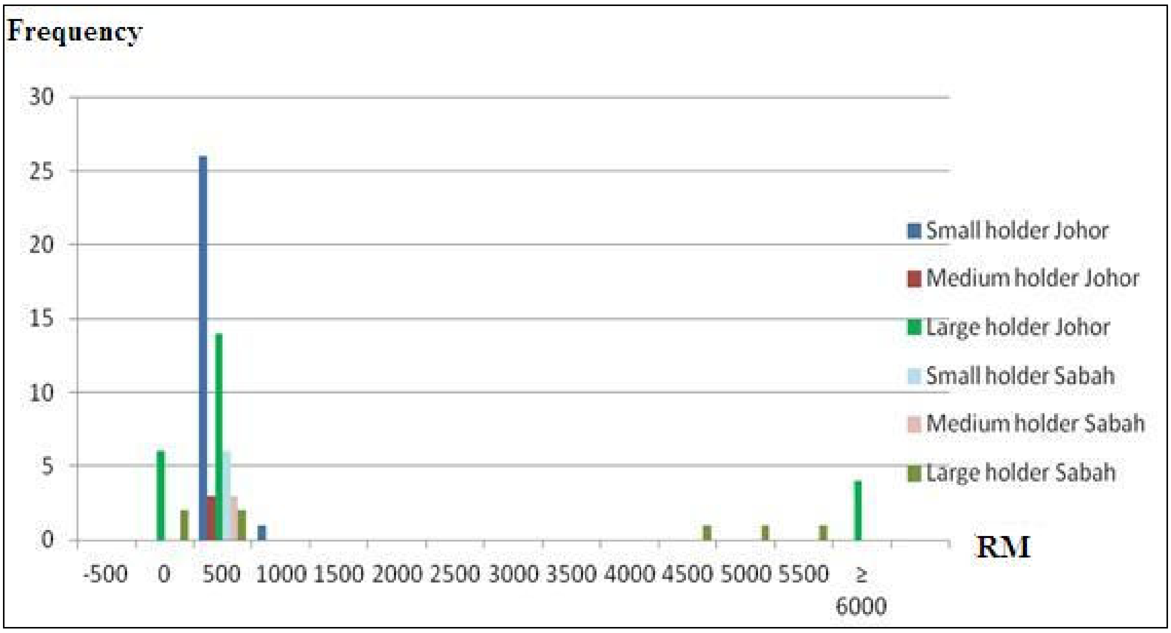
Table 3.12 Gross Margins in the Malaysian Palm Oil Industry per Labourer: 2010 (in RM)

Region	Scales		Gross Margin per labour ≤RM10,000	RM10,001-40,000	≥ 40,001	Total
Johor	Small holder	Count	23	4	0	27
		% of Total	42.6%	7.4%	.0%	50.0%
	Medium holder	Count	2	1	0	3
		% of Total	3.7%	1.9%	.0%	5.6%
	Large holder	Count	7	1	16	24
		% of Total	13.0%	1.9%	29.6%	44.4%
	Total	**Count**	**32**	**6**	**16**	**54**
		% of Total	**59.3%**	**11.1%**	**29.6%**	**100.0%**
Sabah	Small holder	Count	6	0	0	6
		% of Total	37.5%	.0%	.0%	37.5%
	Medium holder	Count	2	1	0	3
		% of Total	12.5%	6.3%	.0%	18.8%
	large holder	Count	2	1	4	7
		% of Total	12.5%	6.3%	25.0%	43.8%
	Total	**Count**	**10**	**2**	**4**	**16**
		% of Total	**62.5%**	**12.5%**	**25.0%**	**100.0%**

Source: Own findings from field research data (2010).

Figure 3.8 shows that smallholders accounted for the highest percentage of plantations with gross margin per tonne per year of less than RM10,000; large estates constitute the highest percentage of plantations in the third group (with the highest gross margin per tonne per year).

Figure 3.8 Gross Margins in the Malaysian Palm Oil Industry per Tonne of Palm Oil: 2010 (in RM)



Source: Own findings from field research data (2010)
Note: * Data can be retrieved at http://goo.gl/BkNp3l

There were 61 plantations that earned a gross margin per tonne per year of less than RM500 (US$166.67), making up the highest percentage of the sample population (Table 3.13). Only one plantation from the sample population earned between RM50 and RM1000 (US$167-333.33). These findings indicated that gross margins on a per tonne per year basis were mostly comparable among farmers at low-level earnings. Only 7 large estates from the sample population managed to earn a gross margin per tonne per year greater than RM1,001.[21]

[21] The value of Fisher's exact test for Johor was 18.510 with N=54 valid cases: 54 and an exact sig. (2-Sided) of 0.000, while the value of Fisher's exact test for Sabah was 7.452 with N=16 valid cases and an exact sig. (2-sided) of 0.36. The combined total Fisher's exact test was 27.168 with N=70 valid cases and an exact sig. (2-sided) of 0.000

Table 3.13 Gross Margins per Tonne for Different Oil Palm Production Scales in Malaysia: 2010

Region	Scales		Gross Margin per tonne ≤RM500	RM501-1000	≥ RM1001	Total
Johor	Small holder	Count	26	1	0	27
		% of Total	48.1%	1.9%	.0%	50.0%
	Medium holder	Count	3	0	0	3
		% of Total	5.6%	.0%	.0%	5.6%
	large holder	Count	20	0	4	24
		% of Total	37.0%	.0%	7.4%	44.4%
	Total	**Count**	**49**	**1**	**4**	**54**
		% of Total	**37.0%**	**.0%**	**7.4%**	**44.4%**
Sabah	Small holder	Count	6		0	6
		% of Total	37.5%		.0%	37.5%
	Medium holder	Count	3		0	3
		% of Total	18.8%		.0%	18.8%
	large holder	Count	4		3	7
		% of Total	25.0%		18.8%	43.8%
	Total	**Count**	**13**		**3**	**16**
		% of Total	**81.3%**		**18.8%**	**100.0%**

Source: Field research data (2010)

3.6.6 Cost Structures, Mean, and Median Values of Actors in the Malaysian Palm Oil Value Chain in Johor and Sabah

This section presents the cost structures of growers (small-, medium-, and large-scale), nurseries, palm oil processing mills, and refineries. A comparison is drawn between actors in the Malaysian palm oil value chain in Johor and their counterparts Sabah by contrasting the difference in the means and medians of their basic data, and their cost structures. The median was also chosen for data description as it measures central tendency and spread of the data. It is also robust against outliers and non-normal data. As a way to ensure that the cost structures of growers are comparable, the cost per hectare was also identified in the case of growers.

Cost Structures and the Mean and Median Values of Growers in Johor and Sabah

Smallholders

Significant costs were incurred for land preparation activities during the first year of establishing a plantation, such as clearing and preparing the land, improving drainage, building roads, and establishing and planting of oil palms. The establishment costs were higher in Johor than Sabah (Table 3.14). The average land preparation costs for smallholders was RM2,326 (US$775) per ha in Johor and RM1,716 (US$572) in Sabah. This is slightly lower than the findings byNoormahayu et al (2009), which indicate that small producers in Selangor, Peninsular Malaysia, spent RM2,779 (US$926.3) for preparation of oil palm plantations on peatland. There are a host of other factors that contribute to these differences, including variability in soil types, slopes, and drainage, as each field has its particular geophysical characteristics (Ronald et al., 2012). Variability in assets, such as labour and machinery, also in addition contributed to cost differences. Nonetheless, variable costs, such as fertiliser, pesticides, and drainage costs (on a per hectare per year basis), were higher in Sabah than in Johor (Table 3.14). Adequate drainage is necessary in areas with peat soil. However, by comparing the observed data (the median total, or per ha land, preparation costs; and the total annual pesticide costs), it is possible to infer that the total annual fertiliser costs were higher in Johor than in Sabah, although most of the agricultural inputs are produced in Peninsular Malaysia.

Table 3.14 Cost Structures for Small Scale Oil Palm Growers in Johor and Sabah, Malaysia: 2010 (in RM)

No	Types of Items	Johor, peninsular Malaysia (n=27)		Sabah, Borneo (n=6)	
		Mean	Median	Mean	Median
A.	**Basic Information**				
1	Size (hectares)	3	4	3	3
2	Size (acres)	8	9	8	8
3	Mature oil palm (acres)	5.5	4	4.5	4.25
4	Average production (t) per year	58	42	73	81
5	Average selling price per tonne (RM)	470.00	490.00	490.00	480.00
6	Average labourer age (years)	35	35	25	25
7	Distance to collection centre (km)	4.8	5	9	9
B.	**Costs for comparison**				
1	Land preparation cost (RM)	6,979.00	7,200.00	5,313.00	4,950.00
2	Annual pesticides costs (RM)	980.00	1260.00	1,085.00	1,050.00
3	Drainage costs (RM)	1,886.00	2,250.00	2,258.00	1,500.00
4	Annual fertiliser costs (RM)	770.00	990.00	853.00	825.00
5	Annual transportation costs (RM)	2,025.00	1,470.00	1,876.00	1,848.00
6	Total Cost for comparison (RM)	12,640.00	13,170.00	11,385.00	10,173.00
C.	**Costs per hectare**				
1	Land preparation costs (RM)	2,326.00	1,800.00	1,716.00	1,650.00
2	Pesticide costs (RM)	326.00	315.00	362.00	350.00
3	Drainage costs (RM)	589.00	625.00	728.00	500.00
4	Fertiliser costs (RM)	256.00	247.50	284.00	275.00

Source: Own findings from field research data (2010).

*Note: Data on cost structures for small holders can be retrieved at http://goo.gl/71RLHk

Medium-scale growers

Transportation costs were higher in Sabah as the average distance between the oil palm production areas and the collection centres is almost twice as much as in Johor (Table 3.15). The average distance to collection centres in Johor was 6.67 km, while in Sabah, it was 8 km (Table 3.15). Besides, the average selling price of each tonne of fresh fruit bunch in Sabah was lower than in Johor (Table 3.15), and the daily reference prices per tonne set by the MPOB were lower in Sabah than in Peninsular Malaysia (Table 3.15). Above all, the total annual median costs for drainage, fertiliser, and transportation were higher in Johor than Sabah.

Table 3.15 Cost Structures for Medium-scale Oil Palm Growers in Johor and Sabah, Malaysia: 2010 (in RM)

	Types of Items	Johor, peninsular Malaysia (n=3)		Sabah, Borneo (n=3)	
		Mean	Median	Mean	Median
A.	**Basic Information**				
1	Size (hectares)	10	8	46	12
2	Size (acres)	25	20	115	30
3	Mature oil palm (acres)	17	20	73	30
4	Production (t) per year	180	240	1288	180
5	Selling price per tonne (RM)	473.00	450.00	470.00	480.00
6	Average labourer age (years)	31	35	25	25
7	Distance to collection centre (km)	6.67	7	8	8
B.	**Costs for comparison**				
1	Land preparation costs (RM)	25,033.00	20,800.00	123,280.00	30,000.00
2	Annual pesticides costs (RM)	3,593.00	2,800.00	15,493.00	2,800.00
3	Drainage costs (RM)	6,417.00	5,000.00	17,667.00	1,500.00
4	Annual fertiliser costs (RM)	2,823.00	2,200.00	15,027.00	2,100.00
5	Annual transportation costs (RM)	6,300.00	8,400.00	45,080.00	6,300.00
6	Total cost for comparison	44,166.00	39,200.00	216,547.00	42,700.00
C.	**Costs per hectare**				
1	Land preparation costs (RM)	2,503.00	2,600.00	2,680.00	2,500.00
2	Pesticide costs (RM)	359.30	350.00	336.80	233.00
3	Drainage costs (RM)	642.00	625.00	384.00	125.00
4	Fertiliser costs (RM)	282.30	275.00	326.00	175.25

Source: Own findings from field research data (2010).
*Note: Data on cost structures for medium holders can be retrieved at http://goo.gl/71RLHk

Large estates

Labourers at large estates in Johor had an average age of 34, while in Sabah, they were 9 years younger (Table 3.16). Most young people in Peninsular Malaysia prefer to work in urban industries; therefore, the farm workforce tends to be older in rural areas. Meanwhile, in Sabah, most of the farm labourers are immigrants from Indonesia, Myanmar, and Philippines. Large estates in Johor incurred higher land preparation costs per hectare than their counterparts in Sabah. Likewise, both mean and median total annual costs of pesticides, fertilisers, and transportation were higher in Sabah. Surprisingly, even though the average area of mature plantation was larger in Sabah (32,753 acres) than in Johor (10,761 acres), the large estates in Johor were able to produce more OPFB (125,642 tonnes as opposed to 98,388 tonnes). It may be due to the average selling price per tonne of OPFB that had been higher in Johor than in Sabah (RM502 per tonne than RM479 per tonne).

Table 3.16 Cost Structures for Large Oil Palm Estates in Johor and Sabah, Malaysia: 2010

No	Types of Items	Johor, peninsular Malaysia (n=24)		Sabah, Borneo (n=7)	
		Mean	Median	Mean	Median
A.	**Basic Information**				
1	Size (hectares)	8,319	3,537	7,368	2,523
2	Size (acres)	9,117	7,300	18,419.7	6,689
3	Mature oil palm (acres)	10,761.2	6,350	32,753	6,240
4	Production (t)	125,642	44,775	98,388	4,000
5	Selling price per tonne (RM)	502.00	500.00	479.00	480.00
6	Average labourers age (years)	34	33	25	25
7	Distance to collection centre (km)	8	5	9	9
B.	**Costs for comparison**				
1	Land preparation costs (RM)	17,673,931.09	6,560,463	13,298,725.00	4,344,334.00
2	Planting costs (RM)	1,281,132.18	531,916.00	10,709,973.00	3,468,465.00
3	Annual pesticides costs (RM)	2,911,664.00	1,208,900.00	2,578,762.00	882,882.00
4	Drainage costs (RM)	5,199,400.00	2,158,750.00	4,604,932.00	1,576,575.00
5	Annual fertiliser costs (RM)	2,287,736.00	949,850.00	2,026,170.00	693,693.00
6	Annual transportation costs (RM)	4,397,470.00	1,567,125.00	3,443,580.00	159,075.00
7	Total cost for comparison	32,462,988	1,388,012.5	36,662,142.00	7,656,559.00
C.	**Costs per hectare**				
1	Land preparation costs (RM)	2,123.66	1,854	1,805.00	1,722.00
2	Annual pesticide costs (RM)	350.00	342.00	349.00	350.00
3	Drainage costs (RM)	625.00	625.00	625.00	625.0
4	Annual fertiliser costs (RM)	275.00	275.00	275.0	275.00

Source: Field research data (2010).

*Note: Data on cost structures for large holders can be retrieved at http://goo.gl/71RLHk

Considering the annual cost and establishment cost, including cost of land preparation, planting, and drainage (assuming the investment is at its initial phase, or first year of operation), the small-scale growers had the lowest cost, while the large-scale estates the highest costs. As expected, the size of plantation positively correlate to the total costs (Table 3.17).

Table 3.17 Total Cost per year, Including Initial Investment (in RM)

Types of Scales	Average total cost in Johor Per year (RM)	Average total cost in Sabah Per year (RM)
Small holders	12,640.00	11,385.00
Medium holders	44,166.00	216,547.00
Large holders	32,470,201	25,952,169

Source: Own findings from field research data (2010).

*Note: Data on cost structures for small, medium, and large holders can be retrieved at http://goo.gl/71RLHk

The two regions were compared on a per hectare per year basis to ensure that the costs between growers of different scales were comparable. The small-, medium-, and large-scale growers in Johor bore higher cost per hectare than the large-scale growers in Sabah (Table 3.18). The smallholders bore higher total costs per hectare than the large-scale growers. These findings may be due to the economy of scales scenario experienced by the large holders. Medium-scale growers in both Johor and Sabah have the highest total cost per hectare compared to growers of other sizes; they spent more money on land preparation, pesticides, drainage, and fertilisers (on per hectare per year basis).

Table 3.18 Total Cost Per hectare, Including Initial Investment Cost (in RM)

Scale of Growers	Average total Cost in Johor Per hectare Per Year (RM)	Average total cost in Sabah Per hectare Per Year (RM)
Small holders	3497	3090
Medium holders	3786	3726
Large holders	3373	3054

Source: Field research data (2010).

*Note: Data on cost structures for small, medium, and large holders can be retrieved at http://goo.gl/71RLHk

The level of efficiency varied among the small- and large-scale growers in both Johor and Sabah. The large estates in Johor were the most efficient on the basis of per hectare, and per tonne, whereas the smallholders in Johor were the least efficient (on per hectare, per labour, and per tonne basis). However, the smallholders in Sabah were efficient on a per hectare basis. In both regions, the medium-size growers were the most efficient of the three scales of growers on a per labour basis. Growers of all scales (small, medium, and large) were almost equally competent.

Nurseries

The cost structures of nurseries, the first actor in the palm oil supply chain, are presented in this section. The prices of oil palm seeds and seedlings were generally higher in Sabah than in Johor (Table 3.19). In general, each oil palm seed cost RM1.25 (US$0.42), 3.5-month-old oil palm seedling RM3.50 (US$1.2), eight-month-old palm seedlings RM10 (US$3.3), and one-year-old seedlings RM14 (US$4.7). In Johor, nurseries typically sell 3.5-month-old oil palm seedlings (RM3.50/US$1.2), whereas in Sabah, nurseries favour selling eight-month-old oil palms seedlings (RM10/US$3.3). Regional variation in the vulnerability of planted seedlings requires older seedlings to be planted in Sabah, leading to higher plantation establishment costs in Sabah. The nurseries in Sabah also spent more money on safety equipment than the nurseries in Johor. Therefore, the mean and the median total variable costs to nurseries in Sabah were higher than to nurseries in Johor.

Table 3.19 Cost Structures for Oil Palm Nurseries in Johor and Sabah, Malaysia: 2010

No.	Types of Items	Johor, peninsular (n=3)		Sabah, Borneo (n=3)	
		Mean	Median	Mean	Median
A.	**Basic Information**				
1	Size (acres)	1.25	1.25	14	15
2	Average number of workers	2	2	6	1
3	Average worker age (years)	37	40	32	28
4	Distance with small holders (km)	10.33	7.5	7.5	7.5
5	Average total annual production (RM)	40,500.00	40,500.00	434,000.00	30,000.00
6	Average monthly profit (RM) (provided by subjects)	1,694.0	2,000.00	2,486.00	2,600.00
7	Selling price (RM)	3.50	3.50	11.3	10.00
B	**Assets**				
1	Tools/equipment (RM)	333.00	400.00	566.00	500.00
2	Fixed assets (RM)	60,000.00	80,000.00	2,666.00	2,000.00
3	Current assets (RM)	12,500.00	12,500.00	67,800.00	71,052.00
C.	**Administration Costs**				
1	Annual land tax (RM)	1,627.00	1,627.00	3,807.00	3,990.00
2	Annual road tax (RM)	7.50	10.00	72.00	75.00
3	Contingency expenses (RM)	1,000.00	1,000.00	444	322
4	Safety equipment (RM)	200.00	200.00	733.00	1,000.00
5	SOCSO (RM)	16.00	21.00	5.00	5.00
6	KWSP (RM)	200.00	200.00	200.00	200.00
D.	**Variable Costs**				
1	Oil palm seedling price (RM/individual)	7.00	7.00	7.00	7.00
2	Annual fertiliser costs (RM)	3,000.00	3,000.00	3,520.00	3,300.00
3	Annual pesticides costs (RM)	450.00	450.00	846.00	480.00
4	Annual oil costs (RM)	630.00	632.00	915.00	670.00

Source: Field research data (2010).
*Note: Data on cost structures of nurseries can be retrieved at http://goo.gl/71RLHk

Processing mills

The extraction mills in Johor have higher mean and median daily capacity than the mills in Sabah (Table 3.20). The average daily mill capacity was 962 tonnes in Johor compared with 767 tonnes in Sabah. At extraction mills in Johor, crude palm oil constituted, on average, 48% of the total output; this figure reduced to 25% at extraction mills in Sabah. Johor also produced four times more shell fibre than Sabah. FELDA growers contributed to 65% of the total mill input (OPFB for processing) in Johor, while smallholders only contributed to 5%. The proportion of contribution is similar in Sabah, whereby 60% of the mill inputs came from FELDA growers and 10% from smallholders (see Table 3.20). In addition, the mean and median total annual wages, training costs, and social costs were higher in Sabah than in Johor.

Table 3.20 Cost Structures for Palm Oil Extraction Mills in Johor and Sabah, Malaysia: 2010

No	Types of Items	Johor, Peninsular Malaysia (n=5)		Sabah, Borneo (n=14)	
		Mean	Median	Mean	Median
A.	**Basic Information**				
1	Capacity per hour (t)	45.8	45	50	45
2	Capacity per day (t)	962	950	767	720
3	Target output (t)	42, 440	15,750	10, 436	10, 660
4	Total Revenue (RM)	6,980,391	7,080,263	4,536,460.43	4,258,080.00
5	Depreciation (RM)	53,975	55,500.00	37,286.00	40,000.00
B.	**Outputs produced**				
1	Production crude palm oil (%)	47.64	60	25.22	21
2	Palm kernel oil (%)	15.2	20	11.81	5
3	Shell fibre (%)	19.64	5	5.75	4
4	Bunch ashes (%)	1.16	0.4	3.5	3.5
C.	**Share of input sources from plantations**				
1	Small holders (%)	0.5	0.5	0.29	0.29
2	FELDA (%)	0.65	0.8	0.60	0.60
3	Private estates (%)	0.18	0.2	0.65	0.75
D.	**Costs for Comparison**				
1	Number of workers	85	86	96	100
2	Annual wages (RM)	247, 377.00	200, 000.00	918,857.00	960,000.00
3	Training costs (RM)	8,361.40	7,056.00	15,581.00	16,279.00
4	Social costs (RM)	50,144.80	19,313.00	311,106.00	871.22.00
E.	**Administration Costs**				
1	Annual SOCSO (RM)	5,632,924.00	4,084,338.00	38,435,877.00	863,026.31
2	Annual KWSP (RM)	5,632,924.00	4,084,338.00	38,435,877.00	863,026.31
3	Annual License (RM)	1,083,195.00	402,105.00	12,477.14	13,000.00
4	Contingency expenses (RM)	1,218,572.80	130,604.00	1797562.00	1,687,255.00
F.	**Taxes**				
1	Annual Land taxes (RM)	22,02,477.00	3,000,000.00	627,098.00	960,000.00
2	Annual Road taxes (RM)	56,376.40	50,000.00	16,051.00	16,396.5

Source: Field research data (2010).
*Note: Data on cost structures for processing mills can be retrieved at http://goo.gl/71RLHk

Retailers

In Johor, the average wholesale price of cooking oil to retailers, the final actor in the palm oil supply chain, was RM2.74 (US$0.91) per kg and the retail price was RM2.95 (US$0.98) per kg (Table 3.21). In Sabah, these figures were RM2.34 (US$0.78) per kg and RM2.74 (US$0.91) per kg respectively. The purchasing and selling prices of cooking oil, soap, and margarine were primarily greater in Johor than in Sabah. In contrast, the median total annual costs of diesel, energy, road taxes, and license fees were greater in Sabah than in Johor. In Malaysia, especially in rural areas, the demand for cooking oil exceeds supply. Based on interviews, most palm oil dealers preferred to supply higher-priced cooking oil to Thailand, thus, causing shortages in the domestic supply. There have been many complaints from consumers, but no action has been taken by the Ministry of Domestic Trade, Cooperatives, and Consumerism so far.

Table 3.21 Cost Structures for Palm Oil Product Retailers in Johor and Sabah, Malaysia: 2010

No.	Types of Items	Johor, peninsular Malaysia (n=34)		Sabah, Borneo (n=54)	
		Mean	Median	Mean	Median
A.	**Product Information**				
1	Cooking oil purchasing (RM)	2.74	2.47	2.34	2.45
2	Cooking oil selling (RM)	2.95	2.60	2.74	2.75
3	Soap purchasing (RM)	2.67	2.65	0.73	0.80
4	Soap selling (RM)	3.14	3.00	1.12	1.20
5	Margarine purchasing price (RM)	4.09	4.01	3.12	4.00
6	Margarine selling price (RM)	4.73	4.50	3.63	4.45
B.	**Costs**				
1	Annual Diesel costs (RM)	5,302.00	5,760.00	5,313.00	6,000.00
2	Annual energy costs (RM)	6,974.00	4,860.00	5,357.00	6,000.00
3	Annual wages (RM)	17,968.00	12,336.00	13,209.00	9,600.00
4	Annual road taxes (RM)	1,125.00	1,100.00	1,565.00	2,000.00
5	Annual license fees (RM)	318.00	70.00	162.00	100.00

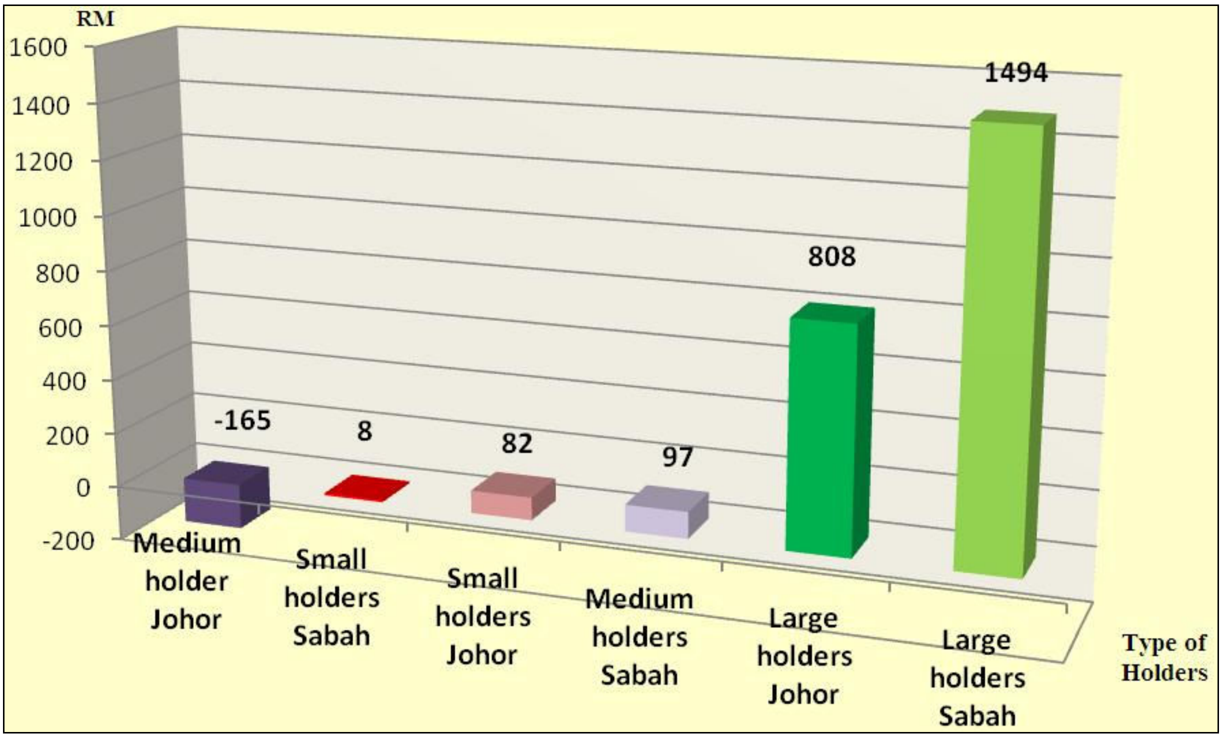
Source: Field research data (2010).
*Note: Data on cost structures for retailers can be retrieved at http://goo.gl/71RLHk

3.6.7 Value-added for Oil Palm Growers

Oil palm growers only produce OPFB for sale to collection centres or millers. The diversification of palm oil products begins at the oil palm mill segment. Thus, value-added of oil palm growers was calculated on the basis of per tonne and per hectare. The value-added created by large-scale growers are the highest among all growers in both Johor and Sabah (Figure 3.9). The value-added per tonne per year was obtained by subtracting the costs from the total revenue; the costs are as follows: variable cost (annual cost of salary, water, pesticides, fertiliser, and transportation), overhead cost (administration cost, unexpected expenses, and depreciation), farm business cost (annual salary of operators, SOCSO, and KWSP), establishment cost (cost of land preparation, planting, and drainage), operating cost (annual land tax, social cost, road tax, staff training cost, and miscellaneous fees). The value-added was then divided by the annual tonnage of OPFB. The medium-scale growers in Johor created negative value-added, which meant that their profits were insufficient to compensate for the equity capital invested in their farms at their opportunity cost as well as the remaining revenues after accounting for all production costs (Boehlje, 2012).

