CHAPTER 5

ANALYSIS & FINDINGS: OIL PALM VARIABLE ANALYSIS AND RESULTS

5.1 Introduction

This chapter focused on the 3rd and 4th objectives of this dissertation:

I. To *analyse and relate variables* (economic, social and environmental) that are important for palm oil production; and

II. To *derive important variables* to establish measurements for sustainable land resource management in the oil palm sector.

For this purpose, variables for this industry were collected as quantitative data form numerous sources. The data sources included:

a. Malaysian Palm Oil Council (MPOC) Records;
b. Malaysian Palm Oil Board (MPOB) Records;
c. Malaysian Palm Oil Association (MPOA) Records;
d. World Bank Database;
e. International Monetary Fund (IMF) Database;
f. Bank Negara Malaysia;
g. Oil World;
h. Roundtable for Sustainable Palm Oil (RSPO);
i. FELDA (Federal Land Development Authority); and
j. Sime Darby Berhad.

The most comprehensive sets of data for the industry were from the IMF and the World Bank, while the MPOC was the most supportive in providing information was necessary for this study to be undertaken. Even though the MPOB has been the custodian of oil palm research and development for Malaysia, it was not possible to get cooperation from this agency for research purposes. From an aggregate of more than 400 variables, 120 variables were found to be suitable for sustainability development. Variables were only selected if they met the following criteria:

I. Relevant and important to the sector concerned;
II. The variables can be defined;
III. Literature review supports selection of the variable;
IV. Defined by time and quantifiable.

The selected variables were significant from the environmental, economic and social aspects. The lists of variables accumulated from the various sources are appended in ***Appendix 2.*** For the purposes of analysis, the list of 120 variables was divided into the environment, social and economic sectors. The value of a variable to the selected sector was measured by the following objectives:

a) Environmental Objective: Variables that influence environmental trends, affecting the impact oil palm plantations.
b) Social Objective: Variables that influence population dynamics.
c) Economic Objective: Variables that influence the price/production dynamics of the FFB and CPO.

5.2 Division of Variables according to Sector

With regards to sustainability issues pertaining to palm oil, it was found that a selection of variables were the most relevant for the oil palm industry. For a systematic survey process, the variables were divided according to the environmental, social and economic sectors to meet the objectives mentioned above.

a) Economic Objective: The variables influenced the price/production dynamics of the FFB) and CPO, as shown in *Table 5.1*.
b) Defining Value: The variables can be quantified and captured in a time-frame for testing.
c) Supporting literature: MPOB (2002-2011), World Bank (2012), Njoo (2001), Asari et al. (2011), Othman, (2003)

Variables in the economic sector included those that were related to financial movements in the palm oil industry indicating market trends. Here, both macro data, such as country-level information, e.g. GDP, FDI, etc. and the micro data, more focused on the oil palm industry, such as the price of CPO and the price of PKO were gathered. International indices were also examined, as trends can be seen through the movement of these indices. ***Table 5.1*** depicts the economic variable for the palm oil industry.

Table 5.1: Economic Variables for the Palm Oil Industry

Economic Variables for the Palm Oil Industry
Food production index (2004-2006 = 100)
Foreign direct investment, net inflows (current US$)
GDP (current US$)
Human Development Index (HDI)
Commodity price
US$ exchange rate
Inflation rate
Commodity Index
Product price
Export value
Biofuel price
Foreign Direct Investment (FDI)
US$ exchange rate
Industrial Production Index
Area Under Oil Palm (Mature & Immature) -Peninsular Malaysia
Area Under Oil Palm (Mature & Immature) – Sabah
Area Under Oil Palm (Mature & Immature) – Sarawak
Area Under Oil Palm (Mature & Immature) – Malaysia
Principal Statistics of Oil Palm Estates (number of estates)
Principal Statistics of Oil Palm Estates (planted hectares)
Principal Statistics of Oil Palm Estates (harvested hectares)
Principal Statistics of Oil Palm Estates (production of fresh fruit bunches)
Principal Statistics of Oil Palm Estates (yield per hectare)
Principal Statistics of Oil Palm Estates (local delivered average price)
Principal Statistics of Oil Palm Estates (total number of workers employed)
Total Planted Hectares of Oil Palm (Total Area)
Total Planted Hectares of Oil Palm (Estate)
Total Planted Hectares of Oil Palm (Smallholding)
Annual Average Prices of Oil Palm Products (CPO - local delivered)
Annual Average Prices of Oil Palm Products (PK - Ex-Mill)
Annual Average Prices of Oil Palm Products (CPKO - local delivered)
Annual Average Prices of Oil Palm Products (RBD Palm oil - FOB Bulk)
Annual Average Prices of Oil Palm Products (RBD Palm Olein - FOB Bulk)
Annual Average Prices of Oil Palm Products (RBD Palm Stearin - FOB Bulk)
Annual Average Prices of Oil Palm Products (PFAD - FOB Bulk)
Annual Average Prices of Oil Palm Products (FFB - 1% Extraction Rate)
Oil Palm Planted Area - Peninsular Malaysia
Oil Palm Planted Area – Sabah
Oil Palm Planted Area – Sarawak
Oil Palm Planted Area – Malaysia
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Peninsular Malaysia)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Sabah)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Sarawak)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Malaysia)

Source: World Bank (2012) and Malaysian Palm Oil Council (2012)

With regards to the environmental issues pertaining to palm oil, it was found that a selection of variables that were the most relevant for the oil palm industry came from both the World Bank and IMF meta-database. For the environmental issues, it was found that the variables in ***Table 5.2*** were most relevant for the oil palm industry. These variables were newer in nature compared to the economic variables, and were more diverse in their coverage. They covered water supply, emission patterns, weather patterns, forest cover and agricultural issues. Environmental indices were also confined to these variables.

