The Economic and Environmental Analysis of Palm Oil Expansion in Indonesia: Export Demand Approach and EIRSAM Model

by

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主　論　文　の　要　旨

論文題目	(Title) The Economic and Environmental Analysis of Palm Oil Expansion in Indonesia: Export Demand Approach and EIRSAM Model
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論　文　内　容　の　要　旨

In recent years, the global demand for palm oil increases every year. The economic growth of India and China contributed a lot to the increase in global demand of palm oil. The usage of palm oil for the bio-fuel industry has also strengthened demand for palm oil in the world market. Since 2009, Indonesia is the largest palm oil producer and exporter in the world market. Indonesian production of palm oil has increased significantly every year; as of January 2012 Indonesia produced 51 thousand metric tons. And about 75% of palm oil production in Indonesia is exported to the world market. In January 2012, Indonesia has a share about 50% of the total world palm oil export market. In 2011, the Indonesian Government through the National Planning Agency announced the Master Plan for Accelerating and Achieving Economic Development. Palm oil is considered as one of the targeted sectors. This is because economic benefits from palm oil sector in Indonesia could increase Gross Domestic Product, provide job opportunity and improve local economies such as Sumatera region. The palm oil industry in Indonesia can generate about 6 million of employment and reduce poverty in rural areas. Furthermore, the palm oil industry in Indonesia can also secure income, health care and education for poor people. The Indonesian government targeted to increase palm oil plantation to about 9 million ha in 2020. Many international and domestic non-governmental organizations and research institutions concerned about the environmental issues of palm oil expansion in Indonesia such as deforestation, degradation, and carbon dioxide emission. Therefore, in September 2011, the Indonesian President announced the Presidential Regulation about the National Action Plan for Greenhouse Gas Emissions Reduction. The Indonesian government targeted to reduce about 75 million tons of carbon dioxide emission of palm oil in Indonesia. In other words, the Indonesian government tries to balance between economic benefit and environmental impact of palm oil expansion in Indonesia. The objectives of this dissertation are divided into four parts. First is to examine the

determinants of Indonesian palm oil export from January 1996 to July 2010 using export demand approach. Second is to quantify land use change and carbon emission of land use change and forestry focusing on Jambi province and East Kalimantan province from 2000-2005, which are two representatives of Indonesian palm oil expansion. Third is to analyze the impact of policies of supporting palm oil expansion and reducing carbon dioxide emissions of palm oil sector in Indonesia using the 2005 Indonesian environmentally-extended inter-regional social accounting matrix model. Fourth is to provide policy makers with the results of export demand approach and accounting multiplier analysis to formulate an appropriate policy as a win-win solution on issues of economic benefit and environmental impact of palm oil expansion in Indonesia.

To meet the above mentioned objectives, this study intends to answer the following questions. First, what factors determine foreign consumers in the world market to demand for Indonesian palm oil from January 1996 to July 2010? Second, how are the land use and carbon stock change caused by land use change and forestry in Jambi and East Kalimantan provinces between 2000 and 2005 as related to palm oil expansion? Third, what are the impact of policies to support palm oil expansion in Indonesia on the whole economic structure in Jambi and East Kalimantan provinces. Fourth, what are the impacts of deforestation and degradation (REDD) incentive and carbon tax on the whole economic structure and environmental account or carbon dioxide emission reduction in Indonesia? To answer these research questions, this study utilizes export demand approach and environmentally-extended inter-regional social accounting matrix model.

As presented in Chapter 2, the world demand of palm oil is increasing significantly every year. In November 2011, Palm oil has the highest share of total world demand of vegetable oils. Economic growth of India and China contributed to increasing demand of palm oil and the renewable energy issues. Since 2009, Indonesia has been the largest palm oil producer and exporter in the world market. Chapter 3 presents the historical development of palm oil plantation in Indonesia and policies implemented by the Indonesian government to support palm oil expansion and to reduce environmental impact of palm oil in Indonesia. The important findings of Chapter 3 concluded that the Indonesian government put a lot of efforts to support palm oil expansion as well as to support the reduction of carbon emission of palm oil.