Medium-sized producers in Johor also bore the highest transportation costs, labour wages, administration costs (unexpected costs), and overhead costs. The medium-scale growers hired an average of three farm labourers, whereas smallholders hired only an average of one labourer. The average plantation size was between 8 and 16 ha. Thus, the medium-sized growers need to improve their production management practices. Besides production management practices, poor soil fertility and the geophysical factors at the plantation level may have also contributed to these findings.

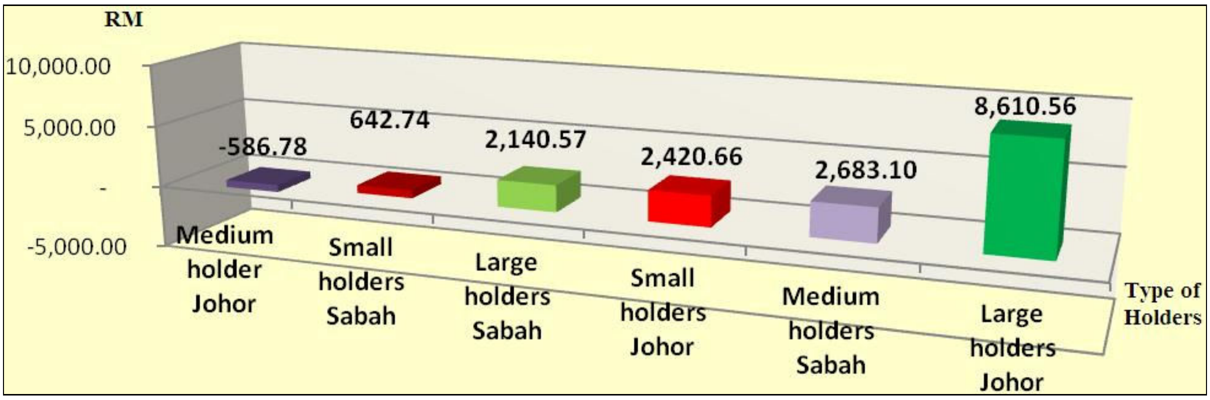
Figure 3.9 Value Added Creation per tonne by Oil Palm Growers in Johor and Sabah, Malaysia: 2010 (in RM)



Source: Field research data (2010).
*Note: Data on cost structures for small, medium, and large holders can be retrieved at http://goo.gl/uxIF5H

On the other hand, value-added created by oil palm growers calculated on a per hectare basis presents a different picture. Medium-scale growers in Johor still created negative value-added, and smallholders in Sabah still created the second-least value-added. However, on a per tonne basis, large estates in Sabah created the highest value-added (Figure 3.9), as opposed to value-added on a per hectare basis, whereby the highest value-added was created by large estates in Johor (Figure 3.10). The value-added was calculated by deducting variable costs (annual costs of salary, water, pesticides, fertiliser, and transportation), overhead costs (annual administration, unexpected expenses, and depreciation), farm business costs (annual salary of operators, SOCSO, and KWSP), establishment costs (cost of land preparation, planting, and drainage), and operating costs (annual land tax, social cost, road tax, staff training cost and miscellaneous fees) from the total annual revenue. The value-added was then divided by the number of hectares.

Figure 3.10 Value Added Creation per hectare by Oil Palm Growers in Johor and Sabah, Malaysia: 2010 (in RM)



Source: Field research data (2010).
*Note: Data on cost structures for small holders can be retrieved at http://goo.gl/uxIF5H

3.7 Summary and Conclusion

This study has managed to fill the gaps left by previous researches by considering the different actors in the palm oil industry in Malaysia. The product flow in the palm oil industry in Malaysia was examined in detail, from the upstream to the downstream segments of the palm oil supply chain, highlighting complexities that have not been addressed in the existing literature.

Meanwhile, in the case of growers in Johor, the smallholders were found to be earning lower gross margins than large scale growers on the basis of per hectare, per labourer, and per tonne; this is a result of the long-term impacts of this industry in the region. The recent expansion of the palm oil industry in Sabah, however, has led to an inverse relationship between plantation size and gross margin (except when measured on a per tonne basis).

The data distribution of gross margins per hectare, per labourer, and per tonne indicated that regardless of operation size (large-, medium-, and small-scale growers), the plantations were almost equally competitive. The transitivity of the average gross margin was as follows: average gross margin per hectare in Johor: large estates > smallholders > medium-size growers; gross margin per tonne in Johor: large estates > smallholders > medium-size growers; whereas gross margin per hectare in Sabah: smallholders > medium-sized grower > large estates) (see Figures 3.6, 3.7, and 3.8 ; Tables 3.9 and 3.10). This may be another achievement of the Malaysian palm oil industry that has yet to be identified in the literature: some smallholders even achieved higher gross margins (per hectare and also per tonne) than growers of other scales (Table 3.10), for instance, in Sabah, smallholders earned a higher gross margin per hectare than large estates. Based on the data, two of the large estates sampled earned negative gross margins, these two figures thus compensated for the otherwise higher gross margin even though five of seven samples earned gross margins between RM4,000 and RM8,400. Five of the six smallholders sampled earned gross margin between RM6,400 and RM9,600 (see Annex http://goo.gl/BkNp3l and Table 3.9) (In Johor, Smallholders earned higher gross margin per hectare and per tonne than medium-sized growers). However, the findings may have been affected by the sample size (sample size of smallholders = 27, medium-sized growers = 3). Firstly, the smallholders earned a gross margin per hectare per year between RM2,800 and RM14,075. In contrast, medium-scale growers only earned a gross margin per hectare per year between RM2,154 and RM11,075. Secondly, smallholders in Johor earned between RM219 and RM435 per tonne, while medium-sized growers in Johor earned a gross margin per tonne between RM244 and RM381. The analyses revealed that large estates in Johor utilised production factors (especially labour) to obtain higher gross margins per labourer per year. They hired permanent or contract labourers to work on a wide range of establishment activities (drainage building, holing, planting, fertilising, etc.), whereas both medium- and small-scale growers hired different labourers for specific work (for example, labourer A only for establishment land preparation, B for planting, and C for harvesting). Furthermore, large estates typically exhibited greater expertise in using input methods, whereas many small holders reported that they were uncertain about proper pesticides application (see Annex http://goo.gl/Bjh8bs).

Transportation costs were an issue in Sabah as the distance between oil palm plantations and collection centres was greater than that in Johor. However, smallholders and large estates in Johor bore higher total costs per hectare per year (including investment cost in the early stage of plantation) than their counterparts in Sabah. In addition, comparison between the different scales showed that the smallholders bore higher total cost per hectare per year than large estates. Economy of scales experienced by the large holders may have contributed to this outcome. Production in the Malaysian palm oil industry begins with nurseries, followed by growers, and OPFB dealers (collection centres); they form the upstream of the supply chain. Dealers send the OPFB for processing in extraction mills and refineries. The resulting products then flow to the downstream segments of the chain, which consist of palm oil dealers and exporters. Selling prices vary according to the quality of the oil palm fruit and are set by the respective collection centres and government programmes (FELDA, FELCRA, and RISDA). Every actor in the value chain has to be registered with the MPOB, which is identified as the governance and pivotal actor.

On a global level, the Malaysia palm oil industry needs to take greater initiative to fulfil certification requirements, including the RSPO and the ISCC[22], so that the industry can achieve greater penetration into developed countries. However, this study did not analyse the costs and benefits of the certification scheme. The RSPO and the ISCC are one of the barriers to entry into the international market, and both policies the policy are laid down by external governance of the value chain. Approximately 50% of the global palm oil production is imported by the EU. Interestingly, non-edible oleochemicals are later outsourced to importer countries for processing and sold to supermarkets as final goods, such cosmetics, and pharmaceuticals. EU consumers, however, do not recognise palm oil in the end products since it is only labelled as vegetable oil. Less developed countries, such as Pakistan and China, import these products to fulfil domestic demand regardless of certification status.

The biological life cycle of oil palms dictates that palm oil fruit production only begins at the age of three. Consequently, farmers need to survive without any income from harvest for three years after planting. Large estates are able to better cope with the situation by planting their plots in rotation. Smallholders, by contrast, typically grow similar-aged oil palms throughout their plantations because of the relatively small scale of operation, and therefore, may not earn any income when their oil palms are immature. Smallholders also bear higher relative transportation costs as the costs are calculated on a per tonne basis, but the transportation costs to large estates are charged as a lump-sum usually to the logistics division of their parent company.

The recent expansion of the palm oil industry in Sabah may have caused an inverse relationship between production scale and gross margins in the region (except on a per tonne basis). The

[22] The International Sustainability and Carbon Certification scheme (ISCC). Further information available at: http://www.sustainablepalmoil.org/standards-certfication/certification-schemes/

results had been variable in Sabah, with medium-sized enterprises earning the highest gross margins per labourer. Most farm labourers in Sabah were mostly immigrants from Indonesia, Philippines, and Myanmar. Harvest workers were paid an average of RM35 (US$11.67) per tonne in Sabah compared with RM40 (US$13.33) in Johor. Most smallholders did not hire farm labourers and bore lower establishment costs than large holders. The analyses of cost structures found that variable costs were higher in Sabah, owing to higher transaction costs (Sabah imports inputs from Peninsular Malaysia). Transportation costs were also higher in Sabah than in Johor. Large-scale growers in both Johor and Sabah created the highest value-added among the growers; this showed that large estates are the key actors in the Malaysian palm oil plantations.

The findings also showed that smallholders may have similar ability as large estates and medium-sized growers to supply OPFB to oil palm mills. The ability to access the international market is dependent on not only economic performance but also compliance with international standards. In order to compliance, a transparent and traceable system may be needed for sustainable palm oil production (Duijn, 2013). With such a system in place, each actor in the value chain could act more responsibly to fulfil the requirements of international standards because intermediate products, such as palm oil fruits and process palm oil, can be traced back to their source. A tracking system also enables the identification of end products which contain palm oil from unsustainable sources or processors (Duijn, 2013).

Chapter 4 Cost Benefit Analysis and Externalities of Growers and Mills in the Malaysian Palm Oil Industry in Johor and Sabah, Malaysia

4.1 Introduction

The environmental externalities of the palm oil industry in Malaysia have created barriers to entry into international markets, especially those of developed countries with market restrictions that only allow certified palm oil products, such as the EU and the US. These market barriers exist as palm oil is commonly depicted as a perennial crop that causes devastation to biodiversity and tropical forests, and contributes to land degradation. Between 1990 and 2010, Malaysia lost 8.6% (1, 920,000 ha) of its forest cover (UNDP, 2012).

In addition, activists campaigning against the unsustainable nature of the palm oil industry have also directly affected producers and buyers (DIE, 2012; Jiwan, 2013; Pye, 2013). They prompted the cancellation of multi-million dollar contracts (with companies, such as Unilever and Nestlé) and disrupted financial interactions with major institutional lenders seeking to avoid reputational risks from their investments (e.g. The International Finance Corporation and HSBC) (Paoli et al., 2010).

However, the palm oil industry contributes meaningfully to the Malaysian national GDP, net export earnings, employment opportunities, and poverty alleviation. They form the backbone of rural development in Malaysia through improving living standards and developing the economy (Ministry of Primary Industries, 1995; Plantation Industries, 2007; Basiron, 2008; EPU, 2010–2012; MPOB, 2011; Malaysian Department of Statistics, 2012). Besides, the global demand for palm oil is expected to continually increase, most notably in China and India, because of its highly competitive price and energy efficiency (MPOB, 2004).

4.1.1 System Perspective in Land Use: NGOs vs Malaysian Palm Oil Industry Policymakers

There have been debates between various actors within the palm oil industry and environmental NGOs about the environmental impacts of the palm oil industry. NGOs argue that converting tropical rainforests to oil palm plantations has devastated biodiversity in Borneo. In addition, sociologists have debated migration and flexible labour regimes in plantations (Saravanamuttu, 2013), indigenous peoples and social issues (Anderson, 2013), and the transnational environmental campaign around palm oil (Pye, 2013). Meanwhile, ecologists have debated the ecology and biodiversity distractions due to palm oil investment (Koh and Wilcove, 2008; Danielsen and Heegaard, 1995; Wilcove, 2008). Nonetheless, there are also actors that exemplify the efforts made by the Malaysian government to protect tropical rainforests, such as establishing national parks. Basiron (personal communication) also argued that the controversy over land-use changes and land degradations attributed to the palm oil industry are exaggerated because many oil palm plantations are formerly rubber plantations. In general, the current debate about deforestation is centred on this crucial issue: is deforestation largely caused by the expansion of the oil palm industry, or are most of the current oil palm plantations established upon land formerly used for rubber and timber production (Yusoff and Hanson, 2007). According to TEEB (2010), the Millennium Ecosystem Assessment helped both policymakers and entrepreneurs to evaluate the services of ecosystem in their investments. After all, its application in land use policy seems to be procrastinated. Environmentalists have claimed that the palm oil industry contributes to GHG emissions, causing climate change (RSPO, 2010).[23] Nevertheless, some researchers have refuted this assertion by pointing out that palm oil plantations are ecologically more similar to forests than row crops since oil palms fix and store as much carbon as trees do.

4.1.2 The Efforts of the Study in Capturing the Externalities of this Industry

The controversy over land use for oil palm plantations was investigate by estimating the carbon storage/sequestration values of forests and crops that were more commonly planted prior to the popularity of oil palms, in particular rubber (in Peninsular Malaysia) and cocoa (in Borneo). After reviewing the most current research about oil palm, this is the first effort to evaluate the externalities of the oil palm industry using social CBA; the analysis also includes evaluating the

[23] More discussions can be retrieved at http://www.rspo.org/sites/default/files/Report-GHG-October2009.pdf; and http://news.mongabay.com/2013/0425-rspo-standards-prompt-complaints.html

opportunity costs of previous crops. It is important to compare the carbon sequestration capacity, and effectiveness, of oil palm plantations with those of other types of environment. The CBA offers insight into the opportunity costs of converting different cover types (i.e. forest, rubber and cocoa) to oil palm plantations. The opportunity costs, in this case, are the carbon sequestration capability of the previous cover types. The opportunity costs were evaluated by examining both primary and secondary data: 1) to gauge the level of awareness of sustainable oil palm cultivation practices possessed by producers, and 2) to identify the opportunity costs and externalities of producing palm oil. By adopting a case study approach, the representativeness of the data was not considered, but the issues in the current field were explored in detail by separating actors into extraction mills and grower, and further disaggregating the growers according to their scale of operation.

To completely assess the advantages and disadvantages of the palm oil industry, rather than merely considering the financial sustainability or environmental impacts of this industry independent of one another, a social CBA was applied. The aim of the CBA is to gauge the rates of return as well as the social desirability from both the environmental and the economic perspectives, thereby analysing the financial sustainability of this industry in conjunction with its environmental impact.

4.1.3 Background and Regulation of Malaysian Palm Oil Industry

Land development for Oil palm plantations

The oil palm production area has been expanded extensively since 2000 in Peninsular Malaysia (Henson, 2005). At the beginning of the Malaysian oil palm industry in the 1960s, natural forests were cleared for plantations, especially on the west coast of Peninsular Malaysia since these areas were found to be productive. More recently, oil palm plantations in Borneo, in areas such as Sabah and Sarawak, have been experiencing rapid growth as well. The plantations typically replaced logged and degraded secondary forests (Henson, 2005). However, Stibig et al (2007) asserted that the expansion of oil palm plantations is the main cause of deforestation in the lowlands and swamp forests of neighbouring Riau and Jambi in eastern Sumatra (Indonesia); along a coastal plain of Sarawak in Malaysia; and in many localities across Kalimantan, including the boundary zone of the Tanjung Puting National Park (famous for its orang-utans).

Since the mid-1990s, the total area of oil palm plantations in Malaysia and Indonesia have grown from 2.4 to 4.0 million ha and 1.7 to 6.0 million ha respectively (Casson, 2003). However, not all oil palm developments in Borneo and Sumatra resulted in forest conversion. Similar to the regulations Peninsular Malaysia, the conversion of forested state land to oil palm plantations is only allowed if the piece of land is designated for agricultural use. Besides, because cocoa production in Malaysia has been shrinking since 2000 (the outcome of Malaysian agricultural policy), many of these areas have been converted to oil palm plantations (Henson, 2005). Hence, the rate of deforestation have been decreasing significantly; the years between 1987 and 1995 saw a steady decline in the rate of deforestation. According to policymakers for the Malaysian palm oil industry, converting rubber and cocoa to oil palm is considered a sound policy for palm oil investment. However, environmentalists and ecologists said that the decision to shift the industry focus towards oil palm will result in opportunity costs. They also mentioned that oil palm is not native to Malaysia. Instead of converting rubber or cocoa to oil palm, afforestation programmes could be a viable alternative. Henson (2005) only provided a preliminary assessment of the carbon stock externalities during the rapid expansion of the Malaysian oil palm industry. Another research (Agus, 2005) estimated that every hectare in Gunung Pulai, a mountain in Johor, produces 352.6 tonnes of forest biomass and 176.3 tonnes of carbon storage. However, that study did not describe the attributes of forests sufficiently to allow comparisons with other carbon storage estimates or reflect the environmental opportunity costs and externalities of converting forest to agriculture in Johor. The following paragraph gives an overview of the palm oil mill segment in Johor and Sabah.

Palm Oil Processing Mills in Johor and Sabah

There are more operational extraction mills in Sabah, one of the study regions, than (124 mills, total capacity of 31,743,200 tonnes) in Johor (64 mills, total capacity of 16,414,400 tonnes). All mills in Sabah were operational at the time of the study, and only one mill in Johor was not in operation (MPOB, 2012). In 2010, a total of 419 palm oil mills had been licensed under the Environmental Quality Prescribed Premises Crude Palm Oil Mill Regulations of 1997.

In Malaysia, a total of 196 directive letters and 376 notices were issued to palm oil processing mills because of failures to meet legal requirements in 2010. In addition, 77 citations were issued for offences and 95 court actions were taken against oil mills that failed to comply with environmental regulations, resulting in fines totalling RM948,000 (US$316,000). Approximately 87% of the palm oil mills were subjected to the Environmental Quality (Prescribed Premises and Crude Palm Oil Mill) Regulations of 1977, 96% were subjected to the Environmental Quality (Clean Air) Regulations of 1978, and 96% were subjected to the Environmental Quality (Scheduled Wastes) Regulations of 2005 (Department of Environment [DOE], 2010). Furthermore, a total of 21 mills in Johor and 27 mills in Sabah received instructions from the DOE, 34 mills in Johor and 19 mills in Sabah received notices, 16 mills in Johor and 26 mills in Sabah received citations, 41 mills in Johor and 20 mills in Sabah were subjected to court action, and 2 mills in Sabah had their licenses suspended (DOE, 2010).

The frequency of sanction against breach of environmental regulation may reflect either firm enforcement of policy and regulations on palm oil mills in Malaysia or the gravity of externalities caused by palm oil production. It also calls into question the effectiveness of the disciplinary fees, which are the result of a command and control mechanism, and economic incentives in the Malaysian environmental policy. James (1990) mentioned that the industry usually takes into account the short-term costs of fulfilling specific regulatory requirements, but it neglects the externalities and social costs, which have long-term impacts on the industry. The DOE controls emissions by imposing pollution fees on errant mills. The fees are set at RM10.00 (US$3.33) per tonne of BOD discharged for effluent, and RM0.05 (US$0.02) per tonne for terrestrial waste disposal (Idris, 2003). In order to fill the gaps left by previous researches, the externality costs were determined, and its effects on the industry were internalised in the CBA.

4.2 Theoretical Framework—Cost Benefit Analysis

4.2.1 The Importance and the Advantages of CBA

Social benefit means an increase in utility to societal welfare, whereas social cost is a decrease in societal welfare. Likewise, the sum of individual benefits is the total social benefit, while the sum of individual costs is the overall social cost (Pearce, 2006; 42). In order to justify any investment or business activity, the benefits should be greater than the costs. Future costs and benefits of an investment can be expressed in present discounted values by deriving them from opportunity costs. A dollar investment in a project per se has its opportunity cost (its return in alternative use) (Harrison, 2010). The benefits and costs of an investment that accumulate over time and get discounted are called Net Present Value (NPV) (Granvorka and Saffache, 2010). The concept of discounting is based on the principle that a dollar received in the future is worth less than a dollar received now. Discount rates used in CBA function as a benchmark for investors or entrepreneurs to increase savings and investment (Harrison, 2010). If consumption is declining, the discount rate would be negative (Stern, 2007). In the concept of discounting, a lower weight is attached to a unit (for instance, RM1) of future benefits and costs than to an equivalent present unit (Atkinson and Mourato, 2008). This temporal weight is a discount factor and it is written as follows:

$$\mathbf{DF=1/\ (1+s)^{t}}$$

Even though the optimal techniques for designing a CBA have been continually debated, it is the most comprehensive theoretical economic evaluation analysis. This is reflected by its broad application in economic and social policy decision-making for over 50 years (Robinson, 1993; Pearce, 2006). As highlighted by O'Riordan (1990) and Pearce et al. (2006), this method can also be used to address sustainability issues by integrating future wealth creation and conservation of natural resources. Another advantage of this method is that it can prevent inefficiency by overcoming predictable problems, identifying suitable priorities; and by clarifying, rationalising, and simplifying societal choices to prevent conflicts (Sunstein, 2000). This argument is also supported by Boardman et al. (2006), who said that CBA is practical to monetise and observe trade-offs between present and future values, as the impacts of particular projects and policies actually occur over time.

In addition, CBA has an important role in policy determination. The World Bank (2010) has used CBA since the early 1970s for estimating effects of policy on living standards. The World Bank frequently includes NPV and Economic Rate of Return (ERR) calculations in their CBAs, which are policy requirements for all project appraisals. Besides, a cost-effectiveness analysis should be performed to determine benefits that cannot be measured in monetary terms. Based on their evaluation, in the past 20 years, projects to which CBA was applied exhibited improved performances. In fact, 93 projects were closed in 2008 as cost-benefit information about these projects was unavailable (*ex ante*). Regardless of the weaknesses of CBA, as long as the respective applicant can apply it according to fundamental standards, CBA can offer worthwhile insights. From a more technical aspect, if the results of a CBA show negative NPVs, it indicates that a country is becoming poorer as a whole (World Bank, 2010). This contradicts the International Development Association (IDA), which argues that a negative NPV does not necessarily mean a country is poorer, but instead, it indicates a waste of resources. Overall, the CBA may be an important tool for policymakers to justify the advantages and disadvantages of a particular investment or industry (Møller et al, 2014).

4.2.2 An Evaluation of the Cost Benefit Analysis

The essence of cost benefit analysis is simple; however, conducting CBA is a complex task. There are, therefore, a number of caveats concerning the findings of a CBA. Common points of criticism of CBA include ***how the monetary values of non-market events or phenomenon are determined.*** It is difficult to calculate the value of non-market goods, such as natural resources, because evaluating ecosystem services and biodiversity, which involve human interactions, is becoming increasingly more complex. The value of these non-market goods is subjective. It may be less desirable, useful or important to some communities, but more valuable to others. Previous scholars who have contributed to the debate about this issue include Spier (1971), Hanley and Spash (1993), TEEB (2010), and Riera (2012). Another point of criticism of CBA is that ***the benefits and cost of an investment will affect different groups of communities.*** The advantages may well benefit the investors, but the disadvantages may affect the indigenous communities. Therefore, the costs and benefits to individual groups need to be identified and considered. Besides, fully capturing the benefits and costs to both groups poses a great challenge. Another shortcoming of CBA is that it may lead to the **uncertainty and the difficulty in comparing its relative values**. For instance, an investor may need to stop expanding their oil palm plantation in order to preserve biodiversity and the habitat of some species. The investment, therefore, can be valued in two different ways: 1) its contribution to economic development, 2) its costs to biodiversity. ***The distributional effect in CBA is another drawback. The assumption of singularity of weights*** on the net benefits to an individual, regardless of who benefits and who bears the costs, is inherent in this effect. An externality cost of one euro has a more significant impact on lower class than upper class of society (Atkinson and Mourato, 2006). The justification of CBA, which is related to its **positive versus normative perspective, is a factor**

in justifying the CBA. CBA is conventionally justified by evaluating the impact of a particular investment or policy. Theoretically, the group that benefits from a decision would compensate those who are disadvantaged for their losses, thus both groups would be better off. However, there is a gap between theory and practice. Discussion about this issue has been the subject of debates in literatures, such as Hammit (2013), Pearce et al., (2006), and Zerbe (2006).

Another aspect of the debate about CBA is **the use of discount rates**. The World Bank (1991; 149) recommends the "standard opportunity cost of capital used", for instance, 10%. A discount rate can be derived by calculating the average discount rate over several years. Alternatively, a range of discount rates can be used to estimate the impact of low, medium and high interest rates on NPV. The use of a zero discount rate for environmental projects has also been proposed. However, Pearce et al. (1990) (cited in Nadkarni et al., 1992) asserted that it is impossible to accurately estimate externalities related to complex ecosystems for two reasons: 1) environmental oriented projects are inherently different from one another, and thus, discount rates cannot be chosen arbitrarily; 2) as an investment has to be rationally located, a discount rate can only be a benchmark for that purpose. As for environmental CBA, most environmental economics textbooks suggest using "an average of the market rate of interest" (Heesterman, 2004). In addition, a review by Stern suggested using a low and positive time discount rate (Nordhaus, 2007). "A high rate of discounting of the future will favour avoiding the costs of reducing emission now, since the gains from a safer and better climate in the future are a long way off and are heavily discounted (and vice versa for low discount rates). Allocation across generations and centuries is an ethical issue for which the arguments for low pure time discount rates are strong" (Stern, 2007).

4.2.3 The Relevance of Various CBA Concepts to Palm Oil

CBA has been applied to many aspects of agriculture, such as evaluating agricultural projects or large-scale enterprises that grow perennial crops, such as oil palm (ICRA, 2012). Oil palm plantations have a 25-year commercial cycle, which, relative to other typical farm business cycles, is a long-term process. Therefore discounting the future benefits and costs of investment is crucial for projecting the monetary values of the externalities of oil palm production.

The Malaysian palm oil industry has both contributed economically to farmers and caused externalities. CBA is chosen as a tool to analyse the industry because it is able to consider both the positive and the negative aspects of this industry. Due to the 25-year commercial cycle of oil palm trees, the external costs of palm oil investments can be captured by discounting the future benefits and costs (over a period of 25 years). Pearce (2006) asserted that “the best way in which policymakers can contribute to sustainability is by selecting the best projects, whereby best is defined relative to a standard cost-benefit test.” In the case of the palm oil industry, plantations have certain characteristics in terms of scale, the plantation history (previous cover type), and management practices. Additionally, applying CBA to palm oil investments could provide policymakers with at least the minimum standards with which they can use to identify the characteristics, or conditions, to upgrade the sustainability of palm oil production. The CBA allows us to consider a number of issues. Do palm oil investments in Sabah provide more benefits than costs? Do converting forest/rubber/cocoa crops to oil palm plantations provide more benefits than costs? What are the social costs and benefits generated by growers at each production scale?

Some variables and technical aspects in accord with past literatures were used as guidelines for the CBA, as shown in Table 4.1:

Table 4.1 Guidelines in Conducting CBA Research

Author	Guidelines	Variables or Factors to be Considered
ICRA (2012)	Application of CBA in considering agricultural externalities	Fertiliser is needed to maintain soil fertility, but it may cause externality to the community.
World Bank (2010;37)	Four steps for conducting CBA	1) Relevant costs and benefits were identified, including positive and negative externalities; 2) Relevant costs and benefits were measured in monetary terms; 3) The costs and benefits over a project's lifetime were compared; and 4) Projects were accepted or ranked according to criteria based performance.
World Bank (2010;37)	Usual Analysis in CBA	1) Benefit-Cost Ratio (a project is accepted if the benefits are greater than costs or if the ratio is greater than one). 2) NPV (when the value is positive) 3) Internal Rate of Return (when IRR is greater than market rates or the rate of return that is socially acceptable).
Harrison (2010)	Choice of discount rates	Low discount rate may worsen future generations. The ethical arguments were that discount rates may be a reason to increase savings and investment.
Meeusen (2008)	Variables in the social CBA	The amount of energy consumed (CO_2 emission) by transport, processing, and trade phases was unimportant or not crucial.
Buytaert (2011)	Variables related to environmental and social costs	Some variables, such as deterioration in natural resources and external effects on biodiversity, were omitted as they were too difficult to estimate (from an economic point of view) and translate into monetary terms.
TEEB (2010)	Comparison of future cost and benefits	Loss aversion. The value of losses was higher than gains. The researchers determined the values of gains and losses using a reference point. The losses were of higher value than the gains.
TEEB (2010)	Low or high interest rates?	In general, higher discount rates lead to the degradation of biodiversity and ecosystem. On top of that, low discount rates may lead to an increase in investment, and thus, negatively affect the environment.