a) Environmental Objective: Variables which influence environmental trends, impacting the oil palm plantations, were chosen.
b) Defined: Can be quantified and captured in a time-frame for testing
c) Supporting literature: World Bank (2012), IMF (2012)

Table 5.2: Environmental Variables that Influence the Palm Oil Industry

Environmental Variables that Influence the Palm Oil Industry
Agricultural land (% of land area)
Agricultural methane emissions (% of total)
Agricultural nitrous oxide emissions (% of total)
Agriculture, value added per worker (constant 2000 US$)
Agriculture, value added (% of GDP)
Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal)
Annual freshwater withdrawals, domestic (% of total freshwater withdrawal)
Annual freshwater withdrawals, industry (% of total freshwater withdrawal)
Annual freshwater withdrawals, total (billion cubic meters)
Arable land (% of land area)
Arable land (hectares per person)

Source: World Bank, 2012

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Table 5.2: Environmental Variables that Influence the Palm Oil Industry

Environmental Variables that Influence the Palm Oil Industry
CO2 emissions (kt)
CO2 emissions (metric tons per capita)
Energy-related methane emissions (% of total)
Forest area (% of land area)
Forest area (sq. km)
Improved water source, rural (% of rural population with access)
Improved water source, urban (% of urban population with access)
Methane emissions (kt of CO2 equivalent)
Nitrous oxide emissions (thousand metric tons of CO2 equivalent)
Organic water pollutant (BOD) emissions (kg per day per worker)
Organic water pollutant (BOD) emissions (kg per day)
Other greenhouse gas emissions, HFC, PFC and SF6 (thousand metric tons of CO2 equivalent)
Renewable internal freshwater resources per capita (cubic meters)
Renewable internal freshwater resources, total (billion cubic meters)
Terrestrial protected areas (% of total surface area)

Source: World Bank, 2012

With regards to social issues pertaining to palm oil, it was found that a selection of variables that were the most relevant for the oil palm industry came from both the World Bank and FAO meta-database. Even though the Malaysian Palm Oil Board covered much of these data as well, there were not forthcoming with information, and no data bank was available for research use. For the social issues, it was found that the variables in ***Table 5.3*** were the most relevant for the oil palm industry. The data coverage here included macro information with regards to the Malaysian agricultural sector, for example, indices on health and mortality. The micro data, on its part, described labour movements, including foreign labour numbers and gender divisions.

a) Social Objective: Variables with values that impact population dynamics were selected.

b) Defining Value: Variables that can be quantified and captured in a time-frame for testing were selected.

c) Supporting literature: MPOB (2002-2011), World Bank (2012), FAO (2012)

Table 5.3: Social Variables for the Palm Oil Industry

Social Variables for the Palm Oil Industry
Local Labour (Peninsular Malaysia)
Foreign Labour (Peninsular Malaysia)
Local Labour (Sabah)
Foreign Labour (Sabah)
Local Labour (Sarawak)
Foreign Labour (Sarawak)
Total Number of workers employed during the last pay period
Wages (Agricultural Sector)
Health (mortality rate)
Mechanisation
Potable water supply
Education (literacy rate)
Employees, agriculture, female (% of female employment)
Employees, agriculture, male (% of male employment)
Employment in agriculture (% of total employment)
Employment to population ratio, 15+, total (%)

Source: MPOB, 2012 and World Bank, 2012

5.3 Malaysian Data Spread from 2003 to 2011

Detailed information for the oil palm industry is available in published form only from 2002 to 2011 and can be obtained from Malaysian Palm Oil Board publications. The spread of the information is mainly on the cost of palm oil production in Peninsular Malaysia, Sabah and Sarawak. The data also covers information pertaining to oil palm production in the regions mentioned. MPOC data spread from 2003 to 2011 is depicted in ***Table 5.4***.

The drawback of this information however is it cannot be used for economic analysis, as the data collection has been erratic. Observable trends are also limited due to this problem.

Table 5.4: Data for Cost of Oil Palm Production in Malaysia

Cost of Oil Palm Production in Malaysia
Local Labour (Peninsular Malaysia)
Foreign Labour (Peninsular Malaysia)
Local Labour (Sabah)
Foreign Labour (Sabah)
Local Labour (Sarawak)
Foreign Labour (Sarawak)
Development & Maintenance Cost (RM per hectare)
Non-Recurrent Costs (Malaysia)
Upkeep & Cultivation (Malaysia)
Fertilisation (Malaysia)
Non-Recurrent Costs (Sabah)
Upkeep & Cultivation (Sabah)
Fertilisation (Sabah)
Non-Recurrent Costs (Sarawak)
Upkeep & Cultivation (Sarawak)
Fertilisation (Sarawak)
Cost of Oil Palm Planting (RM per hectare)
Non-Recurrent Costs (Malaysia)
Upkeep & Cultivation (Malaysia)
Fertilisation (Malaysia)
Non-Recurrent Costs (Sabah)
Upkeep & Cultivation (Sabah)
Fertilisation (Sabah)
Non-Recurrent Costs (Sarawak)
Upkeep & Cultivation (Sarawak)
Fertilisation (Sarawak)
Total Immature Cost (Malaysia)
Total Immature Cost (Sabah)
Total Immature Cost (Sarawak)
Average Cost of Estate Upkeep & Cultivation (Malaysia)
Average Cost of Estate Upkeep & Cultivation (Sabah)
Average Cost of Estate Upkeep & Cultivation (Sarawak)

Source: Malaysian Palm Oil Board, 2011

5.4 Important Variables for Sustainability and Governing Groups

One of the main tasks in this study was to identify the variables from the environmental, social and economic sectors that are important for palm oil sustainability. Based on the RSPO, Report 2011, the lists of principles that govern sustainability are the following eight principles:

1. Commitment to transparency;
2. Compliance with applicable laws and regulations;
3. Commitment to long-term economic and financial viability;
4. Use of appropriate best practices by growers and millers;
5. Environmental responsibility and conservation of natural resources and biodiversity;
6. Responsible consideration for employees and for individuals and communities affected by growers and mills;
7. Responsible development of new plantings;
8. Commitment to continuous improvement in key areas of activities.