Chapter 4 presents findings of export demand approach to examine determinants of Indonesian palm oil export to the world market using monthly data from January 1996 to July 2010. The major findings of chapter 4 are in following. First, Indonesian palm oil export has in-elastic price elasticity and income elasticity. Second, the long-run price and income elasticity are smaller than that in the short-run. Third, there is no substitution effect found for the world price of soybean oil. In-elastic price elasticity and income elasticity of Indonesian palm oil export both in the short-run and in the long-run indicate three impontant factors. First is that the availability of substitutes to Indonesian palm oil is small. Second is that the share of the budget for

palm oil on the total expenditure of consumer in importing countries is small. Third is that foreign consumers consider palm oil as a non-luxurious good and fourth is that there are time and transaction cost which must be borne by consumer to switch from Indonesian palm oil export to others. Population, consumer's taste and preference are another factors which possibly influence Indonesian palm oil export. However, these are not captured in our econometric model. Large market share of Indonesian palm oil export to the total world palm oil export also supports the econometric result. It indicates Indonesia has a strong position in the world market of palm oil sector. It causes the importing countries face less opportunity to change to other products when there is a price change in Indonesian palm oil export. Marketing strategies such as differianting or value added product and government policies are two important strategies which should be implemented by the Indonesian government for palm oil export.

Chapter 5 presents socio-economic and environmental indicators for Jambi province and East Kalimantan province. Study sites selected in this study are Jambi province which represents for Sumatera region and East Kalimantan province which represents for Kalimantan region. Jambi province was selected because palm oil plantation is the second largest estate crops in Jambi province. East Kalimantan province is the largest area in Kalimantan region. The main characteristics of socio-economic indicators for Jambi province and East Kalimantan province that most people in these two provinces are working for palm oil and rubber. Land use change activity data presents the decrease in undisturbed forested area due to conversion to palm oil and rubber plantation. The conversion of undisturbed forested area or others to rubber and palm oil plantation caused a decrease of carbon stock called carbon dioxide emission. This study uses method of the Intergovernmental Panel on Climate Change which is stock-difference approach to calculate carbon dioxide emission. It is found that palm oil has a large share of total carbon dioxide emission in Jambi and East Kalimantan provinces. Findings of Chapter 5 prove that palm oil expansion in Jambi and East Kalimantan provinces caused large carbon dioxide emission due to land use change activity between 2000 and 2005.

Chapter 6 presents the findings of the second analysis which is examining the impacts of policies of the Indonesian government on supporting palm oil expansion as well as policies to reduce carbon dioxide emission from palm oil expansion using the 2005 Indonesian environmentally-extended inter-regional social accounting matrix. This study integrates carbon dioxide emission data of Jambi and East Kalimantan provinces into the 2005 Indonesian inter-regional social accounting matrix. Since carbon dioxide emission data are available at the province level, and the 2005 Indonesian inter-regional social accounting matrix are available at the regional level, this study utilized production ratio to calculate carbon dioxide emission for Sumatera region and Kalimantan region. Five simulation scenarios used in this study. First, total palm oil production in the regions of Sumatera, Kalimantan, and Papua will increase by 1 million Rupiah in each region. Second, total investment in palm oil sector in Sumatera, Kalimantan and

the Eastern part of Indonesia will increase by 1 million Rupiah. Third, the Indonesian government will use financial assistance of reduced emission of deforestation and degradation (REDD) from the Norwegian Government as incentives for palm oil companies in Sumatera, Kalimantan, and the Eastern part of Indonesia by 1 million Rupiah for each region. Fourth, the Indonesian government will use financial reduced emission of deforestation and degradation (REDD) incentive as subsidy. Fifth, the Indonesian government will implement carbon tax to companies. This is assumed to be increase in indirect tax revenue for the Indonesian government by 100 billion Rupiah. The accounting multiplier analysis using the 2005 Indonesian environmentally-extended inter-regional social accounting matrix using five simulation scenarios mentioned above found that palm oil expansion in Indonesia brings positive impacts on gross domestic product, labor, backward and forward production sector, and income within the region as well as to other regions except in Kalimantan region. However, it also causes larger environmental impact or produces carbon dioxide emission. Reduced emission from deforestation and degradation incentives policy is found giving more economic impacts and reducing carbon emission of palm oil.