Hepburn et al (2009)	Discounting under uncertainty	There were uncertainties about biodiversity loss, and therefore, lower discount rates were recommended for the valuation of future biodiversity loss.
Sayer et al (2012)	The opportunity cost of oil palm plantation	Carbon stock of oil palm plantation (50 to 100 t per hectare) (subjected to the logging magnitude and recovery time) Unlogged rainforest (175 to 215 tonne per hectare) Other vegetable oil carbon stock (6 tonne per hectare) Oil palm was not an option for forest, but it was a better option than other alternatives.

In addition, several literatures about applying CBA to other oil seeds as well as oil palm, along with the characteristics and elements of CBA found in these literatures, are shown in Table 4.2. A 25-year time frame was used in other studies, such as Nordin et al., (2004), NoorMahayu et al., (2009), and Agus et al., (2007). This study adopted the same time frame. While other studies only used an average discount rate in their CBA, in this study, a range of discount rates, between 1% and 8%, was employed to analyse different scenarios. In addition, constant price data were also used, which was also conducted by other studies [see: Nordin et al., (2004), NoorMahayu et al., (2009), and Monjezi and Zakidizaji (2012)].

Table 4.2 Literatures on CBA related to oil seeds

Research country	Author	Type of oil seed	Data	Time frame	Interest rates	Price	Yield	Designed CBA/analysis conducted	Cost	Sensitivity Analysis	Biodiversity
Sumatera, Indonesia	Butler et al (2009)	Oil Palm	Hypothetical data	30 years	Deforestation rate %, Forest convert to oil palm(1-8)years 12.5 %	Both constant and variable price	Low-17 tonnes per ha, high yield- 20.5 tonnes/ha	REDD vs oil palm plantation	Set up cost, Operation cost	Yes	Excluded
Malaysia	Nordin et al (2004)	Oil palm	Cash flow analysis	25 years	10 %	Constant price (RM500 per tonne)	5000 hectare, 2500 organic/ inorganic fertiliser	Organic vs inorganic fertiliser NPR, IRR and BCR	Establishment cost, variable cost	Yes. Price and yield	Excluded
Malaysia	NoorMahayu et al (2009)	Oil palm	Social economic analysis (200 small holders)	25 years	4 %	Constant price (RM530 per tonne)	Profit level influence by planting density	NPV, BCR and IRR	Establishment cost, variable cost	Market selling price	Excluded
Indonesia	Agus et al (2007)	Oil palm	- Carbon emission and opportunity cost. - Co2 emission from different land use	25 years	-	-	Annual income per hectare per year	Opportunity cost	Input cost, labour costs Low opportunity cost	-	-

			system (Rice, maize, paddy, rubber, and oil palm)								
Iran	Monjezi and Zakidizaji (2012)	Canola	57 farms (irrigated farming 34, dry farming 23)	-	-	constant	Kg per hectare	- Net return - Benefit cost ratio - input output energy	-Fixed cost -Variable cost	-	Excluded
Denmark	Moller et al (2014)	rape diesel, ethanol from wheat, and ethanol based on straw	-	-	-	constant		- LCA combined with welfare economic analysis (CBA)	-energy consumption, CO2 emission, Denmark produce biofuel	Yes - Fossil energy consumption and Co2 emission	Excluded

4.2.4 Palm Oil and Environmental Footprint

Various researches about the environmental footprint of palm oil have discussed the issues of land-use change, externalities of oil palm plantations, and emissions from palm oil processing mills. The issues of land use were related to carbon emission, which contributes to climate change because of forest land-use conversion. Researches on oil palm plantations also found that the emissions from plantations were largely due to input use, specifically fertilisers. Externalities from palm oil processing mills were due to carbon emission from palm oil mill effluent (POME) (see Table 4.3).

Table 4.3 Researches on Palm Oil Externalities

Author	Researches conducted and findings
Henson (2005)	- Both the total forested area and tree crops in Malaysia had decreased by the year 2000.
Mattson et al.(2000)	- Indirect land-use change issues (iLUC) of Malaysian palm oil:- biodiversity loss, local extinction of orang-utans, deforestation, and trades-off between the production of food and fuel.
Devisscher (2007)	- Externalities: loss of forests and water quality, including the degradation of natural resources, biodiversity loss, contribution to global warming, and reduction of essential ecological services. - The input used devastated the environment.
Yusoff and Hanson (2007)	- Oil palm plantations had the greatest negative impacts within the industry's supply chain, largely due to chemical fertiliser use.
Nazir and Setyaningsih (2010)	- Palm oil extraction at mills had been responsible for approximately 3.5% of the total negative environmental impacts of the industry in Malaysia.
Wu et al. (2010)	- Carbon emissions in the milling and the refinery segments originate from POME, which is produced by the steam and the water used in mills. - Palm oil mill treatments are typically similar throughout the country and are usually based on the 'end-of-pipe'[24] strategy.
Yacob et al. (2005)	- 518.9 kg of CH_4 per day was emitted from each open POME digestion

[24] End of pipe (EOP) is not a pollution prevention measure, but rather involves improving environmental performance, usually requiring higher technical costs. EOP minimises pollutants in the air, water, and production waste (Hellweg et al., 2005; 190).

	tank in the FELDA Serting Hilir Palm Oil Mill.
Sulaiman et al., (2011)	- Palm oil mills externalities: Biochemical Oxygen Demand BOD, Chemical Oxygen Demand (COD), solid oil and grease, and ammoniacal nitrogen. Nevertheless, if POME is efficiently utilised in the mills, anaerobic treating systems are capable of processing POME to produce biogas.
WWF Germany (2007)	- Research on GHG emissions due to direct land-use changes, resulting from converting natural forests to oil palm plantations.
Reinhardt et al. (2007)	- GHG balances of palm oil biodiesel could be negative (e.g. palm oil biodiesel could cause higher life cycle GHG emissions than conventional diesel fuel).
Fargione et al. (2008)	- Estimated the conversion of rainforests, peatlands, savannahs, or grasslands to produce food-crop-based biofuels in Brazil, Southeast Asia, and the USA. - Biofuels made from waste biomass or grown on degraded or abandoned agricultural lands planted with perennials were not associated with these levels of carbon debt and can provide immediate GHG advantages.
Gibbs et al. (2008)	- Clearing tropical forests and grasslands to produce biofuels would lead to long-term carbon debts, whereas converting degraded lands would provide carbon savings, even with the highest yield biofuel crops.
Ludin et al (2014)	- Estimated fuel consumption in Malaysian palm oil plantation (litre per year) and carbon emission (kg CO2 eq).

4.2.5 The Roundtable Sustainable Palm Oil (RSPO)

Many of discussions found in institutional literatures of this industry have been centred on the Roundtable on Sustainable Palm Oil (RSPO). The RSPO was founded in 2004 in response to global call for sustainable palm oil production. The RSPO aims ‘to promote the growth and the use of sustainable oil palm products through credible global standards and engagement of stakeholders’ (Wu et al., 2010; 1481). It was first established in Malaysia when WWF began exploring the possibilities of collaboration amongst several key stakeholders.

The RSPO is a non-profit association that unites stakeholders from seven sectors of the palm oil industry: producers, processors and traders, consumer goods manufacturers, retailers, banks and investors, environmental or conservation NGOs, and social or developmental NGOs. The RSPO works toward developing and implementing global standards for sustainable palm oil by encouraging each stakeholder to bring group-specific agendas to the roundtable, and to facilitate discussion among traditionally adversarial stakeholders and business competitors to reach a consensus regarding the RSPO decisions and objectives (RSPO, 2012).

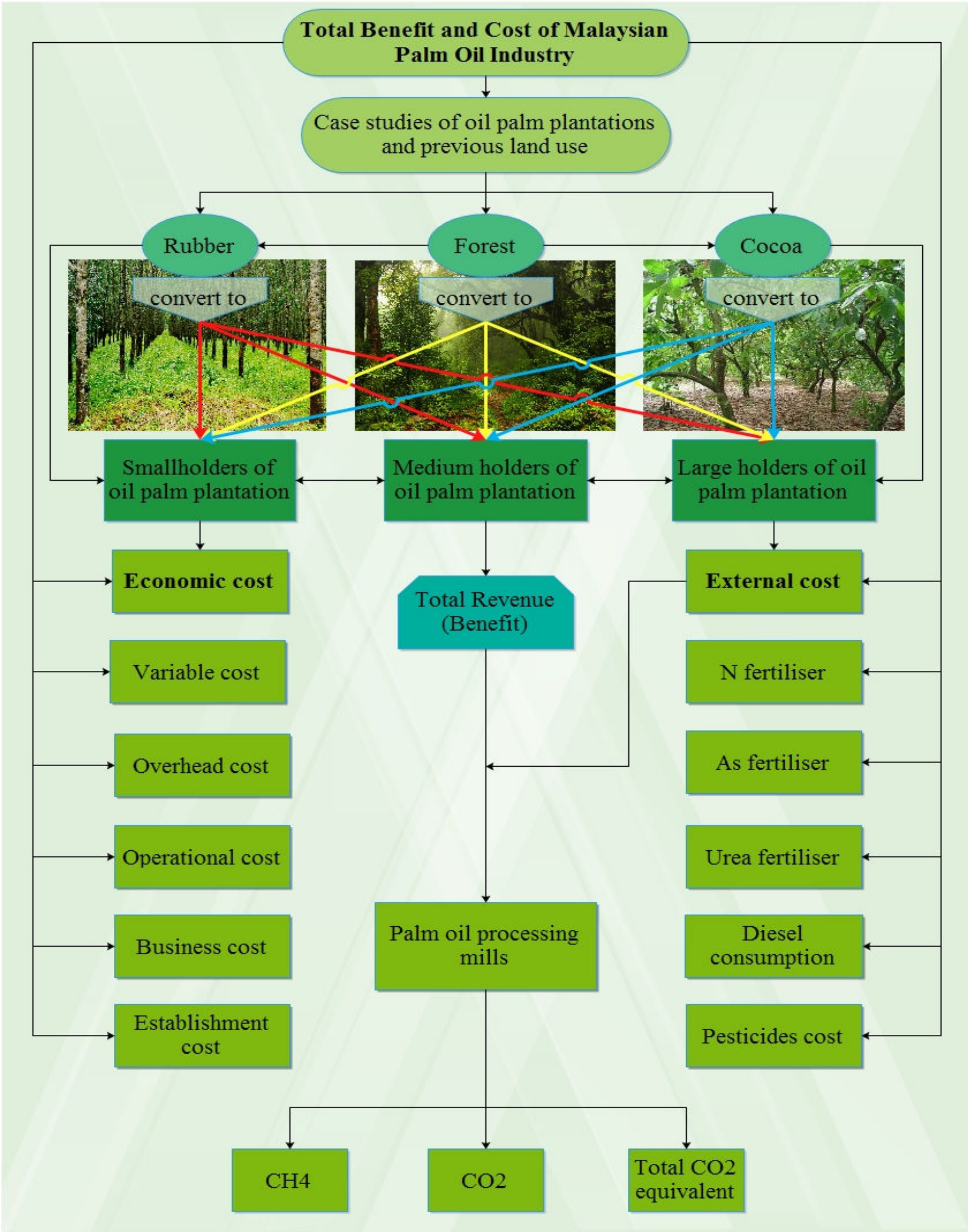
Moreover, a detailed study of the RSPO, which was conducted by Paoli et al. (2010), found that effective corporate social responsibility (CSR) is increasingly being adopted by actors in the palm oil industry. The industry actors are increasingly assuming greater responsibility for the social and environmental impacts of their operations, often even exceeding existing legal requirements. The major challenges faced by the RSPO are: 1) improving corporate governance of plantation operations; 2) encouraging RSPO members, namely processors, traders, manufacturers, and retailers, who profit from palm oil to share the costs of implementing sustainability measures; 3) strengthening partnerships between NGOs and companies to provide social and environmental expertise, and 4) creating a more supportive regulatory structure in producer countries to implement practices that comply with sustainability criteria. Given that oil palm cultivation is considered to have the most negative environmental impacts in the palm oil supply chain (Yusoff and Hanson, 2007; Nazir and Setyaningsih, 2010), it is necessary that palm oil plantations strive to improve their environmental performance; however, they will continue to struggle without the broader support of stakeholders from initiatives, such as the RSPO (Paoli et al., 2010).

Meanwhile, Schouten and Glasbergen (2011) found that the RSPO process to be fairly legalised. It should be acknowledged, however, that it is difficult to effectively represent every stakeholder group, most notably small-scale growers (RSPO, 2004; Schouten and Glasbergen, 2011). Another shortcoming of the RSPO is that its code of conduct lacks provisions for measuring and verifying the progress of its members towards, and enforcing, certification. Despite being perceived as a crucial mechanism for improving the sustainability of the palm oil industry, some major palm oil importing countries (including Pakistan) have shown no interest in participating in the RSPO.

4.2.6 Conceptual Framework for Social Cost Benefit Analysis

Figure 4.1 shows the influences of interest rate (discount rate) upon the investment and capital accumulation of actors. Three case studies were conducted to cover each of the different scales of oil palm production (smallholders, medium-sized growers, and large estates), which were converted from rubber, forest, and cocoa crops. These case studies may reflect the opportunity costs of choosing oil palm as a second generation crop. Each of these case studies includes economics costs and externality values. The variables used in the CBA for economic costs were variable costs, overhead costs, operational costs, farm business costs, and establishment cost, while the externalities include nitrogen fertiliser, ammonium sulphate fertiliser, urea fertiliser, diesel consumption, and pesticide use (Figure 4.1). These variables were chosen based on previous studies (Nikander, 2008; Zulkifli et al., 2010). In this study, the magnitude of fertiliser pollution caused by oil palm cultivation was not compared with those caused by cultivating previous crops. Both of the previous studies used life cycle assessments to analyse the impacts of oil palm plantations. A limitation of the CBA in this study is that biodiversity loss was not captured. This is due to low reliability of available data. On the other hand, the externalities produced by processing mills, such as methane (CH_4) and carbon dioxide emissions (CO_2), were captured. The constituents of the externalities were determined by referring to Yacob et al. (2005), who conducted a baseline of mill emissions.

Figure 4.1 Conceptual Framework for Cost Benefit Analysis



Source: Own illustration

4.3 Methods

4.3.1 Cost Benefit Analysis

The externalities caused by the palm oil industry were integrated into the CBA to measure the following components:

The financial profitability and environmental sustainability of small-, medium-, and large-scale growers (on a per hectare basis); and of palm oil extraction mills; in Johor and Sabah (on a per tonne basis) were calculated using a time frame of 25 years, the approximate equivalent of one commercial cycle of the oil palm industry.

The opportunity costs to smallholders who participated in a land settlement programme managed by FELDA were examined. The FELDA farmers were offered two options: 1) to manage not only their own farms but also their own costs, or 2) to be fully managed by FELDA and receive a fixed monthly wage of RM1,200 (US$400) in return. The formula used for CBA is as follows:

- **NPV = PV(B)–PV(C)**

$$NPV = \frac{\sum^{t} (Biat)}{(1+r)^{t}} - \frac{\sum^{t} (Cia,t + Cib,t + \ldots)}{(1+r)^{t}}$$

Biat	=	Total annual revenue
Cia	=	Establishment/development cost (financial cost)
Cib	=	Annual Salary (financial cost)
Cic	=	Annual water use (financial cost)
Cid	=	Annual pesticide use (financial cost)
Cie	=	Annual fertiliser use (financial cost)
Cif	=	Annual transportation cost (financial cost)
Cig	=	Fuel (financial cost)
Cih	=	Administration cost (financial cost)
Cii	=	Operators Salaries (financial cost)
Cij	=	SOCSO (financial cost)
Cik	=	KWSP (financial cost)
Cil	=	N fertiliser (external cost)
Cim	=	Carbon storage for tropical forest (opportunity cost)
Cin	=	Carbon storage for rubber plantation (opportunity cost)
Cio	=	Carbon storage for cocoa plantation (opportunity cost)
Cip	=	Effluent for AS fertiliser production (external cost)
Ciq	=	Effluent for urea fertiliser production (external cost)
Cir	=	Diesel consumption (external cost)

Cis	=	Pesticide use (external cost)
t	=	The duration of project in years
r	=	Interest rate

If the NPV of a project is positive, then the plantations or mills should proceed with it, whereas if the NPV is negative, the business management is inefficient (Boardman et al., 2006). NPV is influenced by both the economic variables and the externalities, meaning that changes in either one affects the calculated NPV. Hence, in order to review the overall business performance, the NPV was computed. The annual revenue and returns were estimated using a period of 25 years and were then discounted to the present values. The sum of discounted revenues and costs indicate if an investment incurred more benefits or costs (Turner et al., 2000; Noormahayu et al., 2009). If the NPV is positive, the business will potentially create a net return (profit) for the investor. On top of that, the magnitude of NPV indicates the expected profit of the business.

4.3.2 Benefit-Cost Ratio

Benefit-cost ratio (BCR) was used to estimate the benefit received per unit cost of a project. It is thus an indicator of the efficiency of an investment in a project. If the BCR value of a business is greater than 1, the business is justified, taking into account economic grounds. The higher the BCR value, the more effectiveness is the business. The BCR formula is as follows:-

$$BCR = \frac{\sum_{t=1}^{T}\sum_{i=1}^{n}\frac{B_{it}}{(1+r)^t}}{\sum_{t=1}^{T}\sum_{j=1}^{m}\frac{C_{it}}{(1+r)^t}}$$

B	=	Annual benefit of the project
C	=	Annual cost
r	=	Discount rate (real interest rate)
n	=	Number of items that constitute benefits
m	=	Number of items that make up costs
t	=	The duration of the project in years

Assumptions of the CBA are as in the following:

1) Price and total production are constant
2) Farmers earn a constant total revenue and total cost every year
3) The real interest rate (1 to 8%) is used to calculate the discount value

The steps to conduct a CBA are as follows:-

1) Discounted Total Revenue – Discounted Total Cost of each sample (per hectare)
2) The NPV per hectare are sorted from the biggest to the smallest value
3) The NPV per hectare are sorted into the best, standard, and worst case
4) The differences in cost structures between the respective scales are as follow:-

Firstly, the NPVs of the oil palm plantations was calculated; the growers were disaggregated into different scales according to their size of operation (see Tables 4.4 and 4.5).

Table 4.4 Cost Benefit Analysis for cost differentiation between scales for Oil Palm Plantations in Johor (in RM)

Productive farmers under FELDA scheme	Small Holders (Johor)	Medium Holders (Johor)	Large Holders (Johor)
- Transportation per year - Operators Salary (RM1000 per month) - Carbon storage (forest) - N fertiliser (base) - Effluent for AS fertiliser (base) - Diesel consumption (base) - Pesticide use (base)	- Transportation per year - Operators Salary (RM1000 per month) - Carbon storage (rubber/forest) - N fertiliser (base) - Effluent for AS fertiliser production (base) - Diesel consumption (base) - Pesticide use (base)	- Transportation per year - Operators Salary (RM2000 per month) - Carbon storage (rubber) - N fertiliser (base) - Effluent for AS fertiliser production (base) - Diesel consumption (base) - Pesticide use (base)	- Operators Salary (RM7000 per month) - SOCSO - KWSP - Carbon storage (rubber/forest) - N fertiliser (low) - Effluent for AS fertiliser production (low) - Diesel consumption (low) - Pesticide use (low)

Source: Own illustration

Table 4.5 Cost Benefit Analysis for cost differentiation between scales for Oil Palm Plantations in Sabah

Small Holders (Sabah)	Medium Holders (Sabah)	Large Holders (Sabah)
- Maintenance of double cup Hilux - Maintenance of small lorry - Operators salary (RM1000 per month) - Carbon storage (rubber/forest) - N fertiliser (base) - Effluent for AS fertiliser production (base) - Diesel consumption (base) - Pesticide use (base)	- Maintenance machine 1 - Operators salary (RM2000 per month) - Carbon storage (forest/cocoa) - N fertiliser (high) - Effluent for AS fertiliser production (high) - Diesel consumption (high) - Pesticide use (high)	- Maintenance tractor machine 3 - Operators salary (RM7000 per month) - SOCSO - KWSP - Carbon storage (rubber / forest / cocoa) - N fertiliser (low) - Effluent for AS fertiliser production (low) - Diesel consumption (low) - Pesticide use (low)

Source: Own illustration.

Secondly, the costs and benefits of palm oil mills in both Johor and Sabah were identified. By taking into consideration the technology used (conventional or advanced technology), each case study was categorised into one of the three cases: worst, standard, and best. The externalities (mills effluents) are dependent on the capacity of the processing mills. There are no differences in the types of costs borne between the mills in Johor and Sabah.

Table 4.6 Cost Benefit Analysis for cost between Mills in Johor and Sabah

Palm Oil Processing Mills in Johor	Palm Oil Processing Mills in Sabah
Wages per year	Wages per year
Social Cost	Social Cost
Road Tax	Road Tax
Training Cost	Training Cost
Maintenance	Maintenance
SOCSO	SOCSO
KWSP	KWSP
License	License
Other Expenses	Other Expenses
Unexpected Cost	Unexpected Cost
Production cost	Production cost

Source: Own illustration.

The CBA includes 'inflows' (revenue) and 'outflows' (costs) (Wang and Biedemann, 2010). However at the beginning of a project, there may be investment costs (establishment costs), which are included in the CBA. The cost structure used in the CBA consist of variable, overhead, operational, farm business, and establishment costs (Table 4.7). The externalities of the palm oil industry integrated into the CBA were taken from empirical studies conducted by Nikander (2008) and Zulkifli et al. (2010). The study by Zulfikli et al. (2010) was chosen as a reference for a few reasons: 1) it considered continued land use from former oil palm plantations (102 plantations in Malaysia, 25-year life time, and characteristics of plantations similar to this research); 2) the planting density of plantations in that study is 142/ha (for this study, the figure is on average 135/ha); 3) the input data, parameters, and ranges used in their sensitivity analysis were given in units of tonnes of FFB per hectare per year and are thus useful for synchronisation with the data in this study (Table 4.7). Based on the literature review, externalities are related to inputs used on the plantations, such as fertilisers, pesticides, diesel used for transportation, and mechanisation (Table 4.7). More specifically, nitrogen fertiliser is frequently cited as a major contributor to GHG emissions. In the case of the extraction mill segment of the supply chain, CH_4 and CO_2 from open digesting tanks used to treat POME are the main source of GHG emission. The externality parameters considered in the CBA are as in the following:

Table 4.7 Input Factors for Oil Palm Fresh Fruit Production in Tonnes per Hectare: Malaysia

Financial data for plantations in Johor and Sabah	**Description**
Total annual revenue per year (RM)	Primary data from fieldwork and plantation report data: average selling price (per t) multiplied by the average quantity produced per year (t)
Total Establishment/development costs (RM)	Primary data from fieldwork: costs were inclusive of clearing land, drainage, site preparations, and planting
Total Variable costs per year	
Total Annual salary (RM)	Wages are paid according to the production of oil palm fruit bunches (in t), salary is the wages per tonne multiplied by the annual production quantity
Total Water Costs per year (RM)	Average monthly water cost multiplied by twelve months

Total pesticide costs per year (RM)	Pesticide cost per acre multiplied by the total acreage and use per year (large estates use pesticides four times annually; usages by smallholders is variable)
Total fertiliser costs per year (RM)	Total acreages multiplied by 0.5 and fertiliser cost per bag (respondents reportedly use half of the fertiliser bags per acre)
Total transportation costs per year (RM)	Cost per tonne multiplied by monthly production and twelve months per year
Overhead costs	
Total Fuel Costs per year (RM)	Average monthly oil cost multiplied by twelve months
Total Annual Administration costs and unexpected expenses (RM)	Permanent labour costs, contingency costs, and costs of interventions (used to treat diseases or damages)
Farm business costs	
Annual salary of an operator employed by large estates (RM)	Monthly salary of RM7000 multiplied by twelve months
Annual salary of a smallholder farmer (RM)	Monthly salary of RM1200 multiplied by twelve months
SOCSO per year (RM)	Social Security Organisation (provides social security through insurance, including medical and cash benefits, artificial aids, financial guarantees, and protection to families) paid annually by large growers
KWSP per year (RM)	KWSP—EPF savings are retirement funds. Employers contribute 12% of a labourer's retirement benefits

Source: Own illustration.

Table 4.8 External Factors for Fresh Oil Palm Fruit Production in Tonnes per Hectare in Malaysia

Input data for externalities: Johor	**Small-scale growers**	**Medium-scale grower**	**Large-scale grower**
Tonnes FFB per ha per year	19 (base)	18 (base)	15 (low)
N fertiliser in tonnes per ha per year	73	73	50
Kg CO_2-eq (emission in the field/soil emission)	64,232,000	64,232,000	45,880,000
Economic assessment of land use change value (t CO_2 per ha)—tropical forest ***(a)** carbon storage	9.02	9.02	9.02
Economic assessment of land use change value (t CO_2 per ha)—rubber ***(b)** carbon storage	4.9	4.9	4.9
EF for AS fertiliser production kg CO_2 eq/kg N per ha per year	2.7	2.7	0.9
EF for urea fertiliser production kg CO_2 eq/kg N per ha per year	1.3	1.3	0.9
Diesel consumption GJ per ha per year	3.2	3.2	2.1
Pesticide use in kg per ha per year	3	3	3
Input data for externalities Sabah	**Small-scale growers**	**Medium-scale growers**	**Large-scale growers**
Tonne FFB per ha per year	24 (base)	28 (high)	13 (low)
N fertiliser in tonnes per ha per year	50	120	50
kg CO_2 eq. (emission in the field–soil emission)	64,232,000	91,760,000	45,880,000
Economic valuation assessment of land-use change (t of CO_2 per ha)—tropical forest ***(c)** carbon storage	7.86	7.86	7.86
Economic valuation of land-use change (t of CO_2 per ha)—cocoa ***(d)** carbon storage	3.1	3.1	3.1
EF for AS fertiliser production kg CO_2-eq/kg N per ha per year	2.7	7.6	0.9
EF for urea fertiliser production Kg of CO_2-eq/kg of N per ha per year	1.3	4	0.9
Diesel consumption GJ per ha per year	3.2	5.1	2.1
Pesticide use kg per hectare per year	3	3	3

Notes: Kongsager et al.*(b) *(d) (2012); Henson*(a) *(c) (2005; 292)
Note*: Carbon price, external factor, and external costs can be retrieved at http://goo.gl/ybESZL

Table 4.8 shows the input factors of FFB production in units of tonnes per hectare. These figures are data gathered through fieldwork. The usages of fertilisers and pesticides have been classified into base, low, and high according to a definition found in a study by Zulkifli et al. (2010). In the study Zulkifli et al. defined low, base, and high, annual FFB production as 50 t, 73 t, and 120 t, of N fertiliser per hectare respectively (Table 4.8). The CO_2 equivalent (in tonnes) of the emissions caused by fertiliser and agricultural inputs were calculated using their global-warming potential (expressed as a factor of carbon dioxide) to harmonise their values with calculations of biofuel GHG emission in Europe.[25] The values, in CO_2 equivalent, were then multiplied by the market price of carbon (RM24.5/US$8 per tonne) to obtain the monetary value of carbon emissions. Meanwhile, the uses of diesel and pesticides were retrieved from Nikander (2008). It is also assumed that externalities are sensitive to carbon price; if carbon price increases to US$20, it may lead to an increase in external costs. This spells out the influence of carbon price on external cost, that is, the higher the carbon price, the higher the external costs become.

4.3.3 Assessment of Land-Use Change Values

To assess changes in land-use values, a method described in a study conducted by Kongsager et al. (2012) was used. Kongsager et al. evaluated aboveground carbon sequestration of major plantation crops in Ghana, including cocoa, oil palm, and rubber. The aforementioned study was chosen because Malaysia and Ghana share many similar characteristics. The climates in both countries are similar, for example, the mean annual temperature is 26° C in Ghana, and ranges from 25.5 °C to 27.8 °C in Johor. The agricultural activities comprise mainly oil palm, cocoa, rubber, cattle, and goat production. The landscape in Ghana is also similar to Johor and Sabah, made up largely of secondary forests, agricultural plots, and rural settlements. In addition, as is the case in Malaysia, some of the oil palm plantations were established in areas that were formerly forested. The authors also studied oil palms at various ages (7, 16, and 23-year old), which took multiple stages of maturity and productivity into account. Kongsager et al. (2012) also focused on carbon storage in aboveground biomass since it accounted for the largest percentage of carbon sequestration in forest ecosystem according to the IPCC Guidelines for National Inventories, whereas the carbon sequestration capacity of belowground biomass is independent of land use (Henson, 2005; Kongsager et al., 2012). This study was also chosen since it used systematic methods to measure land use, covering the most important land-use

[25] http://www.biograce.net/content/ghgcalculationtools/standardvalues

changes. In addition, information from a study by Henson (2005) was chosen to capture economic assessment of land use change value of forest. The carbon storage in a forest represents a part of the opportunity costs of converting the forest to an oil palm plantation. Henson estimated the magnitude of carbon sequestration in Peninsular Malaysia and Sabah between 1981 and 2000 (Tables 4.8, *a, *b, *c, and *d). Furthermore, information about the externality factors of the palm oil extraction mills were adopted from a study by Yacob et al. (2005). This study also estimated the NPV of palm oil mills, the second segment in the palm oil value chain, frequently labelled as part of the 'dirty segments'. The explanation of financial and external data is shown in Table 4.9.