The ISPO Certification System set up by the Indonesian government is an instrument that is used by the Ministry of Agriculture to reach their environmental objectives for sustainability and reduce greenhouse gas emissions in Indonesia. The Indonesian Sustainable Palm Oil Certification System has 7 principles, 40 criteria and 126 indicators based on 120 applicable laws and regulations in Indonesia. Because the principles and criteria are based on the applicable law and regulations in Indonesia, it also substantiates the need for measurable variables to determine palm oil sustainability (Suharto, 2012).

The ISCC authority, the German governing agency that certifies palm oil being imported into Europe, especially into Germany, has a list of requirements that define the

characteristics of sustainable production. It is concerned with the identification of all the pathways in the industry and of mapping the road towards improvement and sustainable production. The ISCC criteria for palm oil sustainability is that the oil should not be from a bio-diverse or carbon rich area, where its production has not exceeded the GHG threshold, has corresponded to Global Agricultural Program and social criteria and the mass balance approach has been adhered to. Improvement needs are also addressed through improved nitrogen management; maximum use of legume cover plants as a source of biological N2 fixation; substitution of N fertiliser with lower emissions during manufacture; improved splitting, timing and spreading of N fertiliser; improved accuracy of N fertiliser recommendations; increased estate transport efficiency (back-loading empty bunches); and reduced energy use in housing (ISCC, 2012).

Based on the RSPO Principles, ISPO Principles and ISCC procedures, the governing values for important variables for sustainability in Malaysia are as depicted in ***Table 5.5.***

Though the selection of variables for sustainability is extensive, many of the important variables did not have sufficient data for statistical testing, and also some are new ideas and concepts of measurements for the industry. The best mode of interpretation for these variables was through graph depiction: for trend analysis and production implications.

Table 5.5: Important Sustainability Variables for Agriculture

Important Sustainability Variables for Agriculture
Agricultural methane emissions (% of total)
Agricultural nitrous oxide emissions (% of total)
Agriculture, value added per worker (constant 2000 US$)
Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal)
Annual freshwater withdrawals, domestic (% of total freshwater withdrawal)
Annual freshwater withdrawals, industry (% of total freshwater withdrawal)
Annual freshwater withdrawals, total (billion cubic meters)
Arable land (% of land area)
Arable land (hectares per person)
CO2 emissions (kt)
CO2 emissions (metric tons per capita)
Employment in agriculture (% of total employment)
Fertilizer consumption (kilograms per hectare of arable land)
Food production index (2004-2006 = 100)
Foreign direct investment, net inflows (BoP, current US$)
Forest area (% of land area)
Forest area (sq. km)
Fossil fuel energy consumption (% of total)
GDP growth (annual %)
Improved water source, rural (% of rural population with access)
Methane emissions (kt of CO2 equivalent)
Nitrous oxide emissions (thousand metric tons of CO2 equivalent)
Organic water pollutant (BOD) emissions (kg per day)
Other greenhouse gas emissions, HFC, PFC and SF6 (thousand metric tons of CO2 equivalent)
Permanent cropland (% of land area)
Renewable internal freshwater resources per capita (cubic meters)
Renewable internal freshwater resources, total (billion cubic meters)
Terrestrial protected areas (% of total surface area)
Total Planted Hectares of Oil Palm (Total Area)
Total Planted Hectares of Oil Palm (Estate)
Total Planted Hectares of Oil Palm (Smallholding)
Development & Maintenance Cost of Oil Palm Plantations (RM per hectare)
Non-Recurrent Costs of Oil Palm Plantations (Malaysia)
Upkeep & Cultivation of Oil Palm Plantations (Malaysia)
Fertilisation of Oil Palm Plantations (Malaysia)
Cost of Oil Palm Planting in Malaysia (RM per hectare)

Source: Author, 2013

5.5 Graphic Exploration of the Oil Palm Industry Variables

To analyse other variables, the optimal method was through graphic exploration. ***Figures 5.1*** to ***Figure 5.5*** were worked out in variable clusters for analysis and visual comprehension of how the selected variables changed or did not have any implications for the selected sector. Previous literature work was used to support the analysis of the findings made.

There is a good record of palm oil production data from 1980 to 2011, and it shows that there has been a rapid rise of production of 2,573,173 tonnes/year from the early 1980's to a plateau in the 2009-2010, where palm oil production had stayed at about 17,564,937 tonnes/year. The most intense growth years for production were from the mid-1990's to early 2000s, and for the last three years production has stayed about at 17,000,000 tonnes. From 2005 onwards, production which was at 14,961,654 tonnes/year, tapered off in its momentous growth.