Findings presented in all chapters shown the importance of palm oil expansion for the Indonesian economy as well as the benefits of incentives of reduced emission from deforestation and degradation to reduce environmental impact of palm oil expansion in Indonesia. The policy recommendation of this dissertation can be drawn as follows. First, the Indonesian government should put more efforts on increasing value added for Indonesian palm oil export as well as on improving or upgrading quality standard of palm oil related products and providing special services for foreign consumers to be loyal for Indonesian palm oil export. Second, domestic policies which support palm oil expansion in Indonesia such as providing incentives and lower interest rate for companies and farmers, good infrastructure, and incentives for processing industries related to palm oil sector as well as related to income distribution to less developed regions. Third, the Indonesian government should find an appropriate policy to strongly support the implementation of reduce emission from deforestation and degradation (REDD) projects and incentives in Indonesia such as to educate local people in less developed regions to be aware about sustainable palm oil production, to improve the technology capacity for companies in Kalimantan region and in the Eastern part of Indonesia to be able to produce more environmentally friendly palm oil production, and to encourage private investors to pay more attention for providing social services for local people who are living on palm oil plantation area.

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Acronyms

2SLS	Two-Stage Least Squares
3SLS	Three-Stage Least Squares
ADF	Augmented Dickey-Fuller
ADL	Auto-regressive Distributed Log
AFTA	ASEAN Free Trade Area
AIDS	Almost Ideal Demand System
AusAID	Australian Agency for International Development
BAPPENAS	Badan Perencanaan dan Pembangunan Nasional (National Development Planning Agency)
BAU	Business As Usual
BPS	Badan Pusat Statistik (Bureau of Central Statistics)
BULOG	Badan Urusan Logistik (Bureau of Logistics)
CDM	Clean Development Mechanism
CGE	Computable General Equilibrium
CIFOR	Center for International Forestry Research
CMSA	Constant Market Share Analysis
COP13	Conference of the Parties 13
COP15	Conference of the Parties 15
CPO	Crude Palm Oil
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DNS	Debt for Nature Swaps
ECM	Error Correction Model
EIRSAM	Environmentally-extended Inter-Regional Social Accounting Matrix
EPPO	Export Price of Palm Oil
ESAM	Environmentally-extended Social Accounting Matrix
EU	European Union
FAS	Foreign Agricultural Service of USDA
FFB	Fresh Fruit Bunches
FOB	Free on Board
GDP	Gross Domestic Product

GHG	Greenhouse Gas Emission
HPE	Harga Patokan Ekspor (Export Price Standard)
ICCTF	Indonesian Climate Change Trust Fund
ICEF	Indonesian Carbon Efficient Farming
ICRAF	International Centre for Research in Agroforestry
IDE JETRO	Institute of Developing Economies Japan External Trade Organization
IDR	Indonesian Rupiah
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPOC	Indonesian Palm Oil Commission
IRSAM	Inter-Regional Social Accounting Matrix
KKPA	Koperasi Kredit Primer Anggota (Prime Cooperative Credit for Member)
LNG	Liquified Natural Gas
LUCF	Land Use Change and Forestry
MoF	Ministry of Finance
MPOB	Malaysian Palm Oil Board
NAMEA	National Accounting Matrix including Environmental Accounts
NGOs	Non-Governmental Organizations
NNP	Net National Product
NRP	Net Resource Product
ODA	Official Development Assistance
OLS	Ordinary Least Squares
PDRB	Produk Domestik Regional Bruto (Gross Domestic Product)
PES	Payment for Environmental Services
PFC	Perfluorocompound
PIR	Perkebunan Inti Rakyat (Nucleus Plasma Scheme)
PKM	Palm Kernel Meal
PKO	Palm Kernel Oil
PTP	Perseroan Terbatas Perkebunan (Estate Crops Limited Liability Company)
R&D	Research and Development
RaCSA	Rapid Carbon Stock Appraisal

RAN-GRK	Rencana Aksi Nasional Penurunan Emisi Gas Rumah Kaca (The National Action Plan for Greenhouse Gas Emissions Reduction)
RBD	Refined, Bleached and Deodorized
RBDPO	Refined, Bleached and Deodorized Palm Oil
RE	Resource Endowment
REDD	Reduced Emission from Deforestation and Degradation
RGDP	Real Gross Domestic Product
ROW	The Rest of the World
RSPO	Roundtable on Sustainable Palm Oil
SAKERNAS	Survei Angkatan Kerja Nasional (National Labor Force Survey)
SAM	Social Accounting Matrix
SESAME	System of Economic and Social Accounting Matrices Extensions
SIM	Simulation Scenario
SNC	Second National Communication
SUSENAS	Survei Sosial Ekonomi Nasional (National Socio-Economic Survey)
UNFCCC	United Nations Framework Conventional on Climate Change
USA	United States of America
USD	United States Dollar
USDA	United States Departement of Agriculture
USSR	Union of Soviet Socialist Republics
WPSO	World Price of Soybean Oil
WWF	World Wildlife Fund