Table 4.9 Externalities of Palm Oil Extraction Mills in Malaysia

Input data for mills in Johor and Sabah	
Financial Costs	
Total Annual Revenue (RM)	Total monthly revenue multiplied by twelve months/ Total production less total cost to millers
Total Annual Production Costs (RM)	Production cost per unit multiplied by the output per month and twelve months
Total Variable Costs per year (RM)	
Total Wages per year (RM)	Monthly wages multiplied by twelve months
Total Social Costs per year (RM)	Benefits received by workers and society
Total Overhead Costs per year (RM)	
Total Annual Licensing Costs (RM)	License fee paid to MPOB
Total Annual Contingencies Costs (RM)	Unexpected costs of machinery repair or replacement
Total Annual Training Costs (RM)	Training workers to improve work efficiency
Total Annual Maintenance Costs (RM)	Maintenance of machinery in the mills
Total Annual Road Taxes (RM)	The road tax paid to the mills for transportation from farms/collection centres
Business Costs	
SOCSO per year (RM)	Social Security Organisation (provides social security through insurance: including medical and cash benefits, artificial aids, financial guarantees, and family protection. Paid by mills each year
KWSP per year (RM)	KWSP—EPF savings are retirement fund, employers contribute 12% of labourers retirement benefits
Externality Costs	
Tonnes of CH_4 from POME (six digester tanks)	849 a
Tonnes of CO_2 from POME (six digester tanks)	4,672 b
Total CO_2 equivalent (from six digester tanks)	21,652 c

Note: POME = Palm oil mill effluent; a, b, and c: the study was conducted by Yacob et al. (2005) for 273 days on a sample of processed FFB with a capacity of 54 $t/hr.^{-1}$
Data on palm oil mills can be retrieved at http://goo.gl/qYbU6Q for the case study in Johor, and http://goo.gl/nNWaLj for the case study in Sabah.

All carbon emissions were then valued in monetary terms by multiplying the equivalent carbon emission with carbon prices (RM24.5/US$8 per tonne) provided by Greentech Malaysia (2010), which is a resource for CDM project developers in Malaysia. However, carbon sequestration was valued based on forest carbon price in 2012 (RM16.8/US$6 per tonne).

4.3.4 Discount Rates

As mentioned earlier, discount rate is a crucial parameter in CBA as costs and benefits vary in their distribution over time (Harrison, 2010). In Malaysia, the average real interest rate in the past 24 years (between 1987 and 2010) was 5%, based on World Bank data. Malaysia had negative interest rates in 2000, 2005, and 2008, but high real interest rates in certain years (up to 11.8% in 2009). The NPV of the actors in Johor and Sabah was calculated with eight different discount rates (ranging from 1 to 8%) to investigate how sensitive the NPV is to changes in interest rates. Only positive interest rates were chosen as negative interest rates are not applicable to CBA (Hanley and Spash, 1993). This approach was also used by Hepburn et al. (2009), who conducted social discount analyses under conditions of uncertainty in Australia, Canada, Germany, and the UK, using average discount rates and natural algorithms to avoid negative interest rates. However, developed countries typically apply lower social discount rates (3 to 7%) than developing countries (8 to 15%) (Symons, 2008). The actual rates are shown in Annex A.

4.4 Results

4.4.1 Growers in Malaysian Palm Oil Industries

Smallholders under the FELDA programme have two options: 1) FELDA manages all production activities, and they receive a fixed monthly income of RM1,200 (US$400) (this option was classified as unproductive; note that the CBA includes externality factors of the plantations), and 2) settlers manage their own farm operations; however, they must sell their harvest to collection centres owned by FELDA. The productive FELDA plantations were classified into three groups, namely best, standard, and worst, according to their NPV per hectare. FELDA adopted this policy so that it can recuperate the costs of establishing plantations, which it provided to growers, when the growers sell their fruit to FELDA collection centres. FELDA also retains some of the farmer’s earnings from sales of fruits as payment by instalments for the establishment costs.

After 25 years, the NPV of unproductive plantations was valued at -RM26,285.0 (-US$8,761.73) (at 5% discount rate) per hectare (Table 4.10). Productive plantations, which manage their own operations, had NPVs of up to RM50,883 (US$16,961) per hectare (BCR 0.4) in the best-case scenario, RM29,053 (US$9,684) per hectare (BCR 1) in the standard scenario, and -RM69,974 (-US$23,325) per hectare (BCR 0.6) in the worst-case scenario (Table 4.10). Productive plantations in the best-case scenario earned RM84, 980 (US$26,776) more than unproductive plantations, or approximately 294% higher (Table 4.10). All productive plantations in this case study had been established on forested sites.

Table 4.10 NPV per Hectare for FELDA Programme Oil Palm Plantations by Relative Productivity in Malaysia (in RM)

Discount rate (%)		Johor			
		Productive			Unproductive
		Best (n=1)	Standard (n=1)	Worst (n=7)	
1	NPV	77,612	44,315	-106,073	-40,093.4
	BCR	0.4	1	0.6	0
2	NPV	69,186	39,504	-94,556	-35,740.3
	BCR	0.4	1	0.6	0
3	NPV	62,072	35,442	-84,833	-32,065.
	BCR	0.4	1	0.6	0
4	NPV	56,034	31,994	-77,058	-28,946.
	BCR	0.4	1	0.6	0
5	NPV	50,883	29,053	-69,974	-26,285.
	BCR	0.4	1	0.6	0
6	NPV	46,465	26,530	-63,503	-24,002.
	BCR	0.4	1	0.6	0
7	NPV	42,656	24,356	-58,298	-22,035.
	BCR	0.4	1	0.6	0
8	NPV	39,356	22,472	-53,788	-20,309.
	BCR	0.4	1	0.6	0

Source: Own calculation.
Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

The externalities of plantations in all categories (best, standard, and worst) were similar because FELDA farmers each received four hectares for planting oil palm. Forest carbon market values were calculated on a per unit basis, as a result, all FELDA plantations earned the same amount of NPV per hectare (the sum of per hectare economy cost and per hectare external cost multiplied by four hectares) (Table 4.11). Taking into account their fixed monthly income (RM1,200;

US$400) and the externalities, the unproductive plantations were not creating positive NPV (Table 4.10). Thus, adopting a 'scaled-up poverty reduction policy' might be an appropriate course of action for FELDA. That is, the FELDA programme would allow unproductive plantations to lease their land to other households. These plantations would earn more money through the lease, and the lessee could earn income by cultivating oil palms. The low revenues and negative NPV that the productive plantations in the worst-case scenario exhibited are the results of several factors, such as: 1) the maturity of the oil palms, 2) farm management practices, 3) low quality of oil palm fruit, and 4) delayed execution of plantation restoration activities.

Table 4.11 Cost Structures of Productive Oil Palm Plantations in Malaysia

Cost Structures	FELDA in Johor		
	Best (n=1)	**Better (n=1)**	**Worst (n=7)**
Average Total Revenue per year (RM)	56,448	54,000	23,829
Average hectare (ha)	4	4	4
Average Total Revenue per Hectare per year (RM)	14,112	13,806	6,346
Average Total Variable Costs per year (RM)	5,860	6,700	4,504
Average Total Overhead Costs per Year (RM)	500	500	500
Average Total Operational Costs per year(RM)	488	985	443
Average Total Farm business Costs per year (RM)	12,000	12,000	12,000
Average Total Establishment Costs (RM)	14,750	16,750	15,208
Average Total Economic Costs per year (RM)	21,598	24,935	20,655
Average Total Externalities costs per year (RM)	21,366	21,366	21,366
Average Total Costs (RM)	42,964	46,301	42,021

Source: Own calculation

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

The smallholders in Sabah earned a less favourable NPV when compared with their counterparts in Johor; this suggests that smallholders in Sabah are less efficient (Table 4.12). They were also inefficient (earning negative NPVs per hectare) in both the standard and the worst-case scenarios. These findings highlight the inefficiency in plantation management in the worst cases and the need to increase revenues to meet costs. Surprisingly, the standard cases in Sabah reported the highest total revenues, and the worst cases the second highest revenues (Table 4.12). The externalities caused by smallholders in Sabah under the 'best' category were lower than those caused by their counterparts in Johor. This is because the sampled plantations in Sabah were established on former cocoa plantations, whereas in Johor, some of the sampled plantations were established on former rubber plantations (one sample), while others on formerly forested lands (two samples). The externalities constitute between 22% and 26% of the total costs in Johor, whereas, these figures range from 17% to 19% in Sabah (Table 4.13). This indicates that investing in smallholders in Sabah was more economical and causes lower externalities. The lower externalities are due to the mixed historical background of plantations in the samples from Sabah (a combination of forests and cocoa). Cocoa plantations have lower carbon stocks than rubber plantations, and natural forests in Sabah have lower carbon stocks than those in Johor.

Table 4.12 Net Present Values per Hectare of Small Scale Oil Palm Growers in Johor and Sabah, Malaysia (in RM)

Discount rate (%)		Location					
		Johor			Sabah		
		Best (n=4)	Standard (n=3)	Worse (n=20)	Best (n=1)	Standard (n=1)	Worse (n=4)
1	NPV	101,837	8,408	-138,995	44,379	10,152	-18,526
	BCR	1	1	0.4	1	1.4	1
2	NPV	90,781	7,495	-123,904	39,561	9,049	-16,514
	BCR	1	1	0.4	1	1.4	1
3	NPV	81,446	6,724	-111,164	35,493	8,119	-14,816
	BCR	1.4	1	0.4	1	1.4	1
4	NPV	73,524	6,070	-100,351	32,041	7,329	-13,375
	BCR	1	1	0.4	1	1.4	1
5	NPV	66,764	5,512	-88,293	29,095	6,655	-12,145
	BCR	1	1	0.4	1	1.4	1
6	NPV	60,967	5,033	-83,213	26,569	6,077	-11,091
	BCR	1	1	0.4	1	1.4	1
7	NPV	55,970	4,621	-76,392	24,391	5,579	-10,182
	BCR	1	1	0.4	1	1.4	1
8	NPV	47,377	9,948	-70,483	22,504	5,148	-9,394
	BCR	1	1	0.4	1	1.4	1

Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

Table 4.13 Cost Structures of Small Scale Oil Palm Growers in Johor and Sabah, Malaysia

Cost Structures	Johor			Sabah		
	Best (n=4)	Standard (n=3)	Worst (n=20)	Best (n=1)	Standard (n=1)	Worst (n=4)
Average Total Annual Revenue (RM)	35,316	33,447	17,445	24,000	32,700	25,650
Average size (ha)	3	4	3	3	2	3
Average Total Annual Revenue Per Hectare (RM)	36,598	14,400	7,654	10,450	8,640	7,233
Average Total Annual Variable Costs (RM)	4,323	7,577	5,223	3180	3,975	4,961
Average Total Annual Overhead Costs (RM)	400	460	368	0	6,800	4,400
Average Total Annual Operational Costs (RM)	435	479	471	146	183	166
Average Total Annual Farm Business Costs (RM)	12,000	12,000	12,000	12,000	12,000	12,000
Average Total Establishment Costs (RM)	12,625	11,515	11,789	3,300	4,125	4,538
Average Total Annual Economic Costs (RM)	17,784	20,030	17,851	18,626	27,083	26,064
Average Total Annual Externality Costs (RM)	6,281	5,574	5,519	4,316	5,635	6,082
Average Total costs (RM)	24,064	25,604	23,370	22,942	32,717	32,146

Source: Own calculation

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

Meanwhile, in Johor, medium-scale growers under the best category earned lower NPV per hectare than smallholders on average (Tables 4.12 and 4.14). Comparing the two regions, medium-scale growers earned higher NPVs per hectare in Sabah than in Johor (Table 4.14). The average total externalities were higher in Sabah than in Johor across all categories because rubber plantations have lower carbon stocks than forests and all oil palm plantation samples in Johor were converted from rubber plantations (see Table 4.15). In contrast, the oil palm plantations in Sabah falling under the best and the standard categories were converted from cocoa plantations, while those which were classified as worst were established on formerly forested lands. These findings indicate that the land-use change values affected the NPV of growers.

Among the samples categorised under the best cases, ratio of the externalities to the total revenues was low in both Johor (14%) and Sabah (18%) (Table 4.15). However, this figure was higher among the samples categorised as the worst cases (46% in Johor and 47% in Sabah). Meanwhile, the medium-scale growers in Johor caused externalities costs that amount to about 15% to 16% of their total revenues per year, whereas in Sabah, this figure lies between 27% and 32%. This is consistent with assertions that converting tropical forests to oil palm plantations increases opportunity costs and environmental externalities (Yusoff and Hanson, 2007; Nazir and Setyaningsih, 2010). This observation also concurred with the opinions of NGO staff members interviewed in Malaysia (Tan Kee Huat, personal communication; Nithi Nesadurai,[26] personal communication).

Table 4.14 Net Present Values per Hectare of Medium Scale Oil Palm Growers in Johor and Sabah, Malaysia (in RM)

Discount rate (%)		Location					
		Johor			Sabah		
		Best (n=1)	Standard (n=1)	Worse (n=1)	Best (n=1)	Standard (n=1)	Worse (n=1)
1	NPV	39,206	-35,242	-170,768	109,697.4	-8,488	-24,604
	BCR	1.14	1	0.3	1.5	1	1
2	NPV	34,949	-31,416	-152,227	97,787.23	-7,566	-21,932
	BCR	1.14	1	0.3	1.5	1	1
3	NPV	31,356	-28,186	-136,574	87,732.33	-6,788	-19,677
	BCR	1.14	1	0.3	1.5	1	1
4	NPV	28,306	-25,444	-123,289	79,198	-6,128	-17,763
	BCR	1.14	1	0.3	1.5	1	1
5	NPV	25,703	-23,105	-111,955	71,917.47	-5,564	-16,130
	BCR	1.14	1	0.3	1.5	1	1
6	NPV	23,472	-21,099	-102,234	65,673	-5,082	-14,730
	BCR	1.14	1	0.3	1.5	1	1
7	NPV	21,548	-19,369	-93,854	60,290	-4,665	-13,523
	BCR	1.14	1	0.3	1.5	1	1
8	NPV	19,881	-17,871	-86,594	55,626	-4,304	-12,476
	BCR	1.14	1	0.3	1.5	1	1

Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

[26] Nithi Nesadurai is the president of the Environmental Protection Society Malaysia and the editor of the ECO newsletter.

Table 4.15 Cost Structures of Medium Scale Oil Palm Growers in Johor and Sabah, Malaysia

Cost Structures	Johor			Sabah		
	Best (n=1)	Standard (n=1)	Worst (n=1)	Best (n=1)	Standard (n=1)	Worst (n=1)
Average Total Revenue (RM)	108,000	124,800	27,000	1,728,000	81,000	40,320
Average Size (ha)	16	7	8	120	12	7
Average Total Revenues per Hectare per year (RM)	13,500	7,800	3,971	14,400	6,750	5,600
Average Total Variable Costs per year (RM)	19,400	33,400	12,350	336,000	16,600	8,540
Average Total Overhead Costs per year (RM)	2,000	100	35	4,000	10,800	6,800
Average Total Operational Costs per year (RM)	800	340	325	3,250	325	195
Average Total Farm Business Costs per year (RM)	24,051	24,000	24,000	340,000	27,400	15,340
Average Total Establishment Costs per year (RM)	33,500	62,200	28,295	165,000	16,500	9,900
Average Total Economic costs per year (RM)	79,751	120,040	65,005	848,250	71,625	40,775
Average Total Externalities costs (RM)	14,626	29,252	12,432	313,991	31,399	18,839
Average Total costs (RM)	94,377	149,292	77,437	1,162,241	103,024	59,614

Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

Large grower from all categories (best, standard, and worst) in Johor earned higher NPV per hectare than their counterparts in Sabah (Table 4.16). Similar to growers in the two other production scales (small- and medium-scale growers), the plantations in Johor in the 'worst' category earned higher NPV per hectare compared with the producers in Sabah (Table 4.16). The best case for large-scale growers in Sabah had been less efficient in producing oil palm fruit than those in Johor. The latter reported higher total revenues, lower economic costs and lower externalities (Table 4.17). The 'best' plantations in Johor were those converted from rubber plantations, whereas in Sabah, they were established on lands former rubber plantations or forests. The 'standard' plantations in Johor were those converted from rubber plantations (N = 8) or forests (N = 5), whereas those in Sabah were previously forested areas. The 'worst' plantations in Johor were converted rubber plantations (N = 6) and forests (N = 2), while those in Sabah were converted from forests or cocoa plantations. The externalities caused by large growers in Johor, and Sabah, in the 'best' category amount to 2%, and 14%, of the total revenue respectively, but with regards to growers in the 'worst' category, the figure exceeded 100%. This shows that the plantations in the 'worst' category often have significant externalities (Table 4.17); low total revenues and high externalities typify growers in this category. Moreover, in Johor, the externalities caused by these growers constituted about 26% to 27% of the total costs, and in Sabah, between 23% and 36% (Table 4.17). It was also found that externalities produced by plantations varied on a case-by-case basis. Individual plantations adopt their own strategies, for instance, production is highly dependent on labour and mechanisation incentives.

In the past, some plantations used an inter-planting practice called "under-shade planting" to achieve plantation renewal by cultivating young oil palms among older oil palms. However, according to an agricultural scientist at the MPOC, Dr Kheong, this practice is detrimental to the older oil palms. Some plantations lease out recently planted areas to farmers who grow other crops, such as watermelons and peanuts. However, this land-leasing system is no longer popular as oil palm prices have risen. There are also concerns that by allowing outsiders to have regular access to plantations, the risk of fruit theft increases (Kheong, personal communication). Large-scale plantations have greater externalities than small-scale plantations (Table 4.17). Large plantations are more mechanised, relying less on manual labour or draft animals to execute plantation activities. Besides, converting forests to oil palm plantations contributes the highest level of carbon emission, followed by conversion from rubber and cocoa plantations.

Table 4.16 Net Present Values per Hectare of Large Scale Oil Palm Growers in Johor and Sabah, Malaysia (in RM)

Discount rate (%)		Location					
		Johor			Sabah		
		Best (n=2)	Standard (n=13)	Worse (n=8)	Best (n=2)	Standard (n=2)	Worse (n=3)
1	NPV	2,055,077	59,293	-126,276	111,101	51,389	-70,071
	BCR	18	2	0.1	2	1	0
2	NPV	1,831,951	52,855	-112,566	99,038	45,810	-62,464
	BCR	18	2	0.1	2	1	0
3	NPV	1,643,582	49,633	-77,559	88,855	41,100	-56,401
	BCR	18	2	0.1	2	1	0
4	NPV	1,483,709	42,808	-70,015	80,212	37,102	-50,590
	BCR	18	2	0.1	2	1	0
5	NPV	1,347,305	38,872	-61,177	72,838	33,691	-45,939
	BCR	18	2	0.1	2	1	0
6	NPV	1,230,321	35,497	-58,058	30,765	33,691	-41,949
	BCR	18	2	0.1	2	1	0
7	NPV	1,129,476	32,587	-53,299	61,061	28,244	-38,511
	BCR	18	2	0.2	2	1	0
8	NPV	1,042,106	30,067	-49,176	56,338	26,059	-35,532
	BCR	18	2	0.2	2	1	0

Source: Own calculation

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

Table 4.17 Cost Structures of Large Scale Oil Palm Growers in Johor and Sabah, Malaysia

Cost Structures	Johor			Sabah		
	Best (n=2)	Standard (n=13)	Worst (n=8)	Best (n=2)	Standard (n=2)	Worst (n=3)
Average Total Revenues per year (RM)	256,620,924	41,009,452	12,922,864	25,155,000	8,838,000	2,673,493
Average Size (ha)	2,885	5,112	15,709	2,676	1,254	14,572
Average Total Revenues per Hectare per year (RM)	9,431	10,569	347	9,387	5,146	2,234
Average Total Variable costs per year (RM)	1,983,615	3,518,498	10,274,965	3,466,738	2,856,315	9,178,192
Average Total Overhead costs per year (RM)	20,063	24,351	76,008	19,130	8,216	70,974
Average Total Operational Costs per year (RM)	351,660	411,685	1,383,519	16,898	8,011	91,251
Average Total Farm Business Costs per year (RM)	159,604	751,146	136,135	517,383	203,469	47,513
Average Total Establishment Costs (RM)	8,232,126	15,369,164	45,596,748	4,563,936	2,676,720	26,203,255
Average Total Economic Costs per year (RM)	10,747,067	20,074,845	57,467,375	8,584,084	5,752,731	35,496,158
Average Total Externality Costs per year (RM)	3,854,492	7,051,987	21,312,112	3,638,548	1,738,086	20,200,991
Average Total Costs (RM)	14,601,559	27,126,832	78,779,487	12,222,632	7,490817	55,697,149

Source: Own calculation.
Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

Table 4.18 NPV Across Scales of Oil Palm Growers in Johor and Sabah per Hectare (Discount Rates - 4 %) (in RM)

Types of holders	Johor			Sabah		
	Best	Standard	Worse	Best	Standard	Worse
Small holders	73,524	6,070	-100,351	32,041	7,329	-13,375
Medium holders	28,306	-25,444	-123,289	79,198	-6,128	-17,763
Large holders	1,483,709	42,808	-70,015	80,212	37,102	-50,590

Source: Own calculation.
Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

The comparison of NPV per hectare across scales of operations in both Johor and Sabah is shown in Table 4.18. In Johor, large-scale estates performed the best in terms of NPV per hectare. On the other hand, smallholders earned the lowest NPV per hectare regardless of their categories (namely the best, standard, and worst). However, the current study yielded mixed findings about growers in Sabah. In the 'best' category, the large estates in Sabah did well, but the smallholders were deemed to be the worst performer. Under the 'standard' classification, large estates earned the highest NPV, while medium-sized growers the lowest. A study of the plantations categorised as 'worst' showed that the smallholders performed the best, and the large estates were the worst performers. These findings may be due to some factors that were not captured in this study, such as fertility status of plantation soils, which may have influenced the total monthly revenue. Smallholders usually have limited budget compared with plantations owned by a large company. Smallholders may use planting materials of lower quality and less inputs, such as fertilisers, tools, agrochemicals and pesticides, compared with private large estates. Another factor is the financial viability of replanting every 25 years (time period of a commercial cycle). Skilled farm labourers may have also contributed to the findings: well-trained labourers, employed usually by large estates, may produce higher OPFB yield.

4.4.2 Internalising the Environmental Effects in the Cost Benefit Analysis of Extraction Mills

The extraction mill segment in Johor earned higher NPVs per tonne of output at the conclusion of a 25-year period compared with Sabah (Table 4.19). Surprisingly, among the plantations categorised as 'best' cases, the average revenue of mills in Sabah was higher than that of mills in Johor (Table 4.20). In contrast, 'standard' mills in Johor generated nearly twice the annual revenue of their counterparts in Sabah (Table 4.20). The total mill revenues were estimated based on the reported production costs and business profits, and thus, were likely over- or underestimated to some degree (Table 4.20). In the case of 'worst' plantations, the cost structures were not adjusted efficiently according to the total annual revenues because lower revenues per year were not associated with lower total costs. The mills categorised as 'worst' generated, on average, negative NPV per tonne, signifying an unhealthy economic situation (Table 4.19).

Table 4.19 Net Present Values of Palm Oil Extraction Mills in Johor and Sabah, Malaysia (in RM)

Discount rate (%)		Location					
		Johor			Sabah		
		Best (n=1)	Standard (n=1)	Worse (n=3)	Best (n=2)	Standard (n=1)	Worse (n=11)
1	NPV	154,206	62,059	-43,804	32,604	4,331	-460,133
	BCR	4	2	0	1.4	1.1	0
2	NPV	137,463	55,321	-39,048	29,064	3,860	-410,175
	BCR	4	2	0	18	1.1	0.2
3	NPV	123,329	49,633	-35,033	26,075	3,464	-367,999
	BCR	4	2	0	1.4	1.1	0
4	NPV	111, 332	44,805	-31,626	23,539	3,127	-332,203
	BCR	4	2	0	1.4	1.1	0
5	NPV	101,097	40,686	-28,718	21,375	2,839	-301,662
	BCR	4	2	0	1.4	1.1	0
6	NPV	92,319	37,153	-26,225	19,519	2,592	-275,469
	BCR	4	2	0	1.4	1.1	0
7	NPV	84,752	34,108	-24,075	17,919	2,380	-252,890
	BCR	4	2	0	1.4	1.1	0
8	NPV	78,196	31,470	-22,213	16,533	2,196	-233,328
	BCR	4	2	0	1.4	1.1	0

Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

Hydrocyclone technology was associated with the extraction mills in the 'best' and 'standard' categories in Johor. The majority of the extraction mills in the 'worst' category used conventional technologies in their production (only one mill used hydrocyclone technology). Only two of the mills in the 'worst' category in Sabah used conventional technologies; the other nine employed more advanced mechanical technologies. The 'standard' mills used advanced mechanical technology, whereas the 'best' mills used conventional as well as the latest technology. Externalities of the sampled oil mills in Johor amounted to between 4% and 13% of total annual revenue, whereas in Sabah these figures ranged between 7% and 15% (Table 4.20). On the other hand, the externalities lay between 0% and 16% of total annual costs (Table 4.20). This illustrates that mills have low externalities (valued in monetary terms), and are therefore worth investing in, and the economic benefits far outweigh the environmental impacts are not harmful to the environment. This research also found that regardless of the technology used, NPV per unit output determined the level of mill efficiency. The value of externalities produced by mills may not be determined by the technology used. As already mentioned in Chapter 3, Sabah had a serious transportation problem that impacted the output quality because OPFBs need to be processed within 24 hours after harvest. However, the oil extraction rates of mills in Sabah (secondary data from the MPOB) were higher than those in Johor but the price of OPFB was lower in Sabah than in Peninsular Malaysia.

Table 4.20 Cost Structures of Palm Oil Extraction Mills in Johor and Sabah, Malaysia

Cost Structures	Johor			Sabah		
	Best (n=1)	Standard (n=1)	Worst (n=3)	Best (n=2)	Standard (n=1)	Worst (n=11)
Average Total Revenues (RM)	7,122,526	10,709,037	3,485,333	8,634,440	5,914,000	3,666,142
Average Total Output (RM)	720	1,500	46,587	1,750	1,500	12,827
Average Total Revenues per Output (RM)	37,682	21,581	6,607	335,004	20,857	8,428
Average Total Variable Costs (RM)	1,149,826	1,726,603	78,190,496	1,789,029	1,550,977	4,863,431
Average Total Overhead Costs (RM)	643,145	1,073,023	18,743,718	221,291	183,449	97,779,868
Average Total Operational Costs (RM)	728,152	1,844,630	4,348,967	2,267,455	1,943,533	16,620,153
Average Total Mills Business Costs (RM)	59,276	1,145,111	18,374,954	1,139,045	1,069,744	2,099,446
Average Total Economic Costs (RM)	2,580,399	5,789,367	119,658,135	5,416,820	4,747,704	121,362,898
Average Total Externality Costs (RM)	294,708	589,416	455,160	613,975	884,123	432,238
Average Total Costs (RM)	2,875,106	6,378,783	120,113,295	6,030,795	5,631,827	121,795,136

Source: Own calculation.
Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

4.4.3 Sensitivity Analysis

Only three indicators were included in the sensitivity analysis: discount rates (of 1% to 8 %) (Tables 4.12, 4.14, 4.16, and 4.18), reduction of nitrogen fertilisers (Tables 4.21 and 4.22), and sensitivity analysis of carbon prices (Table 4.23). The Malaysian palm oil industry appeared to be quite sensitive to changes in the discount rates. The higher the discount rates, the lower the NPV per hectare generated by the plantations in the 'best' and 'standard' categories. Surprisingly, higher interest rates resulted in lower losses experienced by the 'worst' plantations (Tables 4.12, 4.14, 4.16, and 4.18). This analysis illustrates how changes in interest rates can have considerable effects on the palm oil industry.