The value of non-recurrent costs had also kept in pace with the increase in production, but these values are only available from 2002 to 2010. This cost describes the finances that are non-recurrent to set up the oil palm plantations. The upkeep and cultivation cost for Malaysia also climbed but less severely, and tapered off by 2009 as well. It can be theorised that as the growers acquire more experience in their work, they become more cost effective in the management of the plantations. Upkeep and cultivation was at RM$ 755.55 per hectare in 2002 and climbed to RM$1254.1 in 2010 (***Figure 5.1***).

While fertilisation cost has kept steady progress from 2002 to 2010, the cost of fertilisation in 2002 was RM$366.19 per hectare, while in 2010 it was at RM$382.38 only. This marginal increase can be explained by the fact that the growers save costs in fertilising their plantations, or used outputs from the production like POME and palm oil biomass (FFB waste, etc.) to recondition the soil.

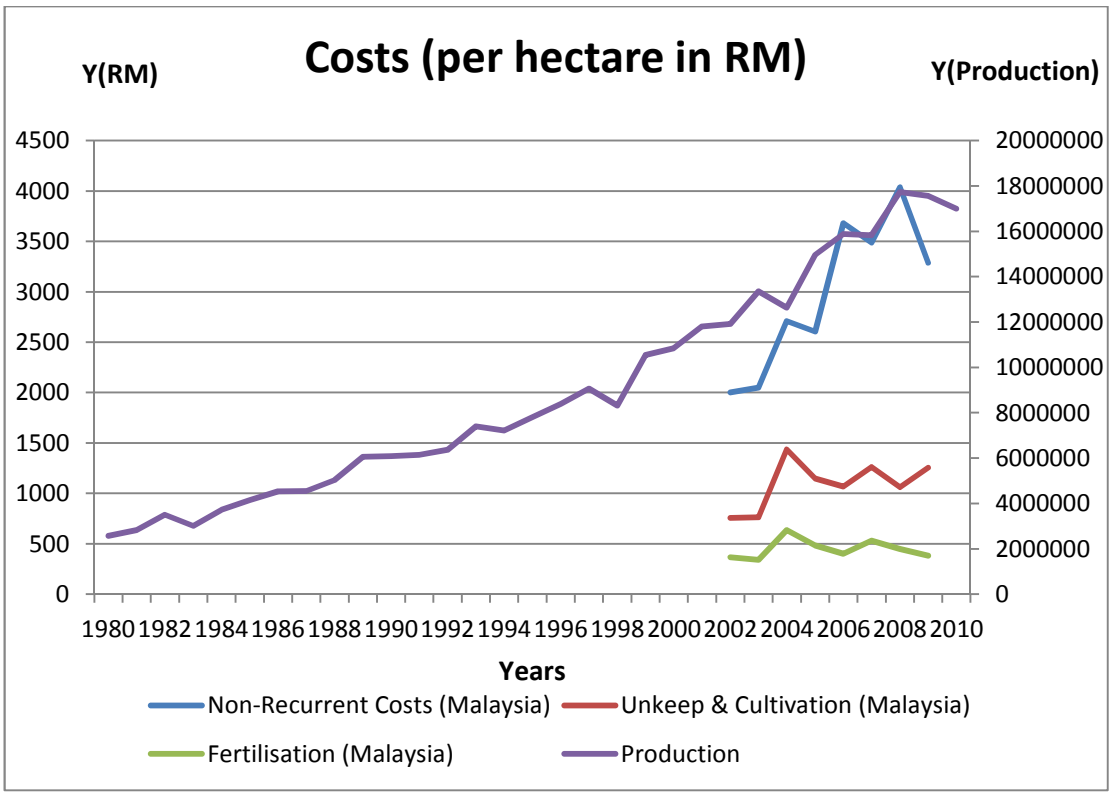

Figure 5.1: Other Costs With Regards to Production from 2002 to 2011

The flow of FDI from 1960 to 2010 was plotted against palm oil production from 1980 to 2010 (***Figure 5.2***). The palm oil industry in Malaysia did not seem to be affected by foreign investment into the country. This is also true of other agricultural crops in Malaysia such as rubber, tea or cocoa. Unlike the Malaysian electronics industry, the palm oil sector has flourished because of the federal government's New Economic Policy (NEP), (the was implemented from 1971-1990) and the 4th and 5th Malaysia Plan, in the 1981- 1985 and 1986-1990 periods.

The policies were to: increase production for export, including new industrial and agricultural items, and greater processing of raw materials, further substitution of domestic production for imports. These initiatives were made through FELDA, and government-linked companies like Sime Darby Berhad that kept pushing palm oil production upward. Later, state-governed bodies, e.g. Ketengah and POIC Sabah, further pushed up production in the early 2000's till now.