Chapter I

Introduction

1.1 Problem Statement

Palm oil has become an important strategic commodity, both in the world market and in Indonesia market. Basiron (2001) and PT Data Consult Indonesia (2009) found that the palm oil industry has the greatest potential to be developed in future among other vegetable oils in the world market. In recent years, the global demand for palm oil increases every year. Two main reasons contributing to an increase of global demand for palm oil are an increase of the economic growth of India and China and the usage of palm oil for bio-fuel as an alternative renewable energy. From 2005 to 2008, more palm oil was produced globally than any other vegetable oil. As of January 2012, the production was 51 thousand metric tons. It also has the biggest consumption level, which was 50 thousand metric tons (United States Department of Agriculture, January 2012). Many researchers believe that this industry will create more demand in the future.

From year 2009, Indonesia is the largest producer and exporter of palm oil in the world. In 2009, total area of land for palm oil in Indonesia is about 7.3 million ha. Indonesian production of palm oil has increased significantly every year; as of January 2012, Indonesia produced 25 thousand metric tons. And about 75% of palm oil production in Indonesia is exported to the world market (Rifin, 2010). Based on data of USDA (January 2012), Indonesia has a share of about 50% of the total world palm oil export market. Therefore, since the second phase of palm oil expansion in Indonesia, palm oil sector has large contributions to the Indonesian economy which are mainly on GDP, rural development, and local economies. In 2009, palm oil sector has a share of nearly 1.7% of total GDP of Indonesia. Goenadi (2008)

stated that palm oil sector in Indonesia generates approximately 6 million job opportunities for poor people. Palm oil sector also contributes to local economies such as in Jambi province and East Kalimantan province. In 2010, the contributions of palm oil industry to crops production of Jambi province and East Kalimantan province are 37% and 75% respectively. Most of palm oil plantations in Indonesia are located in Sumatera and Kalimantan region. Palm oil plantation in Sumatera Region is accounted about 80% of total palm oil plantation in Indonesia. Indonesian Palm Oil Commission (2008) also states that more than 41% of palm oil plantation is owned by smallholders, about 49% is owned by private plantation and 10% by government. Therefore, the increasing global demand of palm oil and the great contributions of palm oil sector to the Indonesian economy made palm oil one of important sectors for accelerating and expanding economic development in Indonesia. As in 2009, the Indonesian government through Ministry of Agriculture announced the national plan to expand palm oil plantation in Indonesia. Palm oil expansion in Indonesia by 2025 is about 9 million ha. This huge expansion is expected to bring more economic benefits to Indonesian economy.

However, palm oil expansion in Indonesia also gets critics from both international and domestic NGOs for environmental impacts caused by palm oil expansion. In 2009, The European Union restricted palm oil import from Indonesia used as an alternative bio-fuel due to the deforestation and degradation issues although Indonesian palm oil already met the RSPO standard. Casson et al (2007) mentioned that about 70% of total palm oil plantation in Indonesia came from forested area. Other study conducted by Koh and Willcove (2008) also stated that over 50% of palm oil expansion in Indonesia for the period between 1990 and 2005 are come from forest area. The deforestation impact of palm oil expansion also creates negative impacts which are illegal logging, lost of biodivesity and fires. In 1997/1998,

Indonesia and other neigbour countries in Southeast Asia region experienced huge fire in Kalimantan island. This created large economic and environmnetal loss. Moreover, a report written by Indonesian Ministry of Environment which is called SNC Report (2010) found that the source for the largest share of GHG emission in Indonesia is from land use change and forestry (LUCF). In 2009, the share of CO_2 emission from LUCF is about 47% of total emission in Indonesia. Another environmental issue of palm oil is the regulation issued by Indonesian Ministry of Agriculture in 2009 (Permentan No. 14/2009) about the allocation of peat land for palm oil expansion. This regulation was critical by some researchers because a land contains large carbon stock. The conversion of peat land to palm oil plantation will cause a decrease of carbon stock. This is called as carbon dioxide emission.