Nitrogen fertiliser contributed the most to externalities. The researcher modelled the effects of reducing fertiliser inputs by 5%, 10%, and 25%. The results of the modelling of the productive FELDA plantations and smallholders, and of the aforementioned scenarios (5%, 10%, and 25% reduction in fertiliser inputs), are presented in Tables 4.21 and 4.22. Sensitivity analysis of FELDA settlers and smallholders was only conducted on a per hectare basis. However, the methodology of modelling a reduction in nitrogen fertiliser input can also be extended to growers of other scales, namely the medium- and large-scale growers. Technically, a massive amount of bio-fertiliser is needed to offset a reduction in chemical fertiliser input, thus smallholders and FELDA settlers, who each own four hectares of oil palm plantations, may be the best type of grower to pioneer application of bio-fertilisers. The left columns in the tables show the results of modelling the base scenario (the NPVs per hectare earned by the group with regular nitrogen fertiliser applications and the usual externality effects at 5% of discount rate). The greater the reduction of externality costs from nitrogen fertilisers, the higher the NPV per hectare farmers will earn, regardless of the category in which farmers were classified (Tables 4.21 and 4.22). Besides, externalities can be reduced by applying biological fertilisers instead of chemical fertilisers, as well as adopting sustainable farm management practices (for instance, processed fruit bunches are often used as fertiliser in plantations). Cleaner technologies and stronger bioeconomy policies, along with international projects, will facilitate access to the EU and the US markets.

Table 4.21 Sensitivity Analysis for Nitrogen Fertiliser of Productive FELDA Oil Palm Plantations, Malaysia (RM)

	Net Present Values of Productive FELDA Plantations (after nitrogen fertiliser reduction)			
	Base scenario (5% discount rates)	5% ↓	10% ↓	25% ↓
Best	50,883	114,713	117,460	121,942
Standard	29,053	90,674	93,420	97,902
Worst	-69,974	-17,052	-14,267	-9,723

Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis and sensitivity analysis can be retrieved at http://goo.gl/ybESZL

The amounts are average values among the FELDA settlers on a per hectare basis; the discounting period is 25 years.

Table 4.22 Sensitivity Analysis for Nitrogen Fertiliser of Small Scale Oil Palm Growers in Johor and Sabah, Malaysia (RM)

	Net Present Values of Small Growers in Johor (RM)				Net Present Values of Small Growers in Sabah (RM)			
	Base scenario (r = 4 %)	5 % ↓	10 %↓	25 % ↓	Base scenario	5 %↓	10 % ↓	25% ↓
Best	73,524	74,247	74,969	77,138	32,041	33,486	34,932	39,269
Standard	6,070	7516	8,961	13,299	7,329	8,775	10,221	14,558
Worst	-100,351	-98,905	-97,459	-93,122	-6,146	-11,929	-10,483	-6,146

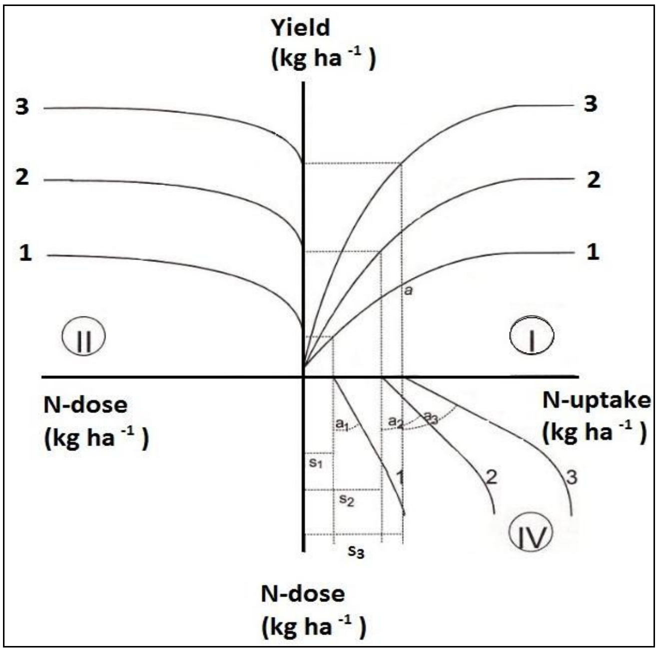
Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

The amounts are average values among the smallholders on a per hectare basis; the discounting period is 25 years.

According to De Wit (1992), the ratio between crop nitrogen uptake and nitrogen fertiliser application exceeds 100% since crop nitrogen also includes nutrients from natural resources. Figure 4.2 shows the relationships between fertiliser application, nitrogen uptake, and yields.

Figure 4.2 Relationships between Yield, Nutrient Uptake, and Nutrient Application



Source: De Wit (1992).

As crop growing conditions improve from scenario 1 to scenario 3, incremental changes in maximum yield occur, the availability of nitrogen from natural sources increases (s1<s2<s3), and fertiliser recovery increases (a1<a2<a3) (Figure 4.2). As shown in quadrant one, yield is not expected to improve significantly (beyond curve one) even if nitrogen uptake increases; therefore, it is only efficient to increase nitrogen fertiliser dosage up to a certain point.

At present, in the Malaysian palm oil industry, farmers apply fertiliser three to four times a year regardless of the age of their oil palms. Further research should be conducted on the effectiveness of fertiliser applications on oil palms with age, particularly during the period between 8 and 12 years old, in which oil palms are most productive in terms of OPFB production.

Table 4.23 Sensitivity Analysis for Carbon Price of Small Scale Oil Palm Growers in Johor and Sabah, Malaysia

	Net Present Values of Small Growers in Johor (RM)				Net Present Values of Small Growers in Sabah (RM)			
	Base scenario (r=4 %)	5 % ↑	10 % ↑	25 % ↑	Base scenario	5 % ↑	10 % ↑	25 % ↑
Best	73,524	72,756	71,570	69,654	32,041	32,015	30, 380	24, 235
Standard	6,070	4544	3004	-1616	7,329	6,363	4,339	-145
Worst	-100,351	-101,878	-103,408	-108,037	-13,375	-13,777	-15, 701	-21 015

Source: Own calculation.

Note*: The example of Social Cost Benefit Analysis can be retrieved at http://goo.gl/ybESZL

The amounts are the average NPV among smallholders on a per hectare basis; the discounting period is 25 years.

Table 4.23 shows the effect of carbon price on NPV of smallholders in both Johor and Sabah. When the carbon price increases by 5%, the NPV decreases from the standard value of RM73,524 to RM72,756. The increase in carbon price per tonne leads to an increase in external costs. It illustrates that carbon market may play a significant role in determining the NPV per hectare of the palm oil industry. If carbon prices increase, the opportunity cost of not converting forest to oil palm will be high. Carbon prices may also be a significant indicator for constructing policy options as they may influence the NPV of the palm oil industry.

4.5 Conclusion

The type of land on which an oil palm plantation is established affects the externality and the sustainability of the operations. Many of the negative effects, however, can be mitigated by appropriate management practices and agricultural policies. The CBA results for unproductive oil palm plantations under FELDA scheme were estimated based on an average NPV of -RM26,285 (-US$8,761.67) per hectare at the conclusion of a 25-year cycle. The most productive plantations had NPVs of up to RM50,883 (US$16,961). The NPVs in both cases included external costs. Furthermore, differences were found between the two study regions (Johor and Sabah), and also between plantation scales.

In Johor, the small- and medium-scale plantations in the 'worst' category had negative NPVs per hectare, indicating inefficiency and, in particular, the need to reduce variable, overhead, establishment, operational, and external costs (especially the large-scale plantations). Meanwhile, the 'best' plantations achieved positive NPVs per hectare across all production scales.

At the end of the 25-year period, small producers in Johor earned higher NPVs per hectare than medium-scale producers. This may be due to an inverse relationship between production scale and profitability and/or the adoption of precision agricultural practices in the case of small-scale operations. It was found that the past uses of the land on which a plantation is established played a significant role in determining external costs. Oil palm plantations that were established on previously forested areas had the highest external costs, followed by rubber and cocoa plantations. The external costs of plantations on formerly forested sites constituted between 27% to 32% of the total costs; on former rubber plantations, the figures were between 20% to 26%; and on former cocoa plantations, between 17% to 19%. **In summary, the magnitude of external costs caused by past land use are ranked as such (from highest to lowest): forest to oil palm > rubber to oil palm > cocoa to oil palm).** High revenues may be used to compensate for externality costs by using a 'sunk cost' argument. In principle, the effects that converting forests to rubber or cocoa plantations had (prior to being further converted to oil palm plantations) on carbon emissions would also need to be considered. In this study, however, the sunk cost was assumed to be zero.[27]

Moreover, the oil palm plantations in Sabah caused higher externalities than their counterparts in Johor; however, they generated higher NPVs per hectare. The external costs produced by medium-scale growers in Sabah were higher than in Johor across all productivity classes. This was due to the land on which the oil palm plantations are established: those in Johor were formerly rubber plantations, whereas in Sabah, they were either cocoa plantations or forests. The calculated carbon emissions, according to historical land-use change and inputs used, are presented in Table 4.24.

[27] The sunk cost refers to investments for which value is forgone upon exit (Cabral, 1995). In this study, the sunk cost refers to the investment in planting rubber, cocoa or forest (prior to oil palm plantation).

Table 4.24 Annual Carbon Emissions According to Land Use History and Inputs used in plantations

	Production Scale	Inputs Used	Land Use History	Tonnes of CO_2/ha/year
Johor	Small	(base)	Forest Rubber	82.32 78.2
	Medium	(base)	Forest Rubber	82.32 78.2
	Large	(low)	Forest Rubber	59.2 55.1
Sabah	Small	(base)	Forest Cocoa	58.1 53.4
	Medium	(high)	Forest Cocoa	128.3 123.5
	Large	(low)	Forest Cocoa Rubber	58.1 53.3 55.1

Source: Own Calculation
Note: * The step-by-step calculation and data can be retrieved at http://goo.gl/Eem3WS

The extraction mills in Johor outperformed those in Sabah in both the 'best' and 'standard' categories. This may be due to higher transaction costs in Sabah. In contrast, among the mills classified under the 'best' category, the mills in Sabah earned higher total revenues than those in Johor despite not managing to reduce output costs efficiently. The technology used for oil extraction is an important factor that determines the NPV of a mill. In Johor, the 'best' and 'standard' mills used hydrocyclone technology, whereas the majority of the 'worst' mills used conventional oil extraction technology. Moreover, the 'best' mills in Sabah used a combination of extraction technologies. The NPV of a mill, including external costs, was not determined by the type of technology employed. However, the adoption of more sustainable practices may also influence the NPV.

The 'worst' plantations in both Johor and Sabah are at risk of financial instability. As such, their cost structures need to be managed more efficiently. The Malaysian government and the MPOB may need to enhance their delivery systems. Training about the practical aspects of plantation management is currently only available to plantation owners but not labourers. From the government's point of view, landowners should train their own farm labourers after they receive training, but this is often not the case. Working conditions in the industry also need to be improved to ensure that the jobs of labourers working in plantations and mills are better protected. Currently, labourers in the palm oil industry, with the exception of well-managed large-scale estates, are often working only on a part-time or seasonal basis. Hence, to ensure the sustainability of the plantations, basic input factors, including labour, needs to be well structured and better managed. Labourers conduct activities that may influence both the efficiency and the sustainability of particular plantations.

Farmers who received support from the government and various bodies should consider using biological fertilisers instead of chemical fertilisers to reduce GHG emissions. This is because external costs were linked to high carbon emissions resulting from the use of nitrogen fertilisers. Thus, further research should be conducted on biological fertilisers produced from oil palm empty fruit bunches as a means of replacing chemical fertilisers. Large amounts of biological fertiliser are needed because it often contains lower levels of nitrogen, phosphorus, and potassium.

Chapter 5 Industrial Policy and the Role of State Industrialisation Strategies in the Malaysian Palm Oil Industry

> "There are no policies for the biofuel industry in Malaysia, as this industry actually serves as a backup strategy for stabilising palm oil prices. If palm oil prices decrease, biofuel is a worthwhile option as a high value-added product" (Mahathir, personal communication).

5.1 Introduction

An analysis of the efficiency of oil palm fruit production, and the social costs and benefits of oil palm cultivation and palm oil extraction was presented in chapter 3 and 4. The analysis focused on oil palm cultivation and palm oil mills because most of the controversies about sustainability in the Malaysian palm oil supply chain surround these two segments. An assessment of policy options aimed at improving the sustainability of the palm oil industry in Malaysia is presented in this chapter. In this chapter, a two-dimensional qualitative policy analysis is described. The analysis comprises: 1) Malaysian policies that are relevant to other palm oil producing countries, and 2) policies of other countries that are relevant to Malaysia's efforts to improve its bioeconomy strategy and the sustainability of the Malaysian palm oil industry. Germany's policy on rapeseed biodiesel and US policy on corn ethanol were used as case studies to construct a policy framework for biofuel production in the Malaysian palm oil industry because there are no comprehensive and relevant policy frameworks in the country at present. Several policy recommendations about joint venture mills, biomass companies, waste reduction efforts, and fostering bioeconomy industries were assessed, as a result of which the most important current issues that the Malaysian palm oil industry is facing were identified and policy options are discussed. Another objective of this chapter is to analyse the policy options constructed for German rapeseed biodiesel and US corn ethanol to improve the efficiency, and the sustainability, of palm oil industries in Malaysia and other countries that produce palm oil as part of their bioeconomy strategy. Policies on chain upgrading and bioeconomy programme are also assessed in this chapter. This chapter is structured as follows: 1) theoretical framework on industrial organisation, 2) the infant industry argument, 3) analytical framework, 4) international policy analysis, 5) summary of policy comparison, and 6) assessment of various policies laid down by

FELDA, Malaysia's central government, the MPOB, and the Ministry of Plantation Industries and Commodities.

5.2 Literature Review

5.2.1 Theory of Industrial Organisation

A strategic orientation of the palm oil industry can be drawn from the theory of industrial organisation. Leahy and Neary (1996) emphasised that the rule of thumb in the theory of industrial organisation is a firm's ability to pre-commit to future actions and to behave strategically. The theory of industrial organisation regards how markets, and in particular industries, behave, and how actors compete with each other to enhance business strategy and public policy. In the Malaysian palm oil industry, actors from similar categories in the value chain compete with each other (for example, competition between privately owned and FELDA owned mills) to produce value-added products, minimise costs, maximise profits, seek market penetration, and enhance sustainability in their production. Meanwhile, within Southeast Asia, Malaysia competes with Indonesia in production quantity, whereas outside the region, the competition rises in terms of sustainability standards and market penetration. The Malaysian palm oil industry also faces difficulty in convincing consumer in the US and Europe that palm oil is not harmful to health.

The theory of industrial organisation is also concerned with government interventions and policies that influence the behaviour and the progress of firms in particular industries. The key aspects of the structure of an industry are as follows: 1) the number and the relative size of firms, 2) the degree of product differentiation, 3) the barriers to entry and expansion, and 4) the extent to which production processes vary. In fact, the history of industrial organisation can be divided into three schools of thought: the Harvard Tradition (1940–1960), the Chicago school (1960–1980), and the Austrian School.

Joe Bain, who developed the structure, conduct, and performance (SCP) paradigm[28], is associated with the Harvard school and is considered as the father of modern industrial

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[28] 'Industrial Organisation' was written by Bain in 1959 and highlights the structure, conduct, and performance (SCP) paradigm, a well-known analytical framework to depict relationships between market

organisation theory. SCP analysis focuses on oligopolies, and barriers to market entry and exit. It is mostly verbal as opposed to mathematical. The Harvard school perceives market power as dangerous to social welfare and establishes a relationship between the concentration of ratio and harmful effects on social welfare. The main weakness of this school of thought is that it assumes that the structure of industrial concentration is exogenous, a result of its use of regressions on the cross section of industries to identify correlations between performance, concentration, and barriers to market entry.

In contrast, the Chicago school criticises the SCP paradigm's use of empiricism without theoretical basis. It is based on neoclassical pricing theory and has a favourable view of market findings. It also adopts a theoretical baseline rather than an empirical approach. The framework begins with perfect competition and interventionism (which is considered as the main catalyst for monopolisation). This school of thought asserts that market efficiency can be achieved through the production and distribution of a firm. It also believes that government intervention is unsuitable as markets should act naturally. Intervention is perceived as costlier than any social benefits, resulting in losses. The Chicago school scrutinises econometric techniques when conducting their analyses. The school uses different market structures to investigate industries and markets. In addition, this approach argues that markets regulate themselves, and the risks of monopolisation are usually alleged rather than proven. Another important line of inquiry in this school of thought concerns market entry and barriers to market entry.

Meanwhile, the Austrian school has a different stance than the neoclassical approach. This school is derived from the perspectives of von Mises and Schumpeters. Mises views the market structure as a dynamic platform for exploring new methods and opportunities, and that competition leads to efficiency and innovation, while Schumpeter believes that a process called 'creative destruction'[29] encourages technical progress as innovations offset outdated technology. The theory of industrial organisation also influences the debate about infant industry, which is

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structure, market conduct, and market performance. It is believed that the market structure identifies the way the market has to be conducted, thus impacting performance.

[29] Creative destruction is the cessation of particular products and the innovative development of new products to offset the discontinuation of the outdated products (MIT, 1975) (http://economics.mit.edu/files/1785).

further discussed in segment 5.2.2. As a rule of thumb in the theory of industrial organisation, policymakers may need to consider the behaviour and the progress of firms in infant industries to help them.

5.2.2 The Infant Industry Argument

The infant industry argument was formulated by Alexander Hamilton and Friedrich List in the nineteenth century. The core principle was identified by John Stuart Mill and other international trade economists; however, the theory of infant industry has been constantly contested by economists. In addition, Rask (1994) described the basic characteristics of an infant industry. Firstly, a domestic infant industry bears higher costs than established (typically foreign) competitors. Secondly, new actors in the industry need ample time to develop before they will be able to compete with established competitors. And thirdly, if there is deliberate support for an infant industry, the returns generated over the long term will be able to compensate for the initial support. As time goes by, the costs of production will decrease, but before this happens, the industries need some temporary protection. This is supported by Bardhan (1971), who pointed out that Hamilton and List's concept of infant industry involves learning by practical application. Meanwhile, Melitz (2005) justified the protection of infant industries from international trade and entry barriers using a welfare-maximising model. Governments also use policy instruments, such as mandates, subsidies, tariffs, and quota, as a way to protect the infant industries.

Mandates and subsidies can be used to foster efficient production. Moreover, tariffs stimulate production and play a small role in avoiding market failures, but this policy tool does not reduce costs. Melitz (2005) conducted a research about how infant industries should be protected and observed that policymakers usually use subsidies, tariffs, and quotas as ways to improve industrial welfare. He also found that quotas were more effective than tariffs in this regard, and are preferable to subsidies too because the level of protection offered by quotas declines as learning progress of firms accelerates. Thus, in order to implement quota policies effectively, tariffs and subsidies need to be reduced. Melitz also found that domestic infant industries can be competitive. They experience valuable "dynamic learning effects" that are externalities of firms (Melitz, 2005; 177). The general academic consensus about infant industries is that industrial protection should be temporarily offered until industries mature and can survive on their own. Bastable (1921) suggested that the cumulative net benefits should be greater than the costs during the protection phase. According to Melitz (2005), the maturity of a particular industry is dependent on its learning potential, the speed at which learning occurs, and is subjected to the exchange of local and foreign goods. These infant industries need to develop their reputation to gain customers' trust and confidence in their products or services.

On top of that, Grossman and Horn (1988) noted that it is common for parties, particularly consumers, to have incomplete information about companies in their infancy that lack reputation, thus leading to a competitive advantage scenario. A lack of experience is a barrier to entry for latecomers to an industry. It is not only causes an industry to operate under imperfect market conditions but also erodes the profits of the new actors (a reflection of the welfare of the latecomers).

More specifically, about the topic of protecting the biofuel industry, Caballero et al. (2012) highlighted that regional and state institutions (governing bodies of an industry) can play a role in helping governments resolve energy security issues and formulate relevant policy solutions. Government subsidies for the biofuel industry are believed by Caballero et al. (2012) to discourage efficiency and to increase external costs (in terms of social and environmental externalities).

Rask (1994) conducted a study on the dynamics of the Brazilian ethanol industry, a bioeconomy industry in its infancy. The development of this industry began 18 years ago, and as a positive outcome of which, Brazil became less reliant on fossil fuels. The Brazilian government's initiative to develop their ethanol industry resulted in production of a renewable fuel that is more sustainable than fossil fuels. Ethanol was initially a very costly substitute for fossil fuels, and therefore, warranted subsidies during the infancy of this industry. Rask also found no empirical evidence that suggested that the profitability of the industry was the consequence of economy of scale or technological changes. Interestingly, no empirical finding indicated a need to subsidise this infant industry. The industry revealed the flaws in the Brazilian bioeconomy policy, whereby capital subsidisation led to overcapacity. At present, annual ethanol production in Brazil is around twelve billion litres. However, the capacity once reached sixteen billion litres in the 1990s. There are ongoing debates about policies that determine the importance of the ethanol industry in the Brazilian economy.

Considering the findings in the aforementioned studies, the Malaysian government could consider providing assistance to the actors in the Malaysian palm oil biodiesel industry up to ‘fertilisation’ phase. Beyond this phase, the Malaysian palm oil biodiesel industry would be competitive enough with the other biofuel industries to ensure survival in the market. Subsidies for this infant industry may be relevant. Although the Malaysian government may need to bear high fiscal burden to subsidise the industry, the country can realise greater benefit in the long term. The biodiesel industry may have positive impacts on the economy and the development of the country. During the early stages of the Malaysian palm oil industry, the government had also invested considerable sums of money to foster the growth of the industry. And these investments have paid off over the long term. This was supported by Leahy and Neary (1996), who examined trade policy recommendations in relation to pre-commitment. They argued that governments can subsidise firms for several weeks or months when firms make output decisions, but they should not continue to provide subsidies when the respective industry actors reach maturity.

Besides, the Malaysian biofuel industry (from palm oil) may need full support from the government. Producing palm oil for biofuel is costly, and at present, the Malaysian government provides subsidies in the form of refinery facilities that can be installed (Basiron, personal communication). On the other hand, Dr Mahathir (personal communication) believes that subsidies can be a way of protecting the environment and improving sustainability. However, there are still many issues pertaining to this industry that are further discussed in section 5.4.3 – Malaysian Palm Oil Biodiesel Policy. Some selected studies about policy plans for bioeconomy plan and sustainable economy are shown in Table 5.1.

5.2.3 Innovation of Palm Oil and Science Policy

Dunn (1981) described scientific policy analysis as an applied discipline that uses multiple methods of inquiry and argument to produce and to transform policy-relevant information to resolve policy problems. Maarten (2003) suggested that problems are a combination of elements of scientific and economic discourse. Thus, there are three aspects of policy analysis: politics, knowledge, and intervention. However, Douglas (1986) stated that knowledge could replace politics to control future events. In most cases, politics dominate knowledge, including knowledge of politics. Douglas noted that policymaking often takes place in an institutional void. One of the methods that can be used for policy analysis is backward mapping (backward problem solving), which concentrates on factors that are indirectly influenced by policymakers, such as the knowledge and problem-solving abilities of lower-level administration, incentive structures, and bargaining relationships among political actors. Scientific policy analysis cannot rely solely on models and algorithms, it also needs to consider advocacy and the adversary process (Iris, 1977). Besides, scientific policy analysts have to define problems and find evidence before problems can be resolved. Some studies about science policy pertaining to bioeconomy and sustainability are briefly described in Table 5.1.

Table 5.1 Studies on Policy Plans for Bioeconomy Plan and Sustainable Economy

Type of policy Plan	Region / country	Authors	Findings
Regional Policy Plans	EU	Wiesenthal et al. (2009)	- Supplying side instrument and supporting capital investment for production facilities were not a major supportive factors of biofuels. - For first generation biodiesel, fixed-cost was estimated to make up only 7% of the total cost of production, whereas for second generation biofuel, this figure increased to 60% of the total cost. However, subsidy for establishment costs is needed to foster the development of the biodiesel industry during its infancy.
Regional Policy Plans	EU	Geibler (2012)	- Recent European biofuel policies have focused on using palm oil for both biofuel and food production. Such policies enable market penetration and access. In addition, the International Monetary Fund (IMF) has fostered palm oil production through liberalisation of its investment policies.
Regional Policy Plans	ASEAN	Goh and Lee (2010)	- ASEAN encourages biofuel programmes address energy security issues as well as environmental concerns. - In the Southeast Asian countries, a large number of subsidies and incentives were provided to biofuel projects. However, the outcomes have failed to meet expectations set by EU (i.e. the transportation sector accounts for 10% of total biofuel consumption by 2020). - This failure is partially due the brief timeline of the policies, unstable input prices (in the case of palm oil), and lack of strict legal enforcement.
Regional Policy Plans	EU	Redpath et al (2011)	- EU develops low-carbon economy through a system called Renewable Energy Agricultural Multipurpose System for farmers (RAMSES). This may help farmers adopt sustainable production and precision agricultural practice.

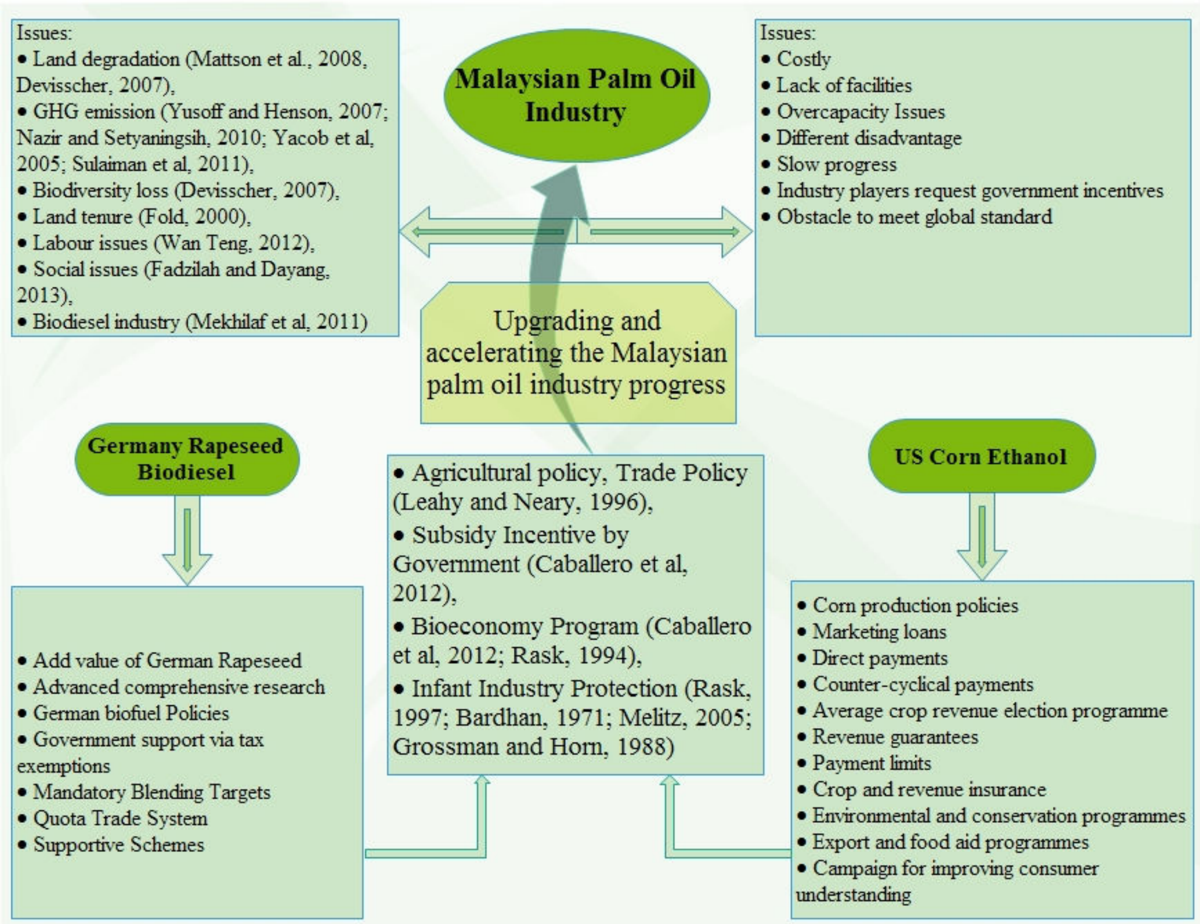
National Policy Plans	Germany	Bioeconomy Council (2010)	- Germany leads in the advancement of domestic and international bioeconomy policies with its science policy strategy (2010) and guidance of its Bioeconomy Council (2010). A comprehensive and strategic plan, along with guidance from respective bodies, may accelerate implementation of the policy.
National Policy Plans	Brazil	Brazilian Agroenergy Research Plan in (2006–2011)	- Supports the energy matrix to improve sustainability - To create the necessary conditions for increasing the sources of biofuel energy sources, contribute to the development of the country, to add value to national supply chains, to stimulate job creation in agribusiness, to broaden income opportunities and equality, to reduce GHG emissions and petroleum imports, and to increase biofuel exports.
National Policy Plans	Netherlands	Nowicki et al., (2008)	- The government of the Netherlands has adopted a few bioeconomy policies. These policies emphasise the three “Ps” – people, planet, and profit.
National Policy Plans for Thai-German Sustainable Palm Oil Production Project	German-Thailand	Seegräf (2010)	- This project promoted the certification of smallholders according to international standards because smallholders are major actors in the industry in Thailand (accounting for 80% of the palm oil produced in Thailand). - The project focused on training workers at four palm oil mills and 1,000 small scale producers to improve their cultivation methods. Training topics include the proper use of fertilisers and pesticides. - Aim is to achieve the standard set by the EU-REDD. - This project showed that palm oil production can be sustainable while conserving agricultural landscapes. Hence, the capacity for developing people, organisations, and societies is a crucial factor for the development and the sustainable production of Thailand’s palm oil industry.
National Policy Plans	Malaysia	Chin (2011)	- Malaysia targets to be the largest producer of biofuel by 2013, but the goal was difficult to meet. - A few obstacles, for example, the sale of B5 biodiesel in this industry.