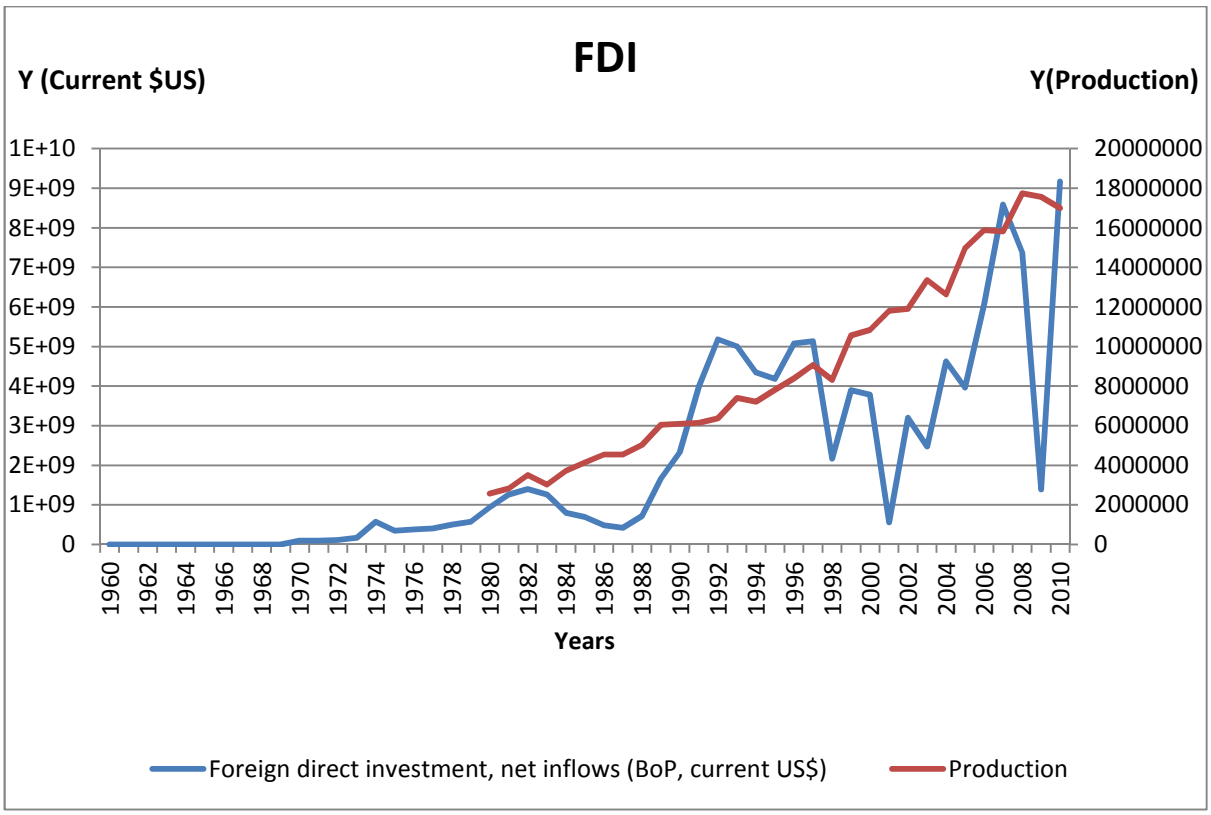

Figure 5.2: Flow of FDI and Palm Oil Production from 1980 to 2010

Figure 5.3 was plotted to show the movements in land use growth for oil palm plantations with regards to production. Records show the legislated Malaysian forest area was at a total of 223,760 square kilometres until 1990, and reduced to 208,900 square kilometres in 2005 and stayed within that range till now. Therefore, we can safely deduce that the planted area for oil palm was not coming from the conversion of the Malaysian rainforest but from the conversion of other agricultural land or industrial zones.

The Total Planted Hectares of Oil Palm (Total Area) are made up of Total Planted Hectares of Oil Palm in the form of estates or smallholdings. The estate figure rose in tandem with production, from 1960s to triple its size in 1970 and then to 545,462 hectares in 1980s, showing a 100% growth. However, Total Planted Hectares of Oil Palm for smallholdings started to grow in size since late 1970s with the NEP policies

and federal government incentives, from 252,035 hectares to a sharp peak around 1986-88 at 830,960 hectares. As plantations were being corporatized through FELDA schemes and corporate buy-overs, the size declined to about 1845781 hectares in early 1990s and has remained at that low level.

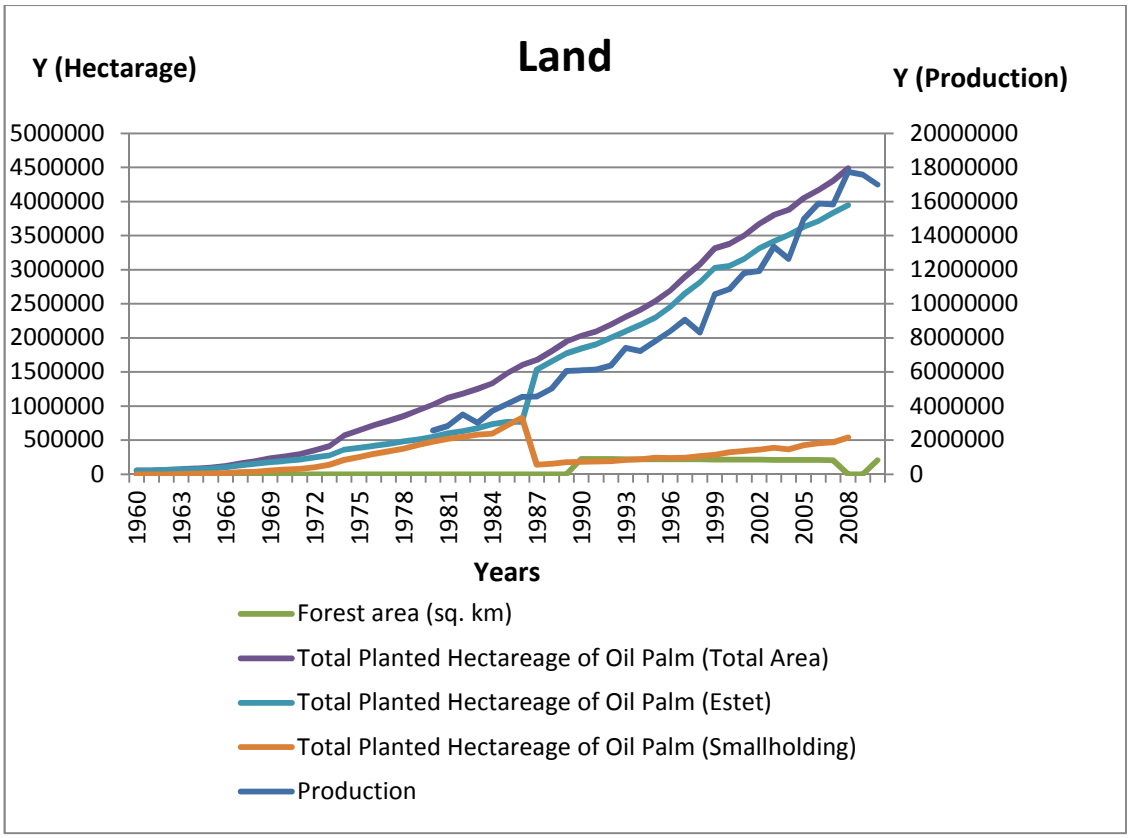

Figure 5.3: The Expansion of Total Planted Area, Estates, Smallholdings and the Malaysian Forest Cover from 1960 to 2010.

Figure 5.4 depicts the agricultural variable, such as arable land (%), agricultural methane emissions (% of total), agricultural nitrous oxide emissions (% of total), and agricultural water withdrawals movement with regards to palm oil production in Malaysia. The agricultural methane emissions (% of total) and agricultural nitrous oxide emissions (% of total) data shows no obvious connection to agricultural progress, but this not a clear indication of lack of connection among them, as both these variables

were new measurements and there was insufficient data for analysis. This is the same with annual freshwater withdrawals for agriculture (% of total freshwater withdrawal). There was also a lack of data for graphic or statistical tabulation.

In the case of arable land cover in Malaysia (% of land area), the percentage from the beginning of records in 1980s has stayed the same without any decline, indicating no desertification. Instead, the figure has improved from 3% to 5.5% in the 1990s till now, and this may be due soil improvement programmes that were carried out under the 3rd and 4th Malaysia Plan which were geared for increased in productivity in the agriculture sector.

Employment in agriculture (% of total employment) experienced a sharp increase in the late 1970s and early 1980s, as more federal government efforts were going into agricultural expansion, as mentioned above. After the mid-1980's, it can be observed that there has been a continuous decline in the number of persons involved in the agricultural sector, from 1985 at 30%, to about only 14% at the year 2010. The drop in the sector can be attributed to the diversification into industry and services in Malaysia, and also further mechanisation of work in the plantations.