			- Introduction of Malaysia's biofuel blend (5% biodiesel and 95% petroleum diesel) has been delayed for a few years and the lack of subsidies has placed palm oil biodiesel from Malaysia in an uncertain position.
National Policy Plans	Malaysia	Lam et al., (2009)	- Malaysia has adopted a biofuel programme, the objective of which is to ensure healthy development of the biofuel industry through a five-fuel diversification policy. - The five strategic dimensions of this programme are: biofuel for transportation, biofuel for industry, biofuel technology, biofuel for export, and biofuel for a cleaner environment.
National Policy Plans	Malaysia	Basiron (2007)	- There are concerns about Malaysian biofuel's ability to meet the standards proposed by the EU market.
National Policy Plans	Palm Oil producer countries	Sayer et al (2012)	- Capturing methane in the palm oil processing mills effluent using ponds qualifies as a Clean Development Mechanism under Kyoto Protocol.
Bioenergy and Rural Development in Developing countries	Developing Countries	Gerber (2008)	- Four case studies on rural development and bioenergy technologies were reviewed. The potential negative impacts of biofuel industry expansion, including palm oil biodiesel in Malaysia and Indonesia, were discussed. - Gerber argued that developing countries can develop biofuel industries scientifically by considering socio-economic and environmental sustainability. Biodiesel producing countries should consider ramping up production to meet their domestic demand instead of foreign markets.

5.3 Analytical Framework

In this chapter, policies on German rapeseed biodiesel and US corn ethanol were assessed because they can be adapted for other palm oil producing countries as well as Malaysia. In addition, the updated Malaysian palm oil biodiesel industry was also reviewed using knowledge gathered from the international policies and findings from this present research. Policy options targeted at growers, the central government, and the MPOB were recommended. Other issues and areas that require future research were also discussed (see Figure 5.1).

Figure 5.1 An Analytical Framework of the Analysis on Malaysian Biofuel Policy



Source: Own illustration.

5.4 International Policy Analysis: Lessons Learned from the German and US Biofuel Industries

5.4.1 Germany Rapeseed Biodiesel

In 2013, 1.43 million hectares of land were used for winter rapeseed production in Germany (German Federal Statistical Office 2013, UFOP, 2012). Rapeseed oil is used to make products, such as lamp oils, soap, high-temperature and tenacious high erucic acid lubricating oils, and plastics.[30] Rapeseed oil is both consumed domestically in Germany and exported. Domestic rapeseed biodiesel production is limited by weather conditions in Germany.

Added Value of German Rapeseed

Unlike other European countries, some biodiesel mills were established beside vegetable oil mills in Germany. Thus, transaction costs incurred from plantations to mills are fairly low. According to the UFOP (2011), the significant growth of the biodiesel industry in Germany has been due to tax exemption for clean biodiesel blends, facilitation of investments at state level, conformity among plants, technological knowledge and experience, and excellent production and processing facilities.

Advanced Comprehensive Research in Germany

The German National Academy of Sciences Leopoldina (2012) conducted comprehensive interdisciplinary research on changes and limits to biofuel usage. They evaluated the availability and sustainability of biomass as an energy source. And they found that the total biomass harvested in Germany is decreasing (e.g. forests becoming a CO_2 source).

In addition, they also conducted a research on bio-fertiliser. Their study showed that biological fertilisers can be used at low levels to promote growth of crops and grass. However, biological fertilisers can only be produced through the fermentation of cellulose tissues, a process in which plants tissues are converted to biogas or bioethanol, and residue (non-fermented lignin and lignocellulose). N_2O emission, which is also a problem of using chemical fertilisers, is inevitable during this conversion process. This effort (the application of biofertiliser) may improve the

[30] http://www.soyatech.com/rapeseed_facts.htm

current practice in the agricultural industry. It was estimated that agriculture contributes to between 30% and 35% of global GHG emissions through deforestation, methane emissions from livestock and rice cultivation, and nitrous oxide emissions from fertilisers. The analyses conducted by the German National Academy of Sciences include the following:

i. Computed net primary production (NPP) in terrestrial systems and primary energy consumption
ii. Bioenergy potential
iii. Human appropriation of net primary production and bioenergy potential
iv. Energy return on investment
v. Area efficiency
vi. GHG fluxes
vii. Fossil fuel cost of net primary production, energy returns on investment, area efficiencies, and capacity credits
viii. GHG emissions associated with net primary production
ix. CO_2 costs of biomass conversion into biofuel
x. Sustainable intensification of crop yields

In 2012, the Bioeconomy Council studied the potential of achieving bioeconomy and found that biomass residues, including biomass waste, have yet to be fully utilised (Bioökonomierat, 2012). In addition, the availability of agricultural land is decreasing as residential areas and transportation infrastructure is expanding. However, the current environmental and conservation policies have reduced the rate of land development. A total of 7.9 % of Germany's energy consumption is derived from bioenergy sources. Bioenergy is largely derived from solid and liquid biomass, biogas, landfill gas, sewage gas, and timber. Arable land that would otherwise be used to cultivate other crops is allocated for fuel crops. In Germany, there are 11.9 million hectares of arable land and 4.9 million hectares of grassland. Currently, 19% of the croplands in Germany are used to cultivate energy crops; rapeseed cultivation, primarily used for biodiesel and biogas production, occupies 86% of that area (2.0 million hectares). The amount of land in Germany used for bioenergy crops could be increased from 2.5 million hectares to 7.3 million hectares from 2020 to 2030 (National Biomass Action Plan for Germany, 2009).

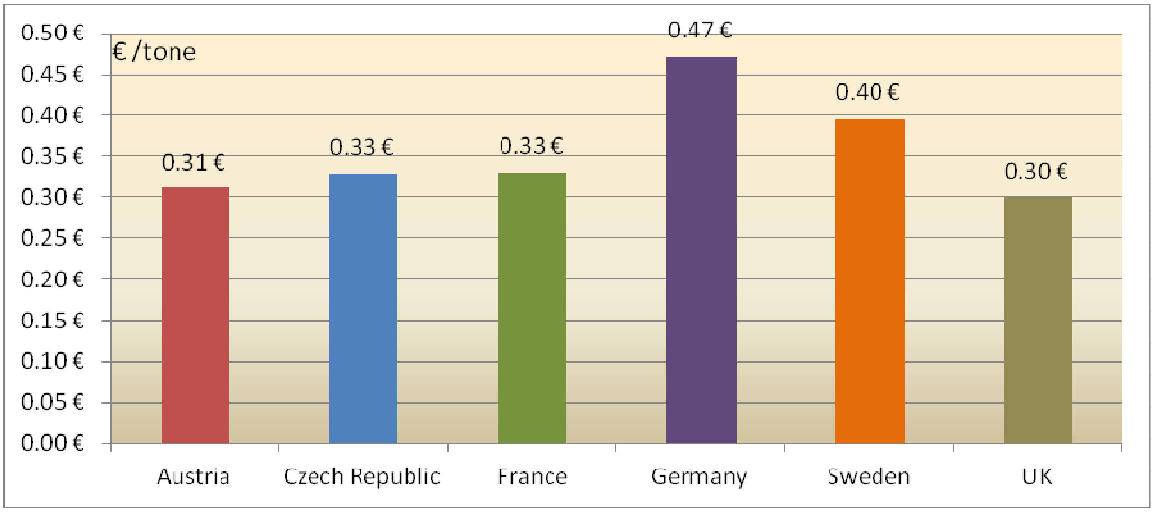
German Biofuel Policies

The main objectives of biofuel policies in Germany are to reduce GHG emissions and to ensure the nation's energy security. These policies include the following:

Government Support Through Tax Exemptions

The German government implemented its biofuel and biodiesel policies in stages. Only biofuels in their pure form are given full tax exemption (Federal Government of Germany, 2004). The impacts of this policy can be observed in the expansion of the B (100) biodiesel market and the increment of relevant government fiscal budget.

Figure 5.2 Tax Benefits for Biodiesel in Member States of the European Union in 2005 (€/tonne)



Source: Adapted from Wiesenthal et al. (2009).

Moreover, the eco-tax on fossil fuel has been increasing in Germany. The eco-tax complements the full tax exemption that has been in place since 1999, thus driving biodiesel price below that of fossil fuel. In 2005, tax exemption for biodiesel was at its highest at €0.47 per litre. Biodiesel sales were 6% higher than the sales of other types of diesel in Germany (Wiesenthal et al., 2009).

Mandatory Blending Targets

A mandatory biofuel blending target was introduced for the petroleum industry in 2007. Petroleum companies can meet the quota either by 1) blending diesel, 2) blending petrol, or 3) producing pure biofuels. A hybrid quota system is used by the government for giving tax exemptions on pure biofuels and encouraging petroleum companies to meet the quotas. Petroleum companies may delegate their quota requirement to third parties which are interested to produce biofuels for the market. If a petroleum company fails to meet quotas set for petrol, a penalty of €43 per gigajoule (GJ) will be imposed on them, and in the case of diesel, an additional €19 per GJ is charged to the company (UFOP, 2011).

Quota Trading System

The quota requirements on the respective petroleum companies are allowed to be used by a third party. This means that biofuel producers may sell their extra quota to petroleum companies. Tax exemptions, in essence, are only provided for pure biofuels. As an illustration, if pure biodiesel is produced in excess of the quota, tax exemptions granted to pure biofuels producers have to be returned to the government. The quota trading system may help petroleum companies meet quotas and evade penalties. As a result, the costs of tax exemptions for pure biofuels can be reduced. German policymakers regard the fiscal burden caused by tax exemptions. The fiscal burden may be offset by the penalties paid by the petroleum companies (UFOP, 2011).

Costs to the Society

As biofuels are costlier than fossil fuels, a few support schemes have been introduced:

> **Subsidies for Farmers – Single Payment Scheme**
>
> The Single Payment Scheme (SPS) was introduced in 2009 as a premium for biofuel crops. This scheme is dependent on two factors: the area under cultivation and the payment entitlements. In this scheme, the fixed costs of a farm (for both food and energy crops) are reduced. As a result, market competitiveness exists between biofuels and fossil fuels (UFOP, 2011).
>
> **Sustainability Standard Cost**
>
> The biofuel industry in Europe, including Germany, has to meet the sustainability criteria of article 17 of the EU RED. The biofuel industry policies are inefficient as there are over capacity plants in Germany and contractual prices linking vegetable oils and fossil fuels (UFOP, 2011).

5.4.2 US Corn Ethanol

32.37 million hectares of land are used for corn cultivated in the US, predominantly in states such as Illinois and Iowa (which together constitute 1/3 of the US corn production). Corn is one of the main ingredients in many livestock feeds, food products, industrial products, and alcohols (including fuel ethanol). Approximately 80% of the corn ethanol produced in the US is consumed domestically, and the other 20% is exported (USDA, 2012).

Corn production in the US increased tremendously after World War II due to technological improvements, such as hybrid and improved varieties, synthetic fertilisers, modern pesticides, and improvements in planting practices and harvesting machineries. Improved production practices, such as reduced tillage, irrigation, crop rotation, and pest management, also contributed to the rising corn production. These factors, along with government subsidies to corn producers, led to an ever-greater supply of corn in the USA, which in turn, caused corn prices to fall to US$2 per bushel by late 1967 and remained low for several decades (USDA, 2012). Inexpensive corn led to low prices of corn derivative products, including oils and alcohols. The Renewable Fuel Standard (RFS) established by the US Energy Policy Act 2005 offered additional incentives for the production of ethanol biofuel. The combination of these incentives and low corn prices contributed to rapid growth in the production of, and the demand for, ethanol biofuel. As the demand for ethanol biofuel increased, supplies tightened and the price of corn increased sharply, thereby lowering profit margins.[31] Nevertheless, technological advances in corn oil extraction and alcohol distillation (e.g. ethanol biofuel production from grains and solubles) compensated for the depressed profit margins (AGMRC, 2013).

Besides, the number of farms that produce corn, sorghum, barley, oats, etc. in the US has been declining in recent decades as a result of increasing corporatisation of agricultural production, leading to fewer, but larger, 'farms'. The number of large corn-producing farms (>200 ha) has increased, while the number of smaller, individual or family-owned farms has decreased significantly (USDA, 2012).

In the US, agricultural policies were designed to protect income of farmers via flexible contract payments, marketing loans, disaster aid, conservation payments, and crop insurance. The market instruments used by the government to support corn producers include import fees, duties, and

[31] http://agecon.ucdavis.edu/people/faculty/aaronsmith/docs/Carter_Rausser_Smith_Ethanol_Paper_Sep18.pdf

import quotas on sugar (high-fructose corn syrup is one of the major derivates from corn that is used as a sugar substitute in the US food industry) (USDA, 2012).

Corn Production Policies

The policies that directly address ethanol biofuel production from corn are part of the Food, Conservation, and Energy Act of 2008 (2008 Farm Act), which provides corn producers access to the following marketing loan benefits:

Marketing loans: allow producers to repay commodity loans at lower rates than the original interest rates when 'posted county (local) prices' are below the projected value considered in the commodity loans (USDA, 2012).

Direct payments (DPs): provide eligible landowners and producers annual contracts with the Farm Services Agency (FSA) in the USDA (USDA, 2012).

Counter-cyclical payments (CCP): paid whenever the target price of a commodity is greater than the calculated effective price for that commodity (USDA, 2012).

Average Crop Revenue Election (ACRE) programme: started in 2008 based on the Farm Act and administered by the FSA. In this programme, farmers can choose either a 'revenue-based counter-cyclical programme' or CCPs. Producers who choose to participate in ACRE will have a reduction in DPs and marketing assistance loan rates. ACRE payments will be made 1) if "the actual state revenue per acre falls below the state guarantee per acre," and 2) if "actual farm revenue per planted acre falls below the farm benchmark revenue per acre" (USDA, 2012).

Revenue guarantees: for the respective commodities under the ACRE programme, these guarantees are provided to participants each year according to "national market prices and State-level average planted yields" (USDA, 2012).

Payment Limits (Participant Selection): the highest amounts paid to participants are US$40,000 per person through DPs, and US$65,000 through CCPs. These limits were set by the 2008 Farm Act. As for marketing loan benefits (MLGs and LDPs), no threshold for the highest amount was set. If farmers earn an 'adjusted gross farm income' greater than US$750,000 (up to three years on average), they are not qualified for DPs but may qualify for other programmes. Farmers with an 'average adjusted gross non-farm income' more than US$500,000 (up to three years on average) may not qualify for DPs and CCPs, ACRE payments, marketing loan benefits, or disaster payments (USDA, 2012).

Crop and Revenue Insurance

Farmers may purchase crop insurance (to hedge against harvest risks) and revenue insurance to protect against revenue losses regardless of the source of losses. The USDA pays a portion of insurance premium for producers and also a part of the transaction costs (delivery and administrative costs) of private insurance companies. Moreover, the 2008 Farm Act included a "supplemental Agricultural Disaster Assistance" to assist farmers who lose earnings because of natural disasters or catastrophes. Farmers who bear more than 50% of normal losses are also eligible for the insurance (USDA, 2012).

Environmental and Conservation Programmes

All arable land (including fallow land) is supported for conservation, according to the 2008 Farm Act. In this programme, farmers are required to select and to implement an approved conservation plan. Conservation programmes, including the 'Environmental Quality Incentives Program' and the new 'Conservation Stewardship Program', may help protect provide assistance for pieces of land that are still used for crop production. Land retirement programmes, such as the 'Conservation Reserve Program' and the 'Conservation Reserve Enhancement Program', reward farmers for not cultivating crops on environmentally sensitive land. The area managed under the Conservation Reserve Program began reduced from 15.9 million hectares to 13 million hectares since 2010, according to the 2008 Farm Act (USDA, 2012).

Export and Food Aid Programmes

Export programmes are managed by the USDA Foreign Agricultural Service and the US Agency for International Development (USAID). They help publicise and reinforce trading of US feed grains in international markets through the 'Export Credit Guarantee Program', the 'Market

Access Program', and the 'Foreign Market Development Program'. Export credit guarantees are designed to help foreign importers who are constrained by foreign exchange rates and those who need credit to buy US commodities. The respective institutions guarantee commercial financing of US agricultural exports through repayment of private and short-term credit for three years. The institutions also do not offer financing, but they underwrite payments from foreign banks, which allow US financial institutions to offer competitive credit terms to foreign banks (USDA, 2012).[32]

Campaigns for Improving Consumer Understanding

Campaigns are conducted to make farming practices (e.g. uses of fertilisers and pesticides) transparent to consumers. These campaigns are intended to improve public perception of agricultural practices (Corn Refineries Association, 2012).

5.4.3 Malaysian Palm Oil Biodiesel Policy

Biodiesel in Malaysia is produced under the Promotion of Investment Act 1986. Malaysia has had a comprehensive biofuel programme since 1982 (Malaysia, 2006). Palm oil has high use potential because of its high yield per hectare and high oil content. Palm oil production per hectare is 27 times higher than other oil seeds. Oil palm biodiesel emits 62% lesser GHG emissions than fossil fuels; it also has better performance than soybean (40%), rapeseed (45%), and sunflower biodiesel (58%) (Sani, 2009; Abdullah et al., 2009). Moreover, a study by Zah et al., (2007) found that the Malaysian palm oil biodiesel contributed approximately to 59% of global warming potential, 58% of cumulated non-renewable energy demand, 380% of summer smog potential, 340% of excessive fertiliser use, and 500% ecotoxicity as compared with other unblended biofuels (see Zah et al, 2007). As a leading global producer of palm oil, Malaysia has the potential to play a pivotal role in global palm oil diesel production. Malaysia believes that it does not have to sacrifice more of its forests to meet the biofuel quota set by the EU. However,

[32] More detailed explanation can be found at: http://www.ers.usda.gov/topics/crops/corn/policy.aspx#.UboPp9ikr1s

there may be an opportunity cost in terms of lower food production. Malaysian law stipulates that areas deforested for economic reasons shall be replaced by reforested areas of similar size.

Issues in the Palm Oil Biodiesel Industry

A few years ago, the Malaysian government was optimistic because the biodiesel industry in Malaysia had yet to become economically viable (Wahab, 2012, 3). The government expected that 500,000 tonnes of palm oil biodiesel would be produced from 570,000 tonnes of CPO by 2013. However, this target was unlikely to be achieved (Wahab, 2012; 4). There are several issues in the Malaysian biodiesel industry that have led to underperforming yield, such as a lack of facilities. New facilities need to be installed in order to further develop biodiesel capacity, and at present, the government provides subsidies for the construction of additional facilities in existing refineries.

Overcapacity is also an issue surrounding Malaysian biodiesel plants at their current production capacity; the total biodiesel production in Malaysia in 2011 only constituted 6% of the total current capacity of 2.7 million tonnes from 23 biodiesel plants. In 2004, the Malaysian government allocated US$16 million for low interest loans, US$3.3 million for federal grants, US$3.8 million to Petronas (a Malaysian government-owned company which develops oil and gas projects), and another US$3.69 million for R&D in 2006 (Goh and Lee, 2010; 3847: GSI, 2009).

In addition, the Malaysian palm oil biodiesel industry faces differential disadvantages regarding duties (Basiron, personal communication). Malaysian biodiesel and CPO are subjected to 30% export duties, whereas Indonesia imposes only a 2% export duty on biodiesel, and 16.5% export duty on CPO (Wahab, 2012; 4). The export tax rates that Indonesia imposes on palm oil products are published by the Indonesian Ministry of Finance in a decree (No. 439/KMK 017/1994) on a monthly basis. In contrast, the export tax rates on Malaysian palm oil products are set by the Malaysian Royal Customs Department, Customs Act 1967, on a monthly basis. In September 2014, the Malaysian government decided to waive export duties on crude palm oil (CPO) for both September and October 2014. The tax exemption was prompted by decreasing palm oil prices and increasing inventory. The Malaysian government believes that the tax exemption would stimulate demand for biofuel. Most importantly, this policy will increase the price of palm oil. For a review of the effect of export tax on Indonesian palm oil product, refer to Amzul (2010). This duties differential disadvantage has likely contributed to Malaysia's drop in ranking among other palm oil producers, such as Indonesia, Thailand, and Colombia, which are more competitive biodiesel producers. In 2011, the exports of biodiesel declined by 39,610 tonnes on a year-over-year basis, from 89,609 tonnes in 2010 (Wahab, 2012, 3).

Furthermore, NGOs and Western countries have been continually highlighting sustainability issues; such as land degradation, GHG emissions, and biodiversity losses; land tenure issues, labour issues, social issues, biofuel and biodiesel implementation issues, and policy issues. Although several environmental policies have been laid down, much more effort is needed to address the concerns of critics of the industry (MPOC, 2007). As the EU is concerned about sustainability of the palm oil industry, these are possible barriers to market entry for Malaysian biodiesel exports.

Biodiesel Policies

From a bioeconomy perspective, the objective of the Malaysian biofuel/biodiesel industry is to reduce petroleum imports. Nonetheless, there are no established policies governing the industry as it was conceived as a backup strategy to support the palm oil industry in the event that palm oil prices drop. If palm oil prices decrease, biofuel and biodiesel will become worthwhile options as value-added products (Mahathir, personal communication). As biofuel production is costly, it is not worth producing palm oil biodiesel when the prices of inputs into palm oil production are high. However, the Malaysian government should consider designing a national biofuel and biodiesel policy because of dwindling domestic crude oil deposits and rising domestic energy consumption. The bioeconomy model, aimed at achieving sustainable production and consumption of renewable fuel, can play a pivotal role in the economy. And investment in this industry is needed to improve the sustainability of future development.

The biofuel/biodiesel industry is in its early stages of development under the B5 programme (the B5 is a fuel blend of 5% biodiesel and 95% petroleum diesel), operating in the central region of peninsular Malaysia (Putrajaya, Malacca, Negeri Sembilan, Kuala Lumpur, and Selangor).[33]

[33] http://biz.thestar.com.my/news/story.asp?file=/2012/4/17/business/11114257

Since its implementation in 2009, the biodiesel blend is only available in three states at 1,150 petrol stations, and annual consumption of B5 is 155,440 tonnes, or 178 million litres. The B5 blended diesel is difficult to be found in Kuala Lumpur and Selangor, the capital city of Malaysia (Wahab, 2012; 3). The Department of Standards Malaysia has accredited Malaysia's first biodiesel blend, Envo-diesel (B5), according to the National Standard in 2007 (Mamat, 2009). Through the MPOB, the government has allocated RM43.1 million (US$14.4 million) for the construction of B5 biodiesel blending facilities throughout the country. As of 2012, local biodiesel actors had complained that the government had been slow at implementing the B5 programme and requested that its progress to be accelerated. Moreover, the actors in the Malaysian biodiesel industry have argued that plans to increase the percentage of biodiesel in blended fuel from 5% to 10% (i.e. from B5 to B10 biodiesel), and eventually to B20, should be implemented properly. The actors of the Malaysian biodiesel industry want the government to incentivise investments in downstream value-added products made from palm oil biodiesel. According to Dr Mahathir (personal communication), the Malaysian government should provide as much help as possible because biofuel and biodiesel productions are currently not economically viable. He also felt that Malaysia should focus on other value-added products and food production. The main importers of Malaysian biodiesel are the US, the EU, Singapore, South Korea, Romania, Taiwan, and Australia (Yatim, 2009). Technology used in biodiesel plants was primarily developed by the MPOB (Basiron, personal communication).

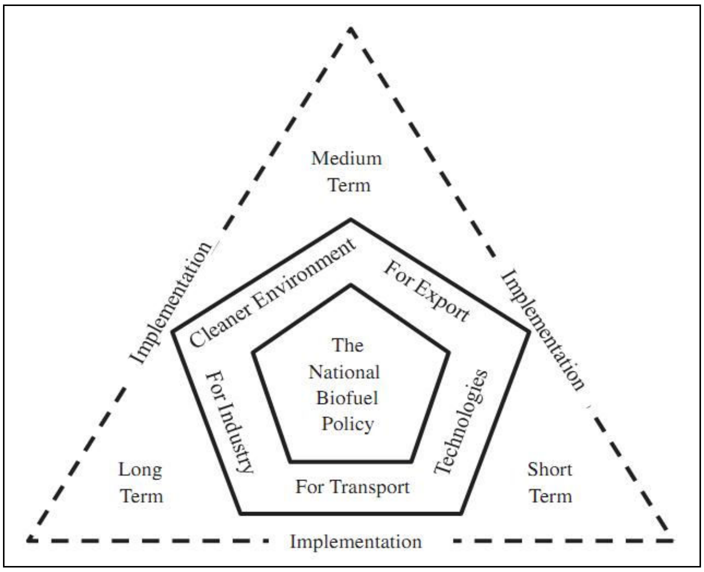
National Biodiesel Policy

The National Biofuel Policy was designed through extensive consultations with all stakeholders based on the research findings of the MPOB since 1982. The Malaysian government has invested in biodiesel technology R&D, which is conducted by the Standards and Industrial Research Institute (SIRIM), the MPOB, and local universities. A technology transfer (TOT) seminar was held to disseminate research findings among related domestic industries. The Malaysian biodiesel policy was designed using the United Nations Framework Convention on Climate Change (UNFCC) and EU policies as guidelines. The critical factors that were considered during the drafting of the Malaysian biodiesel policy are as follows:

i. Competitiveness of the EU economy
ii. Security of the energy supply
iii. Environmental protection (Bozbas, 2008; Yatim, 2009)

However, the implementation of this policy had been delayed because of high palm oil prices since 2008 (Hoh, 2008).

Figure 5.3 Strategic Dimensions and Implementation of the National Biofuel Policy in Malaysia



Source: Abdullah et al. (2009).

This new framework: Strategic Dimensions and Implementation of the National Biofuel Policy in Malaysia is vague and the current level of implementation is limited (Figure 5.3). A more comprehensive policy on biofuel/biodiesel development in Malaysia should provide greater benefits for the industry. Moreover, policies may need to ensure that Malaysian biofuels meet global standards, including the European Standard Specifications for Biodiesel Fuel (EN 14214), the American Standard Specifications for Biodiesel Fuel (B100), and Blend Stock for Distillate Fuels (ASTM 6751).[34] As pointed out by Abdullah et al. (2009), the properties of typical palm

[34] A comparison of these standards can be viewed in Foon et al. (2005).

oil biodiesel for both normal and low pour points can fully meet the European and ASTM standards without much difficulty, however, the current status of the palm biodiesel industry shows that many obstacles do remain. Data from the Malaysia Road Transport Department in Wahab (2012) illustrate the biofuel consumption potential in Malaysia:

Table 5.2 The Number of New Motor Vehicles Registered in Malaysia as of December 2011

Motorcycles	Cars	Buses, Taxis, Hire, and Drive Cars	Goods Vehicles	Others	Total
9,985,308	9,721,447	180,998	997,649	545,867	21,401,269
46.66%	45.42%	0.84%	4.66%	2.55%	100%

Source: Malaysia Road Transport Department in Wahab (2012; 5).