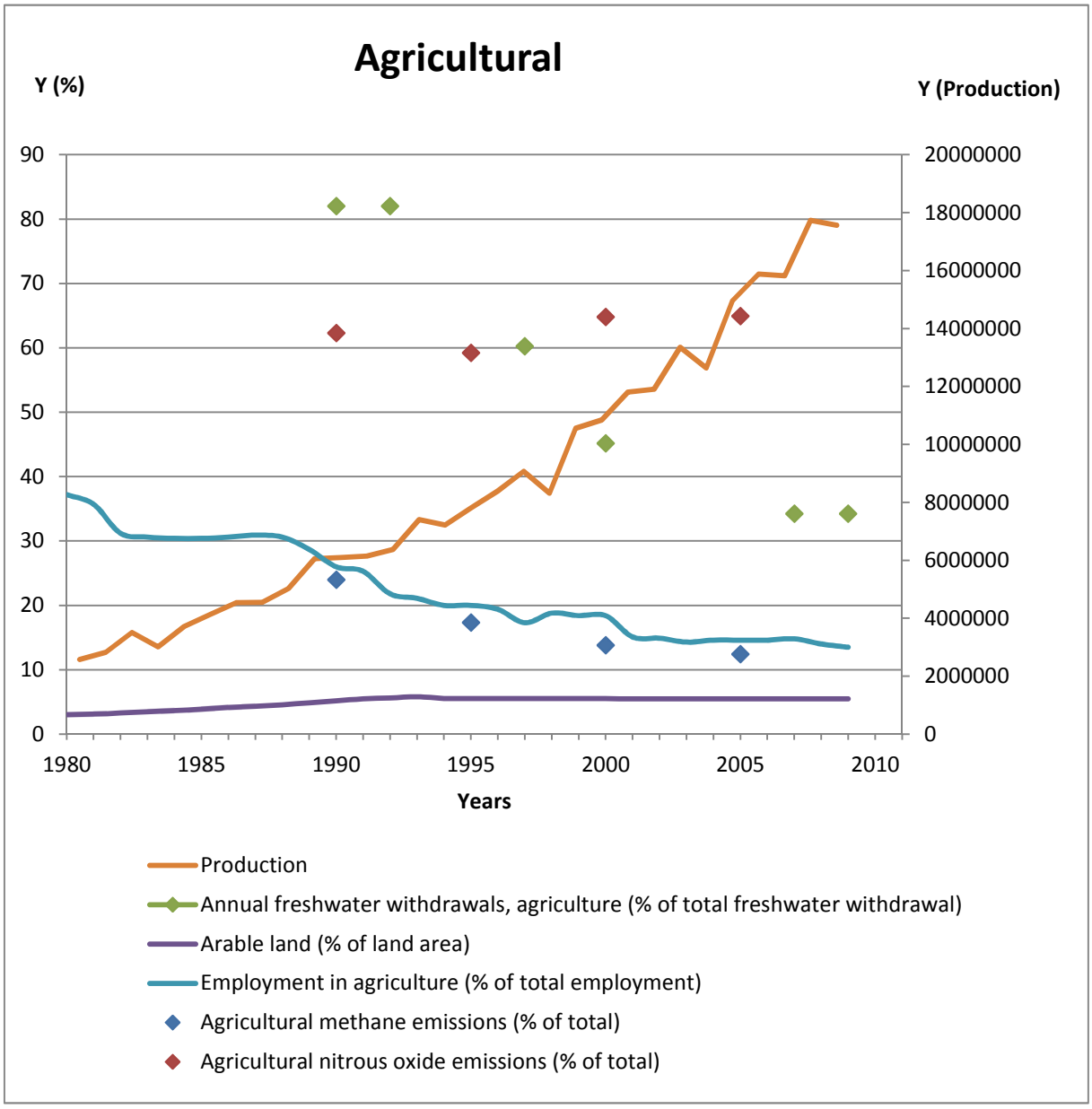

Figure 5.4: Agricultural Variables, progress from 1960 to 2010

Figure 5.5 plots the production of palm oil against GDP growth (annual %) in Malaysia from 1980 to 2010, which shows that GDP annual growth has been at a steady 7% but dipping with the Asian Economic Crisis in 1997-98 and then later in 2008 with the Global Financial Crisis. The global crisis started to show its effects in the middle of 2007 and into 2008 where the ASEAN and its commodity sectors owed its recovery to the stimulus-fuelled sustained growth from China and India. Oil palm being a perennial

crop does not adhere to market variations or volatility. Producing nations like Malaysia and Indonesia, to prevent a further plunge in the CPO price, have strategically moved into more downstream activities within their countries, reducing export volumes. While major buying nations like China, India and Pakistan on the other hand, have increased their purchase volume, as CPO prices are cheaper than other vegetable oils in the commodity market. The permanent cropland (% of land area) has remained about same since 1960s, while the terrestrial protected areas (% of total surface area) saw a marked increase in 1988-1990 and has stayed there since (***Figure 5.5***). Forested area, in comparison to terrestrial protected area, where forest area has decreased, has led to the increase of terrestrial protected area.

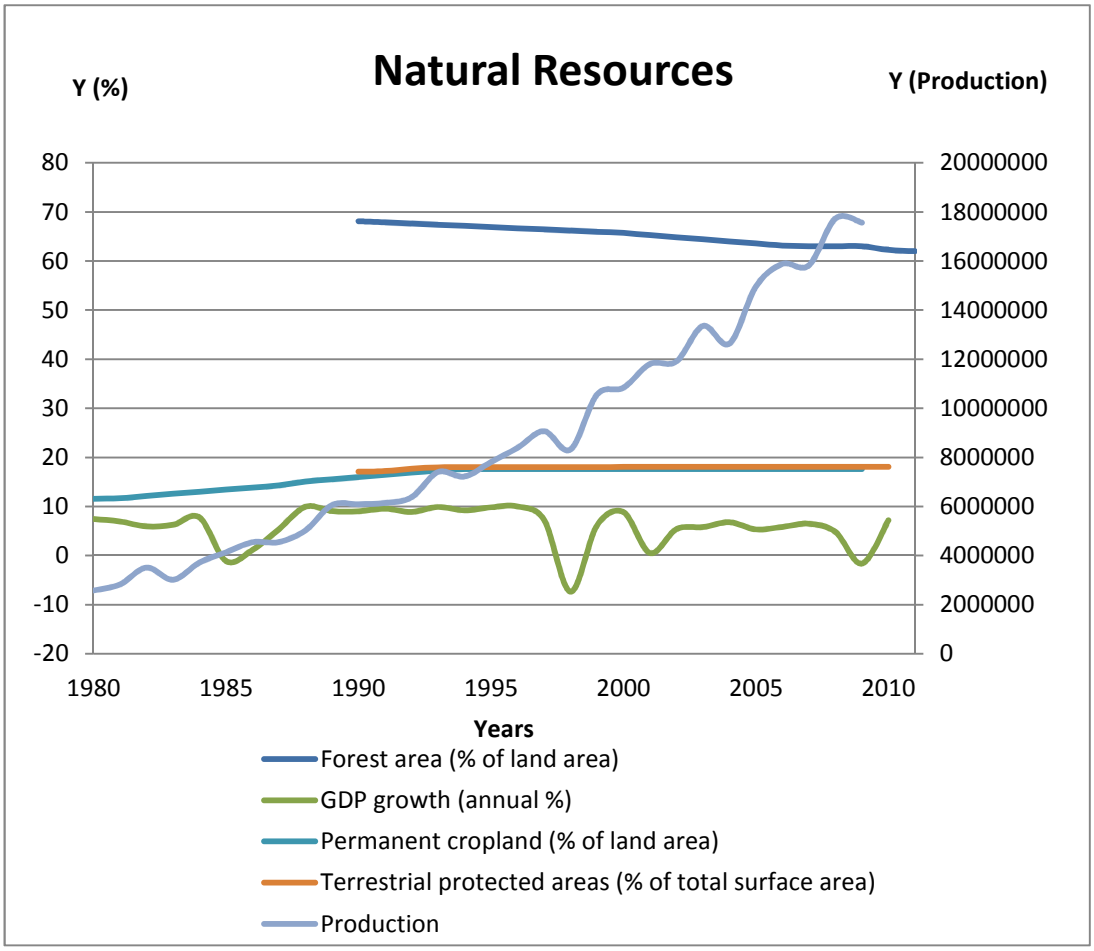

Figure 5.5: Changes in Natural Resources and Production from 1960 to 2010.