Only 5% of the vehicles registered in the country in 2011 were considered as 'goods' vehicles (that can consume biodiesel). The percentage of goods vehicle is low relative to petrol-reliant vehicles. This may be a point on which future improvements could be made by the national biodiesel programme. The use of pure or blended biodiesel for this small percentage of vehicles could become a focus. Nevertheless, the market for biofuel is bigger and blended biofuel may be a good starting point.

Learning from other bioeconomy programmes, such as the Brazilian ethanol programme (Rask 1994), the benefits of Biodiesel Policy, if well implemented, are: mitigating the impacts of petroleum price increases, adding savings, and driving currency appreciation (Malaysian Ringgit is currently depreciating, €1: RM4.6). It could also enhance the development of a bioeconomy market and stabilise palm oil demand. Furthermore, it would help create value-added palm oil products and enhance socioeconomic development.

5.4.4 Policy Comparison Summary

Learning from the biofuel industries in Germany and the US, the Malaysian biofuel policymakers should take into account the importance of: 1) protecting an infant industry, such as using the Common Agricultural Framework in the EU, 2) market entry amid existing trade barriers, and 3) comprehensive policies to establish and maintain the industry.

From these two international examples of bioeconomy policy, the Malaysian palm oil industry could learn about the potential of using subsidies to protect farmers and hybrid quota trading systems (to balance government spending and income). The industry could also promote the use of pure and blended biofuels, taxes on petrol, crop and revenue insurance, environmental and conservation programmes, export and food aid programmes, and public relation campaigns.

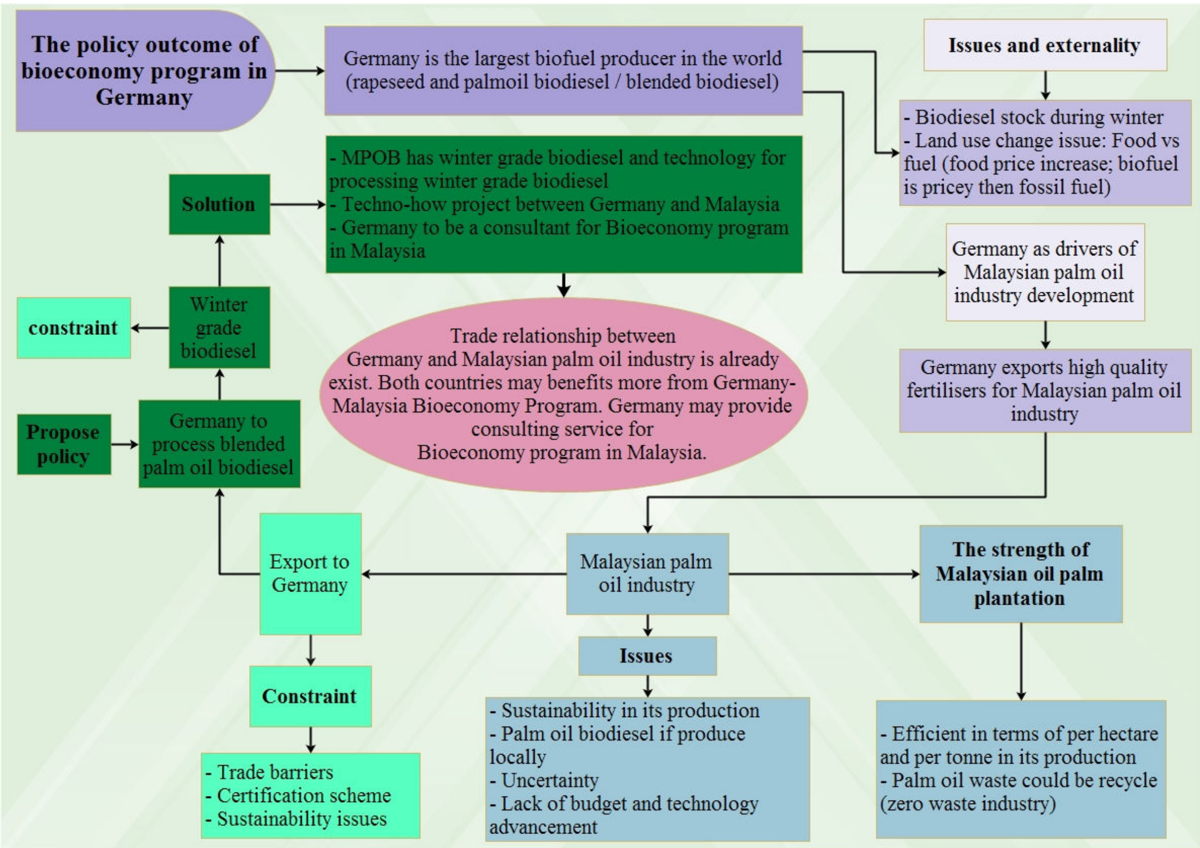
The Malaysian federal government may also consider a trade agreement between Behn Meyer (Germany) and the MPOB as the Malaysian palm oil industry is highly dependent on fertilisers imported from Germany. The German-Malaysian fertiliser chain (Figure 5.4) involves inputs coming from Germany and palm oil end products exported from Malaysia to Germany.

The German government may perceive the potential of Malaysian palm oil as a bioeconomy product. A delegation from the German Federal Parliament (Budget Committee) visited Malaysia from 6 to 8 January 2011. A team of experts in agriculture, consisting of Mr Georg Schirmbeck, MP Dr Michael Luther, MP Lothar Binding, and MP Heinz-Peter Haustein, were in Malaysia to collect information about palm oil cultivation, forestry, and Malaysian financial policies (German Embassy, 2013). There were two things that benefited both countries:

The bureaucratic regulation regarding the labelling of fertilisers can be done at the early stage of fertiliser production in Germany. As a result, production costs could become cheaper. The MPOB would like to establish a procedure for labelling fertilisers with their respective formulas (Albert, personal communication). According to a Behn Meyer agricultural scientist, however, this would increase bureaucracy and costs, and lead to inefficiency. Fertiliser trading companies would need to go through a number of segments in the supply chain before their products could be retailed to farmers (Albert, personal communication).

Furthermore, since empty OPEFBs can be processed into biological fertiliser, and Behn Meyer is a well-known expert in producing high quality fertiliser, a trade agreement (which facilitates the exchange of technological knowledge and experience, and R&D cooperation between the MPOB research stations and Behn Meyer) may provide a win-win situation for both exporter and importer. As a result, some of the EU commissions may also begin to appreciate the prospect of growing oil palm as a renewable energy crop for biofuel production. As the Malaysian palm oil industry is relatively productive (in terms of yield per hectare and yield per tonne), and Germany is the largest producer of biofuel, Germany could become the main importer of palm oil products, such as palm oil biofuels. In addition, Germany may be a consultant for Bioeconomy program in Malaysia. Producing palm oil biodiesel is costly, but Malaysia has to consider a policy design that fulfils sustainability requirements laid down by the EU and German if Malaysian palm oil industry wishes to penetrate the EU market. With the trade agreement in place, palm oil biodiesel imported from Malaysia could be used to complement rapeseed production in Germany. Apart from the "food versus fuel" debate surrounding rapeseed, Germany faces numerous obstacles in rapeseed production, among which are the seasonal changes in Germany. Therefore, importing Malaysian palm oil may be the best option for fulfilling biofuel mandate and demand in Germany.

Figure 5.4 German-Malaysian Bioeconomy Policy Framework



Source: Own illustration.

*Notes: Product flow 1 (Purple boxes): German exports high quality fertiliser for palm oil industry.

Product flow 2 (Green boxes): Malaysia exports palm oil to Germany for biodiesel products.

The arrows:	The arrows show the vicious cycle of oil palm inputs (Malaysia imports fertilizer from Germany), and how Malaysia exports its palm oil products to Germany.
The blue and light green boxes:	The blue boxes show the strengths and issues of palm oil production. The strengths of palm oil production lies in its high efficiency and potential to create zero waste, whereas its issues revolve mainly around the sustainability of its production. The trade barriers are also discussed, which need to be considered to establish in this framework.
The dark green boxes:	These boxes show the palm oil output in the German market. These boxes show the value added to Malaysian palm oil products by German biodiesel refineries. The constraints and issues faced by Germany in producing biodiesel, and relevant sustainability issues are also noted in the boxes.

5.5 Policy Assessment

An overview of the Malaysian palm oil industry is illustrated in Figure 5.5. The Malaysian palm oil industry helps to feed the world population. Palm oil is the cheapest oilseed available. It also facilitates the economic development of Malaysia and other producer countries. History has noted that those who were landless in Malaysia were given land under various land development schemes. At present, settlers under Federal Land Development Authority (FELDA) are given 10 acres of land (4 hectares). The Malaysian economic and development policy on FELDA have been internationally recognised as one of the success stories from the perspective of economic viability and political stability (Fold, 2000). On top of that, Malaysia has been ranked as one of the top eight performing Asian economies by the World Bank (World Bank, 2004).

FELDA, however, is not without its issues. For example, productive farmers claimed that oil palm prices set by FELDA are too low and independent collection centres offer oil palm higher prices. However, FELDA required its settlers to sell their OPFBs to FELDA-owned collection centres. This issue has been discussed in the previous chapter; factors that determine prices include the quality and standard of oil palm fruits. In the next part of this chapter, several policy options for land allocation (granting versus leasing) in relation to the productivity of FELDA, and for up-scaling of poverty reduction program in Malaysia are introduced.

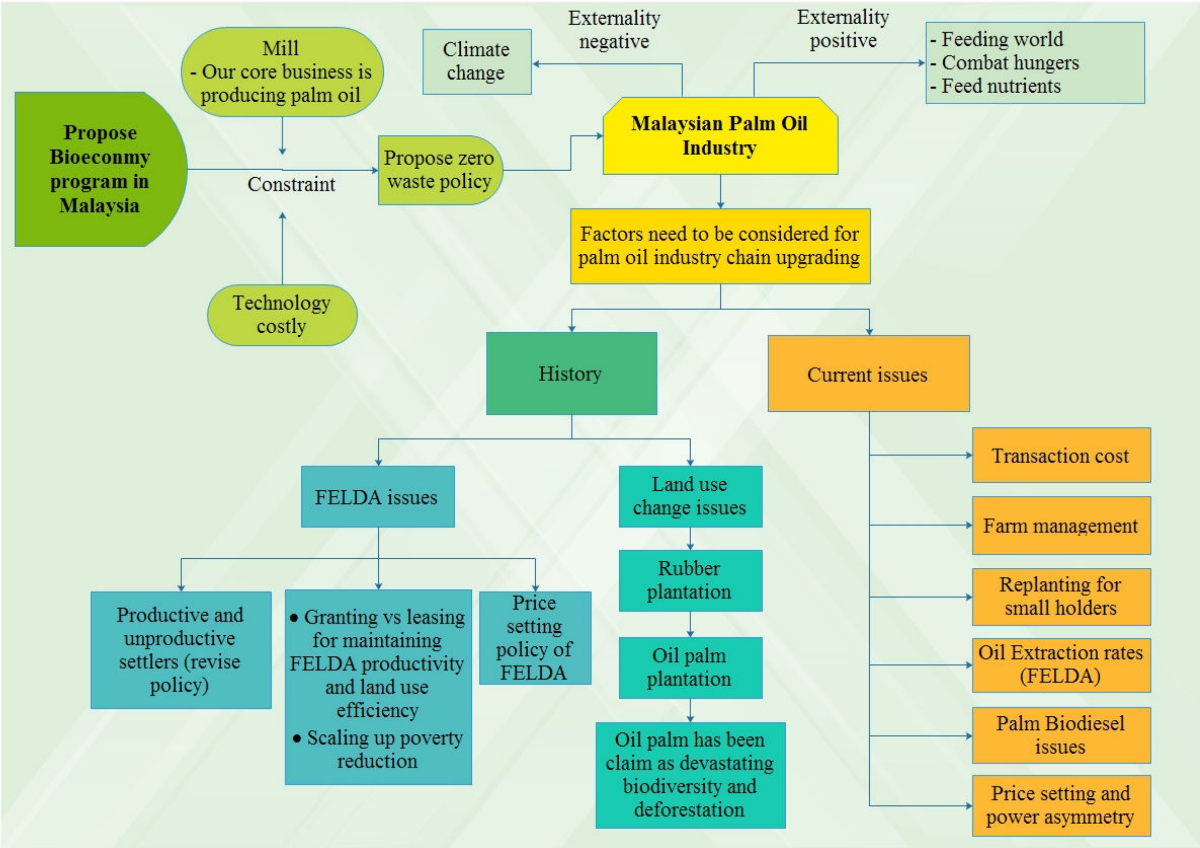
The Malaysian palm oil industry is claimed to be devastating biodiversity and environment. The land-use change for palm oil plantation is a contentious issue. The findings of this study showed that the external costs of palm oil investments may be influenced by the land-use history prior to the establishment of the oil palm plantation. Oil palm plantations are typically established either on forested lands, cocoa plantations, or rubber plantations. Converting cocoa plantations to oil palm plantations results in lower external costs than converting rubber plantations, while clearing forests for oil palm plantations results in the highest external costs. The land use system perspective is used in the discussion of land-use change in chapter four of this study. Land codes and land-use policy, which contribute to this issue, are reviewed in chapter two of the thesis.

In this chapter, some policy options formulated based on assessments and observations made during the field research are provided. Also provided are the findings of the analysis of the pivotal actors in the value chain, discussed in the previous chapters (chapter three and four). As oil palm fruits need to be processed within 24 hours after harvest, transportation, and systems in collection centres and mills are crucial factors to be discussed.

Farm management practices of smallholders and large estates are discussed in chapter three. Several policy options for farm management are also identified in this chapter (chapter 5). As for the oil palm mill segment, issues related to oil extraction rates in FELDA processing mills are discussed. An assessment of policy also showed that asymmetric information exist between buyers (farmers) and sellers (collection centres or millers) with regards to quality and pricing. Biofuel and biodiesel programmes and issues related to them are also discussed in this chapter.

According to industry experts, the palm oil industry could achieve zero waste production. To give further weight to the analysis, key obstacles and constraints are identified. The policy options are discussed in the subsequent section of this chapter.

Figure 5.5 General Scenario of the Malaysian Palm Oil Industry



Source: Own illustration

Note: Productive settlers are FELDA settlers who manage their own farms and sell their oil palm fruits to FELDA-owned mills.

5.5.1 Policy Assessment of the Federal Land Development Authority (FELDA)

Pricing policy issue of Farmers (Settlers under FELDA)

FELDA has been a key institutional actor in the development of the Malaysian palm oil industry. It is considered as the most successful land settlement scheme, according to the World Bank (Suton and Buang, 1996). The programme, however, also faces challenges and has weaknesses, which have been discussed by the World Bank (see World Bank, 1987; TEO, 2009). At present, FELDA is being sued by its settlers over oil extraction rates in several Malaysian states, including Kelantan and Pahang (eastern peninsular Malaysia). These settlers claimed that FELDA manipulated them; the current situation requires careful resolution. FELDA has set low prices for oil palm fruit at their extraction mills, often claiming that the fruits sold by the farmers do not fulfil the quality criteria laid down by FELDA. These settlers claimed that the FELDA processed their allegedly poor quality fruit rather than returning it to them. They also claimed that if FELDA mills had returned the fruits to them, they could have sold it to other collection centres. Another point of contention is that the oil extraction rates set by FELDA are much lower than those of other schemes and do not follow the oil extraction rates established by the MPOB. It was found that the FELDA mills offer the lowest oil palm fruit prices. According to an extraction mill manager working for FELDA (Azman, personal communication), prices are set according to base line prices established by the MPOB and are also dependent on the freshness and quality of the fruit. Meanwhile, in Kelantan, the court ordered FELDA to compensate their settlers.[35] As the backbone of the Malaysian palm oil industry that has contributed significantly to the socioeconomic growth of farmers, FELDA may need to take measures in response to the lawsuits to uphold its public esteem. FELDA may consider allowing its settlers to sell the rejected fruits to other collection centres or paying for the rejected fruits at lower prices. Most significantly, FELDA may need improved transparency of its pricing policy so that the settlers can be convinced of the system and management scheme of FELDA.

Scaling Up the FELDA as a Poverty Alleviation Programme

The decline in productivity of FELDA plantations is reflected by the prices paid for oil palm fruits, determined by quality. However, there may be ways to increase the productivity and efficiency of the FELDA growers. The FELDA could allow settlers who have already received land titles to lease their land to non-FELDA settlers. Some of the first- and second-generation settlers have already improved their standard of living and are no longer poor as their children have grown up, received education, and found well-paying jobs. Most settlers have either decided to let FELDA manage their plantations or hired foreign labourers. A leasing system could be a way to scale up the poverty alleviation impacts of the FELDA programme. The FELDA could continue to help those in poverty by giving them the opportunity to lease land and earn income from oil palm cultivation. Such a programme would have dual impacts on the economy by helping others out of poverty and increasing the productivity of FELDA plantations.

[35] Cases of the FELDA settlers suing the FELDA in court are increasing in Malaysia. For reference, the media report can be found at: http://www.freemalaysiakini2.com/?p=26827

Another option that FELDA may consider would be to open up new areas and begin another generation of settlers. However, Sutton and Buang (1996) noted that the priority of FELDA is increasing productivity, instead of opening up new land.

5.5.2 Central Government Policy Assessment

Agricultural Policies

Agriculture in Malaysia is highly subsidised. The World Bank estimated that between 2% to 3% of Malaysia's GNP in 1984 is attributable to subsidies. Government subsidies affect the allocation of resources and the distribution of income. According to Fee (1985), agricultural policies only affect crops other than oil palm, such as rice. Rice farmers receive an input subsidy of RM200 (US$67) per hectare. Rice prices are controlled through a minimum price policy. The Malaysian government also provides a coupon subsidy of RM164 (US$5.3) for every tonne of rice produced, while the agricultural banks provide loans to rice farmers at zero per cent interest. However, these financial aids are not available to small-scale oil palm growers. Not all smallholders are able to participate in the FELDA programmes, but some manage to receive support for replanting provided by the MPOB or the FOA. They need to take out loans from the bank and survive with their own resources. The Malaysian government may consider giving continual subsidies to the palm oil industry as the industry has contributed tremendously to economic growth and development in Malaysia. The smallholders interviewed for this study said that they found it difficult to repay the loans and hope to receive subsidies from the government (various smallholders, personal communication). Besides, policies that help small-scale growers replant oil palms every 25 years would benefit the industry. Smallholders tend to delay the replanting process because they will only earn income from their oil palms three years after replanting.

Hence, the MPOB would like to establish a replanting programme for independent growers. Based on an NKEA report (2013), areas planted with oil palms above the age of 25 were reduced from 7.49% (2008) to 7.15% (2012) of the total planted area. Replanting programmes need to be conducted annually as the age of plantations varies. Yearly replanting programmes may help the upstream segments of the industry supply chain (farmers). In 2014, the MPOB, an agency of the Ministry of Plantation Industries and Commodities, subsidises smallholders through a replanting scheme, had given out not more than RM7,500 per hectare in Peninsular Malaysia, and RM9,000 per hectare in Sabah and Sarawak for the following activities: 1) preparing oil palm plantation for replanting, 2) purchasing oil palm seedlings from nurseries that comply with the Code of Good Nursery Practice for Oil Palm Nurseries (CoPN), 3) purchasing fertiliser (chemical fertilisers if needed) in the first year and, depending on the remaining provision, the second year. The replanting scheme is subject to 5 hectares of oil palm plantations.

Cover Crops

Encouraging the use of legume cover crop would help improve soil fertility and mitigate some of the negative environmental impacts of oil palm cultivation. Living legumes or grasses can serve as important cover crops. When these plants decay, they release nutrients and organic matter into the soil, improving soil fertility at a low cost. Some cover crops can also be used as food or fodder. The roots of leguminous cover crops can fix atmospheric nitrogen in the topsoil. Moreover, cover crops can attract beneficial insects, and control weeds and plant diseases. They also help to prevent soil erosion and nutrition loss in oil palm plantation (Puan et al., 2011).

Joint Venture Initiatives

It may be beneficial to form joint development ventures between FELDA, FELCRA, and RISDA. As a way to increase economic growth and development, merging the land settlement schemes would pool assets, resources, and capacity to yield greater results. The more the financial resources are, the greater the investment capability and profits. Four hectares of land (the plantation size that settlers receive under the FELDA settlement programme) may be the ideal size for a small farm, as proven by FELDA's success in alleviating poverty. FELCRA and RISDA, which are smaller than FELDA, could become more competitive and efficient in oil palm fruit production if their settlers are also provided with 4 hectares of land. According to Nagiah and Azmi (2012), and Rahman et al (2008), small-scale farmers in Malaysia are less efficient than farmers of larger scales because they use poor quality seedlings and less fertilisers, do not replant oil palm trees even after the trees grow beyond their commercially optimal age, harvest unripe oil palm fruits, and practise poor data management.

Zero waste Industry

Extending contracts to joint-venture companies for biomass production could also improve the performance of biofuel development efforts. In order to make biomass recycling in extraction mills more practical and economically viable, a more practical approach in designing policies on joint-venture contracts could be adopted. As discussed in Chapter 2, the length of current contracts offered to palm oil extraction mills and biomass processing companies is short and do not offer enough security to biomass companies. These companies may benefit from a protection policy that offers longer contract terms to them (Shamsuddin, personal communication). Tun Dr Mahathir also agreed that the companies should be offered longer contract terms. He added that a biomass company may require 10 years of operation before becoming viable to receive a 15-year contract (Mahathir, personal communication).

Smallholders and Certification Schemes

Certification assessment and training for chain upgrading and producing sustainable palm oil are costly. For instance, to be a member of the RSPO, smallholders with less than 500 hectares of land have to pay €500 per year (RSPO, 2012). The high cost of certification may pose a great challenge to smallholders if they want to produce certified oil palm. Thus, through observations during the field research, the Farmers' Organisation Authority (FOA), which usually assists independent smallholders by supplying inputs and transporting OPFBs to collection centres, could initiate group certification (by the RSPO or other certification standards) of independent smallholders. As agreed by Nagiah and Azmi (2012), group certification may improve market access, lead to higher returns, and increase sustainability of production. Learning from the German-Thai sustainable palm oil project, reducing fertiliser use by 10-15% could increase the annual OPFB production by 3 tonnes per hectare, and annual income of smallholders to approximately US$3000. In addition, due to improved quality of oil palm fruits, oil extraction rates increase by 1-2% in palm oil processing mills (Seegräf, 2010; Nagiah and Azmi, 2012).

Managing Risk: Insurance and the 'My Biomass' Initiative

Crop Revenue Coverage (CRC) in the US is an example of options to mitigate producer risk (USDA, 2012). The Malaysian government could introduce a crop insurance system to protect growers from liability and risk. Insurance companies could calculate premiums according to profit targets. For example, producers that earn less than 50% of their normal profits would not have to bear the costs of operation or borrow money to compensate for their losses. In Malaysia, some people prefer to borrow money from private lenders since they require less documentation and have fewer restrictions, but the private lenders impose high interest rates.

Recently, a Malaysian company named 'My Biomass' discovered a value-added palm oil product. Oil palm biomass was exported to Italy for a field trial and was successfully processed into sugar, isobutanol, butanediol, and ethanol. My Biomass was established in 2011 by the Malaysian government, and is a subsidiary of the Malaysian Industry-Government Group for High Technology (MIGHT), which is a part of the Ministry of Science, Technology, and Innovation (MOSTI). According to the managing director of My Biomass, the field trial showed a positive outcome, and the refinery and processing technology tested in Italy will be installed in Johor within the next two years (Puvaneswari, My Biomass, personal communication). My Biomass is a joint venture between the FELDA Plantation Bhd and Sime Darby Bhd, which are two of the largest plantation companies in Malaysia. The president of the MPOC, Dr Basiron, claimed that My Biomass did not consult the MPOC about field trial and the development of this project beforehand, which he saw as an oversight, considering that the MPOC is an expert in this industry. In contrast, Tun Dr Mahathir Mohamed supports the initiative taken by My Biomass, calling it an innovative approach to diversifying the value-added portfolio of Malaysian palm oil products. However, since this is the first project using Italian technology to convert palm oil biomass into sugar, there is an element of uncertainty and risk involved. The integration and collaboration between companies and the MPOC in any project would be an appropriate way to cross-check the reliability and efficiency of a technological investment, thereby minimising risks, and maximising the benefits of the project. Wahab (2012) also argued that cost-efficient ethanol production would still have to compete against highly subsidised petrol (and biodiesel) in Malaysia, and thus, an ethanol industry is unlikely to be developed in the country. Nevertheless, successful risk mitigation in national-level initiatives of this sort will result in a win-win situation among the pivotal actors.

Incentives for Extraction Mills to Adopt Advanced Technology, Biomass Recycling, and Product Diversification

Extraction mills could be given incentives to recycle their biomass in order to generate their own electricity, fuel or bio-fertiliser. This investment would enable extraction mills to utilise their current inputs and outputs, and add value to their production. Palm oil waste can be recycled as either fertiliser or an energy source, thereby improving production efficiency and sustainability, minimising costs, fostering long-term growth, and generating electricity. Generating electricity from palm oil waste also reduces GHG emission. The conventional open treatment pond in mills lead to the release of methane, which contributes to GHG emission; however, “by closing the open digesting system”, methane gas can be captured and used to generate electricity (1.3 Megawatt for a 60-tonne per-hour mill) (Sulaiman et al, 2014). As of 2011, only 10 out of 532 mills in Malaysia fully recycle their wastes into fuel (Shafie et al, 2012).

Recycling waste from palm oil mills into bio-fertiliser is also a worthwhile potential bioeconomy project. Inno-Abedon – Palm Oil Mill Waste Recycle Scheme, a CDM project, is one of the projects about pretreating and recycling POME into bio-organic fertiliser, an estimated 50,183 tonnes of CO_2 by 2018 (the first crediting 10 years of the project) (UNFCC, 2006). Meanwhile, Rupani et al., (2013) recently conducted a study on using vermicomposting technology to make bio-fertiliser from palm oil mill waste. The Malaysian government encourages the adoption of bio-fertiliser (Chan, 2005; Tarmizi and Mohd Tayeb, 2006). However, existing policy design for bio-fertiliser incentives is still questionable. According to Danish Energy Ministry, the palm oil sector has a large potential for CDM; there are 83 Malaysian CDM projects related to palm oil industries (Thebioenergysite, 2010).

The Malaysian central government could encourage mills that still use conventional technologies to adopt more technologically advanced equipment. The Malaysian government may also want to encourage mills to replace conventional low-capacity equipment. This would improve the ability of mills to process OPFBs. Although transitioning to new equipment would temporarily increase costs, this would have tremendous positive long-term impacts on processing capacity and profit margins. The German rapeseed biodiesel industry, the US corn bioethanol industry, and the Brazilian bioethanol industry are examples of how government protection is vital to, and how investment accelerates the progress of, a biofuel industry, especially during its infancy.

It is perceived that greater capacity to produce value-added derivatives provides greater profit and benefits to the actors along the supply chain. The palm oil industry is dependent on the producer at the end of the supply chain (NKEA, 2010; 285), and therefore, the industry may slowly shift towards the downstream part. As mentioned in the previous chapters, as oil palm cultivation expands, better technologies are needed to improve oil extraction rates and to enhance product diversification.

Financial Incentives—Quota Trade System and Tax Exemptions

The quota trading system used by the German biodiesel industry can also be adapted to suit the mineral oil industry in Malaysia. In order to help establish bioeconomy markets for oil industries, the government may consider granting tax exemptions to pure biofuel production. This would encourage the expansion of the biofuel and the biodiesel industries in Malaysia. At the beginning of the year in which the policy is adopted, the fiscal budget will be higher than usual; however, mandatory blending targets and quota trading systems (similar to those in Germany) can compensate for the higher spending.

On the other hand, mandatory blending targets are another option for supporting the biofuel industry. A mandatory biofuel and biodiesel blending market, modelled after the German rapeseed oil policies, could be introduced for the Malaysian oil industry. Both tax exemptions and quotas are policy tools that could encourage the development of a bioeconomy market in Malaysia. Oil companies in Malaysia would have to meet the quotas established by the government for petrol, biofuels, and biofuel blends. A penalty system (which penalises non-compliant fossil fuel producers) can be introduced as a way to make blending targets mandatory. This option may be a novel approach to encouraging the growth of the bioeconomy programme in Malaysia, which is still in its infancy; the Malaysia bioeconomy programme needs better policy and more incentives from the government. With this system, palm oil diesel blends can penetrate other regional markets in Malaysia; at present, the B5 programme operates only in Putrajaya, Malacca, Negeri Sembilan, Kuala Lumpur, and Selangor. There are ten other regions in Malaysia which are potential market for palm oil diesel blends. As the mandatory blending market is imposed on fuel producers, this may be the option to create the market. According to Hassan et al. (2011), Malaysia could meet the 5% biodiesel target with a net GHG savings of approximately 1.03 million tonnes CO_2 equivalent. Hassan et al. (2011) recommended mitigating the impact of GHG emissions from the palm oil used in the transportation sector.

5.5.3 Policy Assessment of the Malaysian Palm Oil Board (MPOB) and the Ministry of Plantation Industries

More Access, More Efficiency: Transportation, Mechanisation, and Bureaucracy Reduction

The transportation issues, especially in Sabah, need to be addressed. As the quality of oil palm fruits declines if not processed within 24 hours of harvest, oil palm fruit dealers should either 1) have better transportation capability or 2) increase the number of collection centres and extraction mills to reduce transportation time.

Plantations may need to figure out how to minimise transportation costs. Some plantations, such as the United Plantation, transport their fruit to the processing mills by train, which is more cost efficient (Mahathir, personal communication) than transporting by lorries.

Labour is also a key component in the development of the biofuel industry. Instead of adopting a labour-incentive strategy, higher level of mechanisation could be a better option. The oil palm industry is heavily dependent on immigrant workers; there are up to 369,000 foreign workers in Malaysian oil palm plantations (NKEA, 2010). The benefits of mechanisation can be evaluated by reduction in labour costs; and increase in productivity, efficiency, and quality (NKEA, 2010). In order to raise the level of mechanisation, growers need to be convinced that mechanising production will bring about tangible benefits. This approach might be costly in the beginning, but returns will also increase over time.

Optimising Input: Standardised Collection Centres and Farmer Training

A standardised approach to palm oil grading may need to be adopted at all collection centres and mills. Collection centres should also be equipped with the same quality analysis capabilities. Some collection centres employ their own laboratory analyses, but others do not, often requiring fruits to be transported to mills for quality grading. Afterwards, the collection centres inform and pay the farmers according to the quality of the fruit. This system is inefficient and time consuming. The ability to determine the quality of the fruit at all collection centres may benefit the industry. Some palm oil producing countries already have mechanism to manage quality during transportation. The code of practice laid down by the National Bureau of Agricultural Commodity and Food Standards, an agency under the Ministry of Agriculture and Cooperatives of Thailand, stipulates that collection centres need to deliver OPFBs directly to palm oil processing mills within 24 hours (Good Agricultural Practices for Oil Palm, 2010).

In addition, the farmers may also need to be trained on optimum input use. The respective organisations could provide technical advice about appropriate input levels to producers. This would help farmers make better decisions on pesticide use and the optimum use of inputs.

Precision Agricultural Practices and Crop Diversification

Farmers could be urged to adopt precision agricultural practices on their plantations to reduce costs and increase profits. Oil palm plantations require large quantities of compost as fertiliser because it contains lower nutrient concentrations than chemical fertilisers.

Farmers could also consider diversifying their operations, such as raising livestock or engaging in aquaculture on oil palm plantations. They could also plant other crops, such as sugarcane, corn, and yams. Farmers could apply for incentives and subsidies from the FOA to offset establishment costs at the early stages of their business. Through these measures, the farmers can diversify their sources of income so that they are not solely dependent on oil palm for income. This may also help farmers during the 3-year period between initial planting and first harvest, in which farmers earn no income from their oil palms. However, cattle production emits more GHG (from the cattle itself or cow dung) than oil palm cultivation, and therefore could raise sustainability concerns (Albert, personal communication).

Specific Policy Options for the Industry: 'Nursery Bank'

A new system called 'nursery bank' may be an option for increasing yield per hectare in the palm oil industry. This is a form of cost sharing. The FELDA nurseries have improved oil palm clones that may be commercialised and shared with other growers to increase the efficiency of the industry as a whole. Currently, individual government initiatives are working independently.

The settlement programmes and private companies use seedlings from their own oil palm nurseries. In Malaysia, oil palm varieties are only commercialised if the respective programmes choose to do so or if companies have access to varietal stocks. Research findings and successful variety development may need to be commercialised and shared with other actors in the industry to grow and develop the industry, notwithstanding competition among the growers. The nursery bank could be developed under the Breeding and Tissue Culture Unit of the MPOB. Presently, the Breeding and Tissue Culture Unit is conducting a research to improve and produce elite oil palm planting materials. Thus, it may be beneficial to the industry if oil palm breeders (owned by respective private estate or MPOB) would sell their best mother plants or seeds to the nursery bank. The MPOB could then distribute the best oil palm seeds to plantations throughout the country. Most significantly, the MPOB may promote the use of the best oil palm seeds to other oil palm nurseries or growers, As a positive consequence, Malaysia could possibly produce the best oil palm breeds and enhance its production yield per hectare.

5.6 Conclusion

The Malaysian government laid down policies for the Malaysian palm oil industry 40 years ago that led to tremendous development and achievements of the industry, allowing it to surpass West African countries to become one of the largest producers and exporters of palm oil in the world.

The Malaysian government laid down its own policy targets; however, some policies are not in accord with the current production capacity of the industry (such as targeting to become the largest biofuel producer by 2013). To improve the effectiveness of future policy development efforts, current situation on the ground should be studied in depth, taking into account the obstacles and constraints of the policy adopted. Such an approach to policymaking would be more reliable and not overly ambitious.

In addition, the international policies compared (the German rapeseed biodiesel industry and the US corn ethanol industry) may not be entirely applicable to the Malaysian palm oil biofuel industry because of differences between the developmental status of the three countries. Malaysia is on target to achieve the status of 'developed country' by year 2020, and hence, such comparisons could still offer meaningful insight.

The developed countries such as Germany and the US have highly developed biofuel policies; their respective biofuel industries have also overcome considerable challenges. Therefore, studying the development of their industry could be useful for the Malaysian biofuel industry. The hybrid quota trading system (imposing the use of pure or blended biofuel, while controlling government spending) is an effective approach to incentivise biofuel industry by the German government, while crop and revenue insurance policies adopted by the US protect farmers from liabilities and losses. Due to challenges faced by oil palm growers in insuring their crops and revenue, such approaches could offer significant benefits.

Chapter 6 Summary and Conclusions

6.1 Synopsis

This study was intended to explore the economics of the palm oil industry in Malaysia, including its positive and negative externalities. It also sought to fill the gaps left by previous researches about the palm oil industry, which have typically been limited to analyses of either the positive or the negative side of this industry without in-depth applied research. More importantly, this study looked into the potential of palm oil becoming a 'bioeconomy' product, a renewable and sustainable resource that contributes food, oil, fuel, and fibre products for both domestic and international consumptions. In order to meet the increasing demand, palm oil cultivation areas have been expanding at a dramatic pace around the world, generating a host of concerns about the externality of the industry. Despite the concerted efforts to improve the sustainability of palm oil production by various actors in the industry, those efforts have so far failed to fulfil the dynamic expectations and the requirements of various consumers and environmental groups (especially those in developed countries, such as the US and the EU), which are considered as external governance of the industry. The news media, NGOs, and certain social groups have continually claimed that the palm oil industry is inherently unsustainable and oppose the industry on multiple levels (Aikanathan, 2013). According to Edgar et al. (2011), if the cultivation area of palm oil were to be reduced, productivity (on a per unit land basis) would need to be increased. On the other hand, Fargione et al. (2008) found that biofuels made from perennial crop biomass with limited carbon debt (such as palm oil) provide GHG advantages. Moreover, Cravens (2011) found the Malaysian palm oil industry to be a good role model based on her case study findings. The general debate about the sustainability of the Malaysian palm oil industry is inconclusive. Palm oil is a worthy investment from a business perspective, but the environmental and social aspects of the industry can only be adequately addressed by comprehensive and well-designed efforts to integrate sustainable practices in production.

This research sought to address the following questions:

1. Who are the key actors in the palm oil industry supply chain?
2. What factors influence the productivity and the competitiveness of oil palm farmers?
3. Which segments in the industrial supply chain have the most negative environmental impacts?

4. What are the opportunity costs of producing palm oil in Malaysia with consideration of the previous crop plantation?
5. What are the externalities of palm oil production in Malaysia?
6. What policies pursued by the government have contributed to the development of the Malaysian palm oil industry and how effective have they been?

The following section synthesizes the findings related to the research questions.

6.2 Synthesis of Research Findings

6.2.1 Actors in the Malaysian Palm Oil Industry

The frameworks of Kaplinsky and Morris (2000), McCormick and Schmitz (2001), and FAO (2006a) were adapted to evaluate the physical and financial flows of the global palm oil value chain. They were applied to the micro-level data from the case studies of actors in the Malaysian palm oil industry. Besides, the gaps identified in the previous research efforts were filled using the global value chain analysis framework and a gross margin analysis. The product flow through the palm oil industry supply chain in Malaysia was examined in depth, and this highlighted its complexity. The palm oil industry in Malaysia begins at the upstream part of the chain that consists of nurseries, growers, and fruit collection centres.

Two types of actors, extraction mills and oil refineries, constitute the processing segments of the chain. They are followed by the downstream part of the chain that consists of palm oil dealers, and exporters. These findings indicated that the industry is far more sophisticated than suggested by existing researches conducted by Vermeulen and Goad (2006), Mather (2008), Ludin et al (2014), the European Union (2012), and Goh and Lee (2010). The expansion of oil palm plantations has been limited due to land scarcity in peninsular Malaysia. The land scarcity is a result of the relatively long history of settlement in this area, and the remaining undeveloped areas are protected by the National Land Code of Malaysia (1965). Furthermore, transportation costs are also found to be higher in Sabah than Johor, and therefore, collection centres, as intermediaries, play a pivotal role in transporting oil palm fruit to the extraction mills in the Sabah region. Through interviewing industry experts, growers and land owner were identified as the key actors in the Malaysian palm oil industry. Most significantly, value-added calculation done in this study showed that the large estates are the key players among the Malaysian oil palm plantations; large estates in Johor had the highest average value-added among oil palm plantations in Malaysia.

6.2.2 Productivity and Competitiveness of Palm Oil Plantations

The second research question posed in this thesis was addressed by using the Northern Victoria Irrigated Cropping Gross Margins (2009–2010) framework. The gross margins of growers were calculated on the basis of hectare, labourer, and tonne according to production scale. All actors in the palm oil industry, regardless of their size, have the potential to be equally efficient in their production because all of them have access to international markets. Small-scale growers were found to earn lower gross margins than large scale-growers in Johor as the industry there has a relatively long-term history. The distribution of gross margins on the basis of hectare, labourer, and tonne did not favour growers of a particular production scale (large, medium, and small); they were found to be potentially equally competitive. Some smallholders even had higher gross margins than large- and medium-scale growers. Oil palm plantation productivity is also determined by other production factors, such as soil, fertiliser application, rainfall, and the choice of oil palm varieties (Menon, 2007; 90).

Variable costs were higher in Sabah than in Johor; this was likely due to the present transaction costs (growers in Sabah need to purchase inputs, such as fertilisers, from Peninsular Malaysia). Transportation costs were also higher in Sabah as road networks and communication infrastructure are less extensive there compared with Johor. Therefore, in Sabah, more collection centres and extraction mills should be established, and transportation capacity should be improved so that growers can transport their oil palm fruits for processing within 24 hours of harvest (time frame to ensure quality of oil palm fruits).

However, there are a number of limitations that might have affected the findings. In conducting the gross margin analysis, the age of the trees, which influences the production of OPFBs, was not taken into account; the effects of past land use (such as forest/rubber/cocoa) prior to establishment of oil palm plantation was also not considered. Besides, the number of oil palm tree per hectare, assumed to be 138 units per hectare, might have contributed to the potential equal competitiveness of holders in both regions. Fertiliser and pesticide usage were calculated as a function of tree density. The calculated gross margins might not have precisely reflected actual situation because it did not capture the application of inputs, age of the oil palms, and past land use of plantations. Past crops have influence on fertility and nutrient level of soil, thereby contributing to the application rates of inputs. On top of that, the gross margin analysis did not distinguish between smallholders under FELDA, FELCRA, and RISDA programmes. Under FELDA, settlers may choose to either manage their own farms (productive farmers) or let FELDA manage their farms and receive a monthly fixed income of RM1200 (unproductive farmers). In contrast, FELCRA smallholders do not have the option to manage their farms, merely receiving RM1200 monthly from FELCRA. Thus, the efficiency of respective schemes could not be compared. It would be interesting to compare the farm gross margins between these development programmes so that the productivity and the efficiency of the schemes, and the precision agricultural practice could be identified.

6.2.3 Opportunity and Externality Costs of Producing Palm Oil and the Dirtiest Segment in the Value Chain

Using a framework by Noormahayu et al (2009) and Boardman et al. (2006), a cost benefit analysis of growers and extraction mills, which incorporated environmental factors and NPV, was conducted for a 25-year time span. These two segments of the industry chain were selected for analysis because they have been frequently associated with negative externalities of the industry (Yusoff and Hanson, 2007; Nazir and Setyaningsih, 2010). The externalities incorporated into the CBA included: land-use changes (opportunity cost in terms of the amount of carbon storage or emission in forest, rubber, and cocoa) and GHG emissions based on the findings of Henson (2005; 292) and Kongsager et al., (2012). Other input data were obtained from studies conducted by Nikander (2008) and Zulkifli et al. (2010); the input data included usage of pesticides and N fertilisers, EF of AS fertilisers, EF of urea fertilisers, diesel consumption. Additionally, data about carbon emission from mills were obtained from Yacob's et al. (2005). Most previous studies about environmental impacts of the palm oil industry used life cycle assessments to investigate externalities of the industry, whereas in this study, the externalities were converted into monetary terms.

In the social CBA, the monetary values of GHG emissions were derived by multiplying their carbon values by carbon market prices provided by Greentech Malaysia (2010), and the carbon sequestration capacity was calculated based on forest carbon market prices (2012). Eight simulation were conducted, each using different savings rates. The mean values of NPV and BCR of each group (best, standard, and worse cases) were compared. This analysis extended the CBA of palm oil plantations in Malaysia, which has already been conducted by Noormahayu et al (2009) and Nordin et al., (2004) to small-scale plantations established on peat land in Selangor, Peninsular Malaysia. This study discovered that unproductive plantations, which earned RM1,200 (US$400) per month, under the FELDA settlement scheme had negative NPV on a per hectare basis after a 25-year commercial cycle. In contrast, the NPVs of productive plantations (the best- and standard-case plantations) were positive.

The small- and large-scale growers in Sabah have less favourable results compared with their Johor counterparts, but medium-scale growers were an exception. In general, the worst-case plantations in Sabah had higher costs. Smallholders bore higher variable and establishment (drainage) costs; while large-scale growers bore higher overhead, establishment (drainage), planting, operations, and external costs. The worst-case plantations at all three production scales in Sabah had negative earnings, particularly the large-scale growers, suggesting poor cost structure management. Past land use of oil palm plantations also played a significant role in determining externality costs. The oil palm plantations that were established in previously forested areas had the greatest external costs, followed by those established on converted rubber plantations, and subsequently those established on converted cocoa plantations (rubber plantations has higher carbon storage capacity than cocoa plantations). These findings are consistent with the claims of the NGO representatives interviewed (Tan Kee Huat, personal communication; Nithi Nesadurai, personal communication). The transitivity of the external cost that is dependent on past land use of a plantation can be summarised as follows: forest > rubber > cocoa. Investments in small-scale growers in Sabah were financially costlier but caused lower external costs because most of the oil palm plantations in Sabah were established on former cocoa plantations. External costs amount to between 22% and 26% of the total costs in Johor, and between 17% and 19% in Sabah. These results confirm the findings of Henson (2005) about changes in biomass carbon stocks of tree crops and forests in Malaysia and also support the proposed policy of prohibiting oil palm expansion into forested areas (Koh and Wilcove, 2008).

As for mills, both the best- and standard-case mills in Johor did better than those in Sabah. The extraction mills in Johor had higher NPV per tonne of output after the 25-year period than the mills in Sabah. The external costs accounted for between 4% and 13% of the total revenue per year in Johor, whereas this figure was between 7% and 15% in Sabah. Compared with plantations, the externalities of mills constitute a lower percentage of the total costs (between 0% and 16%). This illustrates that mills produce lower external costs, they are safer investments, and are less harmful to the environment than plantations. Regardless of technology used for extracting palm oil from fruit (either hydrocyclone or conventional technologies), NPV per output determined the level of efficiency of the mills. These findings affirm those of similar researches carried out by Yusoff and Hanson (2007) and Nazir and Setyaningsih (2010), which also concluded that plantations generate higher external costs than mills. However, there are some limitations to the social CBA calculation for both growers and mills processing, which may have contributed to the findings. Some parameters were not consider during the computation of external costs, including carcinogens, climate change, radiation, ozone layer, ecotoxicity and acidification, greenhouse warming potential, formation of smog that damages human health, acidification, eutrophication, terrestrial ecotoxicity, land occupation and transformation that damages the ecosystems, and cumulated energy demand that leads to depletion of non-renewable resources. The plantations were found to contribute the highest external costs as percentage of total costs in both Johor and Sabah. These findings are similar to the findings obtained in previous studies by Yusoff and Hanson (2007), and Nazir and Setyaningsih (2010).

6.2.4 Government policy for Malaysian Palm Oil Industry and its effectiveness

Using the theory of industrial organisation and the infant industry argument as theoretical frameworks, the issues and obstacles faced by the Malaysian palm oil biodiesel industry and the palm oil industry as a whole were identified. Two examples of biofuel policy (Germany's rapeseed biodiesel policy and US corn ethanol policy) were reviewed with the intent to find ways of upgrading, and accelerating the growth of, the Malaysian biodiesel industry. The review was conducted to study the feasibility of adapting the policies to the Malaysian biofuel and biodiesel industries. According to veteran policymakers, such as Dr Mahathir (personal communication), the Malaysian biofuel initiative was originally conceived only as a backup plan for the palm oil industry in the event of declining palm oil prices.

On top of that, based on the theory of industrial organisation and the argument of infant industry, the Malaysian government may need to consider protecting the biofuel industry until it reaches viability (Bardhan, 1971; Rask, 1994; Leahy and Neary, 1996; Caballero et al., 2012). The reasoning behind this theory is that new industries need to be assisted in order to compete with more established players in the industries. New industries often need time to learn how to develop supply chains, how to interact with markets, and how to cope with policy frameworks. A good example is the Brazilian ethanol industry, which began only 18 years ago and has achieved very positive outcomes in reducing the country's reliance on petroleum. This industry received careful protection from the Brazilian government during its initial development stages.

Even though Malaysia is also an oil producing country, its petroleum reserves are stagnant, and the cost and consumption of 'sweet oil' are rising. As a result, an alternative biofuel industry based on a very well-established agricultural crop in the country offers a logical means of both energy security and support for the economy. The limited progress of the Malaysian biofuel industry is due to the lack of comprehensive policy treatment of the country's biofuel industry, and higher production cost of biodiesel compared with alternative fuels under current conditions. As the German rapeseed industry has shown, investing in targeted research with industry, establishing mandatory blending targets and hybrid quota systems are among the best options to foster the development of a bioeconomy industry based on palm oil biofuel. Malaysia could learn from these examples and integrate relevant elements into its domestic policies.

A number of Malaysian policy options that may be appropriate for other palm oil producing countries were also investigated. The land development policies implemented through settlement programmes, such as FELDA, FELCRA, and RISDA, may also be applicable to other developing countries. These policies function as an instrument to alleviate poverty and develop rural areas. The government could provide loans for plantation development. Once the settlers completely repay the loans from the government, they would receive legal title to the land initially provided by the government. The effects of the land development programmes include: creating job opportunities, improving township amenities, providing education, and reducing rural-urban migration.

In addition, the main issue that the researcher would like to highlight for the consideration of the governance of the Malaysian palm oil industry is the number of relatively straightforward measures that can be implemented to improve post-harvest productivity. Oil extraction rates are largely dependent on the quality of oil palm fruits, which is dependent on farming inputs, length of time between harvest and processing (ideally within 24 hours of harvest), plantation management practices, and oil palm variety selection. Based on the findings of this study, transportation has been a key issue, especially in the Sabah study area. To solve this problem, each plantation has to determine their best option for balancing transportation needs and costs. Thus, collection centres should be dispersed such that all oil palm plantations are located within 5 km of a collection centre.

Besides, the sustainability of the palm oil industry has been the subject of many public criticisms from external actors. In order to export palm oil products to specific international markets, such as the EU and the US, the products need to meet food safety and quality requirements, and in some cases, sustainability standards. As a means of meeting such international standards, Malaysian policymakers may consider adopting policies that help the industry fulfil the requirements of various certification schemes. For instance, to address concerns about GHG emissions, emission monitoring programmes should be in place to evaluate the actors in the Malaysian palm oil supply chain. At present, Malaysia is conducting a pilot study on a national voluntary certification scheme, Malaysia Sustainable Palm Oil (MSPO). The current progress of this scheme would be an interesting area for further research, and a comparison could be made between the MSPO (national voluntary scheme) and the RSPO (international voluntary scheme). In addition, the governance of the value chain may need to prescribe the code of practice for each actor in the value chain, including collection centres. At present, the MPOB issues a code of practice only for nurseries; oil palm estates and smallholdings; palm oil mills; palm kernel crushers; palm oil refineries; and the handling, transportation, and storage of palm oil products (MPOB, 2014).

6.2.5 Suggestions for Further Research

Future research is needed to gather relevant data on the industry on the ground. Collecting primary data about the Malaysian palm oil industry is a very challenging task. The actors in the industry are often reluctant to provide explicit data. However, primary data are needed to understand the actual status of the industry when designing programmes and policies (currently National Key Economic Area under the Economic Transformation programme of the palm oil industry is under development). The evaluation of this policy and its impact may be a significant step in reviewing the progress of the palm oil industry in Malaysia.

Future research would also benefit from a more complex data analysis method, such as dynamic bioeconomic models. A suitable bioeconomic model would be able to integrate both biophysical and socioeconomic variables (Brown, 2000; Börner, 2006). A dynamic model would be able to distinguish between the inter-relationships and the dynamic behaviour of a particular industry. Ramly et al. (2012) used such a model to identify the impacts of government intervention on the Malaysian rice industry, while Hidayatno et al. (2011) applied system dynamic analysis to the production of biodiesel chain in Indonesia. System dynamic sustainability model may be applied to encompass the complexity of biodiesel production, which involves multiple sectors and actors. The system dynamic model can also be integrated with financial modelling, life-cycle analysis (LCA), and business sustainability strategy to analyse government policies. A holistic empirical approach may be taken to analyse policies governing the Malaysian palm oil industry. In addition, GHG emission is another area that is becoming increasingly important, and therefore, requires investigation. To import a product into the EU, the amount of GHG emitted during its production must be disclosed, and the GHG emissions need to fulfil certification standards. These external costs such as GHG emission could be integrated into CBAs of each segment, along with the supply chains of the palm oil industry, and valued in monetary terms. Another variable that should be considered in greater detail is the relationship between biodiversity and land use. The institutional aspects of this industry are questionable. Hence, future research could investigate why the government has adopted the current policies, and trace the historical development of Malaysian biofuel policies by thoroughly reviewing relevant government documents. Multinational corporations acquiring land from the indigenous community in Borneo is another issue that was not addressed in this study. In Sabah, holders with customary rights to unregistered lands are eligible to file a claim with the state. The claims have to be made within a specified time frame. Unfortunately, local households are rarely informed of the results of their claim. Farmers or households are required to go through bureaucratic channels to appeal for native titles as it is “non-transferable”, even though it is allowed to be sub-listed (Colchester, 2011).

6.2.6 Limitations of this Study

In this study, descriptive analyses were carried out to thoroughly describe the Malaysian palm oil industry and its current status. However, a complex model to examine this industry was not developed. Data provided by the industry actors were generally considered as private and confidential. The research is also conducted based on the assumption that the current issues in the field were the most important issues requiring investigation. In this study, microeconomic data were gathered from field research and secondary sources were used to examine the issues highlighted.

Furthermore, the Malaysian palm oil industry faces many challenges, such as trade barriers due to sustainability issues. The MPOB was not a partner in this study. The researcher was also unable to gather certain data because they were considered sensitive information. Nevertheless, the researcher was determined to fill as many gaps as possible, in order to identify opportunities and constraints for the further development and transformation of the palm oil industry in a bioeconomy context.

Annex A

1) Data pertaining to interest rates in Malaysia

No.	Years	Interest Rates
1	1987	4,58
2	1988	5,48
3	1989	4,24
4	1990	4,8
5	1991	5,56
6	1992	7,56
7	1993	5,81
8	1994	4,64
9	1995	4,92
10	1996	6,04
11	1997	6,91
12	1998	3,35
13	1999	8,51
14	2000	-1,09
15	2001	8,85
16	2002	3,3
17	2003	2,91
18	2004	0,03
19	2005	1,26
20	2006	2,51
21	2007	1,37
22	2008	-3,86
23	2009	12,87
24	2010	-0,07

Source: World Bank, 2012

Annex B

1) Documented photos from the field work

A Conventional Technology Palm Oil Extraction Mill in Malaysia

Source: Own field research, 2010

A Hydrocyclone Technology Palm Oil Extraction Mill in Malaysia

Source: Own field research, 2010

The Interior of a Palm Oil Extraction Mill in Malaysia

Source: Own field research, 2010

Transportation of Oil Palm Fruit Bunches in Malaysia

Source: Own field research, 2010

Unloaded Oil Palm Fruit Bunches at an independent Collection Centre

Source: Own field research, 2010

Loading Oil Palm Fruit Bunches at a Private Plantation

Source: Own field research, 2010

Weighing Oil Palm Fruit Delivered to a Collection Centre

Source: Own field research, 2010

Testing Equipment for Fruit Quality Control at Palm Oil Extraction Mills

Source: Own field research, 2010

Annex C

1) Data and example of calculation on Google spread sheet

This Google spreadsheet has 19 sheets, which are depicted in the following:-

a) A general overview on the Google spreadsheet for calculation and data set
   - http://goo.gl/Owucui

b) Step-by-step analysis on Gross margin analysis, whereby viewers may see the calculation and the analysis
   - http://goo.gl/TEhz7u

c) Data used for gross margin distribution
   - http://goo.gl/BkNp3l

d) Data used for cost structures on segments along the value chain
   - http://goo.gl/71RLHk

e) Step-by-step calculation for value added analysis (With this step-by-step calculation, viewers may see the calculation of value added in this research)
   - http://goo.gl/uxIF5H

f) Step-by-step calculation on carbon price and external cost
   - http://goo.gl/ybESZL

   i. With the step-by-step calculations of carbon price and external cost, viewers may see how both secondary and primary data were combined. The secondary data were synchronized with the primary data to calculate the carbon price and the external cost.

   ii. Step-by-step calculation on Social Cost Benefit Analysis

g) Calculation of carbon emission (This calculation shows how the table summary of carbon emission was produced, as depicted in Table 4.23 of the thesis).
   - http://goo.gl/Eem3WS

h) Data on small holders in Johor. (This primary data set was used to calculate gross margin analysis, cost benefit analysis, cost structures, and value added. The formula used for bridging the gaps of missing values are shown and are depicted below each column or in the cell base comment.)
   - http://goo.gl/QDJSE6

i) Data on medium holders in Johor. (This primary data set was used to calculate gross margin analysis, cost structures, cost benefit analysis, and value added for growers.)

- http://goo.gl/WErqb4

j) Data on large holders in Johor. (These data were combined with secondary data as a way to increase the sample size and to fill the gap of missing values). These data were used to calculate gross margin analysis, cost structures, cost benefit analysis, and value added.

- http://goo.gl/Bjh8bs

k) Data on mills in Johor (These data were used for cost structures).

- http://goo.gl/qYbU6Q

l) Data on Nurseries in Johor (These data were used for cost structures).

- http://goo.gl/kedVKP

m) Data on Retailers in Johor (These data were used for cost structures).

- http://goo.gl/iJGYHE

n) Data on small holders in Sabah (These data were used to calculate gross margin analysis, value added, cost structures, and cost benefit analysis).

- http://goo.gl/oRPzeS

o) Data on medium holders in Sabah (These data were used to calculate gross margin analysis, value added, cost structures, and cost benefit analysis).

- http://goo.gl/iJtWrO

p) Data on large holders in Sabah (These data were used to calculate gross margin analysis, value added, cost structures, and cost benefit analysis).

- http://goo.gl/kIQGNp

q) Data on mills in Sabah (These data were used for cost structures and social cost benefit analysis).

- http://goo.gl/nNWaLj

r) Data on Nurseries in Sabah (These data were used for cost structures).

- http://goo.gl/KriTkT

s) Data on Retailers in Sabah (These data were used for cost structures).

- http://goo.gl/CG5k1Q

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