However, not all the variables identified could be used to run the regression and correlation test as the data records/fields requirement was not met. (Many of the variables collected could be used for testing, as the data sets were not complete for statistical analysis.) Macro data were also not used for the final analysis, as this information was not relevant to the study. Final selection of variables is listed in ***Table 5.6.***

These variables were tested against palm oil price and total planted area in Malaysia, to show if they have any impact and change the production pattern. Details are discussed further in Chapter 6.

Table 5.6: List of Variables Tested

Variables/Determinants
Agricultural land (% of land area)
Agricultural methane emissions (% of total)
Agricultural nitrous oxide emissions (% of total)
Agriculture, value added (% of GDP)
Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal)
Annual freshwater withdrawals, total (billion cubic meters)
Arable land (% of land area)
Arable land (hectares per person)
CO2 emissions (kt)
CO2 emissions (metric tons per capita)
Employment in agriculture (% of total employment)
Fertiliser consumption (kilograms per hectare of arable land)
Forest area (% of land area)
Forest area (sq. km)
Methane emissions (kt of CO2 equivalent)
Nitrous oxide emissions (thousand metric tons of CO2 equivalent)

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Table 5.6: List of Variables Tested

Variables/Determinants
Organic water pollutant (BOD) emissions (kg per day)
Permanent cropland (% of land area)
Terrestrial protected areas (% of total surface area)
Terrestrial protected areas (number)
Area Under Oil Palm (Mature & Immature)-P.Malaysia
Area Under Oil Palm (Mature & Immature)-Sabah
Area Under Oil Palm (Mature & Immature)-Sarawak
Area Under Oil Palm (Mature & Immature)-Malaysia
Principal Statistics of Oil Palm Estates (number of estates)
Principal Statistics of Oil Palm Estates (planted hectares)
Principal Statistics of Oil Palm Estates (harvested hectares)
Principal Statistics of Oil Palm Estates (production of fresh fruit bunches)
Principal Statistics of Oil Palm Estates (yield per hectare)
Principal Statistics of Oil Palm Estates (local delivered average price)
Principal Statistics of Oil Palm Estates (total number of worker employed)
Total Planted Hectares of Oil Palm (Total Area)
Total Planted Hectares of Oil Palm (Estates)
Total Planted Hectares of Oil Palm (Smallholdings)
Annual Average Prices of Oil Palm Products (CPO-local delivered)
Annual Average Prices of Oil Palm Products (PK-Ex-Mill)
Annual Average Prices of Oil Palm Products (FFB-1% Extraction Rate)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (P.Malaysia)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Sabah)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Sarawak)
Fresh Fruit Bunches (FFB) Yield Tonnes/Hectare (Malaysia)

Source: Author, 2013

5.6 Discussion on the Findings: Palm Oil Variable Analysis

In this chapter, all the possible variables for oil palm plantations in Malaysia are gathered for analysis and measurement, and to assess their importance for the sustainability of the palm oil industry. The main findings from this chapter are:

a. Data Management and Transparency: Even though the oil palm industry is the largest agricultural sector in Malaysia and has been a highly institutionalized, for sustainable development, the availability of data for research and development is the greatest hurdle faced. The transparency and availability of information is one of the requirements for palm oil sustainability, without which improvement and development are greatly hindered.

b. Detailed information for the oil palm industry is available in published form only from 2002 to 2011 and can be obtained from Malaysian Palm Oil Board publications. The spread of the information is mainly on the cost and other values for palm oil production in Peninsular Malaysia, Sabah and Sarawak. However, the information published cannot be used for economic analysis, as the data is not consistently gathered and observable trends are also limited due to this problem.

c. Sustainability Variables and Measurements: These are based on the RSPO Principles, ISPO Principles and ISCC procedures, and the governing values for important variables for sustainability in Malaysia. Though the selection of variables for sustainability is extensive, many of the important variables did not have sufficient data for statistical testing. Also, some variables are new ideas and concepts of measurements, for which the industry does not have extensive records.

d. Environmental Variable: The term environmental variables refer to factual information about greenhouse gas emission, water usage, rainfall and pollution

connected to the oil palm plantations. On many occasions, the data that was needed was not available and on rare occasions, the sampling had to be done by this research team. Unlike economic data, environmental information does not vary from month to month very much, and records are normally in yearly form. Due to this, the data also does not conform to many economics tests that are commonly used. Furthermore, the environmental or plantation variables are highly correlated or "redundant" in relation to one another and their exchange capacity are very tightly correlated.

e. Macro and Micro Economic Variables: This study on the oil palm plantation industry provides the initial charted analysis which paves the way for the next stage of research, based on the prioritization of important variables for the sustainable production of palm oil using micro-level variables. This will substantiate the validity or significance of the variables to each other in the regression and correlation test. Macroeconomic indicators such as GDP, unemployment rates, and price indices were not considered.

   One of the goals of the microeconomics exercise was to analyse the significance of various variables to the palm oil price and total planted area in Malaysia, thus limiting the market mechanisms to the establishment of important variables among palm oil development activities, services and allocation of resources.

f. Production Trend: Unlike the Malaysian electronics industry, the palm oil sector has flourished from the federal government's New Economic Policy (NEP), (1971-1990) and the 4^{th} and 5^{th} Malaysia Plan, spanning the 1981- 1985 and 1986-1990 periods.

In all respects, it is observed that palm oil production has plateaued in the last few years as the national development policy has moved to other focus areas for local development. Indonesia has taken the place of Malaysia since 2010 as the number one producers of palm oil in the world. Introduction of new technology, mechanization, new clones introduced into the plantations have not increased Malaysia's productivity, even with the new advancement in oil palm breeding technology which has shown that a palm oil yield of 7.7 tonnes per hectare per year is possible (Crop Science, 2012).