To overcome the environmental issues of palm oil expansion, a study conducted by Casson et al (2007) proposed some strategies to reduce carbon emission of Indonesian palm oil expansion which emphasizes on the usage of degraded land than peat land to palm oil plantation and an increase in the productivity of yield than expansion of land area. In May 2011, the Indonesian government and the Norwegian government signed the letter of Intent that Norwegian government will assist for projects to reduce carbon emission and two year suspension of all conversion plan of peat land to palm oil plantation. In September 2011, Indonesian President, Susilo Bambang Yudhoyono signed the Presidential Regulation No. 61 year 2011 about the National Plan to reduce GHG emission in Indonesia. In this Presidential Regulation, reduction of GHG emission caused by palm oil sector is one of main targeted sectors in Indonesia. Therefore, this study focuses on economic benefit and environmental cost which is aimed to achieve appropriate policy for the Indonesian government to deal with this challenge.

Therefore, the objectives of this study are:

1. To examine the determinants of Indonesian palm oil export from January 1996 to July 2010 to the world market using export demand approach,
2. To quantify land use change and carbon emission caused by land use change and foerstry focusing on Jambi and East Kalimantan provinces from year 2000 to 2005, as two representatives for the overall of Indonesian palm oil expansion,
3. To analyze the impact of the policies of supporting palm oil expansion and reducing carbon dioxide emission of palm oil sector in Indonesia on the whole economic structure using the 2005 Indonesian environmentally-extended inter-regional social accounting matrix,
4. To provide policy makers with the results of export demand approach and accounting multiplier analysis to formulate an appropriate policy as win-win solutions on issues of economic benefit and environmental impact of palm oil expansion in Indonesia.

Furthermore, to meet the above mentioned objectives, this study intends to answer the following questions:

1. What factors determine foreign consumers in the world market for Indonesian palm oil export from January 1996 to July 2010?
2. How is the change of land use and carbon stock caused by land use change and forestry in Jambi province and East Kalimantan province from year 2000 to 2005 as related to palm oil expansion?
3. What are the impacts of policies to support palm oil expansion in Indonesia on the whole economic structure focusing on Jambi and East Kalimantan province as representatives for the overall of palm oil in Indonesia?

4. What are the impacts of REDD incentive and carbon tax on the whole economic structure and environmental account (CO_2 emission) reduction in Indonesia?

1.2 Research Methodology

This research employs export demand approach and accounting multiplier analysis. The export demand approach is used to examine factors determining foreign consumers in the world market for Indonesian palm oil export (1st analysis). And the accounting multiplier analysis is used to analyze the impacts of policies to support palm oil expansion and reducing carbon emission of palm oil expansion in Indonesia using the 2005 Indonesian environmentally-extended inter-regional social accounting matrix (2nd analysis). Therefore, to support this study, the extensive literature reviews which are mainly for environmental impacts of palm oil expansion in Indonesia and the previous empirical research on environmentally-extended social accounting matrix model are conducted. The data used in this study are mainly from secondary data sources such as IDE JETRO database of Nagoya Office, International Financial Statistics, IMF Database, ICRAF, Southeast Regional Office data base for land cover map, land use, and carbon stock change (activity data) for Jambi and East Kalimantan provinces and the 2005 IRSAM data from collaborative projects between Bappenas, Ausaid, CSIRO and the World Bank. Others are supporting data which come from the Indonesian Bureau of Statistics, Indonesian Ministry of Environment, Ministry of Agriculture, and Indonesian Palm Oil Commission Board, USDA Report on Oil Seeds, the World Bank report, and others.

1.3 Significance of the Study

The significances of this study are:

1. Introduce the 2005 Indonesian environmentally-extended inter-regional social accounting

matrix,

2. Analyze the impacts of policies to support palm oil expansion and to reduce carbon dioxide emission of palm oil expansion in Indonesia,
3. Combine economic analysis and environmental analysis of palm oil expansion in Indonesia which is aimed to formulate more appropriate policy to deal with this challenge.

1.4 Scope of the Study

This study covers the environmental impact of palm oil on CO_2 emission caused by land use change and forestry which is called deforestation (or 1st D of REDD). It does not cover degradation, illegal logging, and the environmental impact of palm oil processing industries. This is because the largest percentage shares of the Indonesia's CO_2 emission is from land use change and forestry by having a share about 74% in 2000. Casson et al (2007) also stated that about 70% of palm oil expansion in Indonesia was forested area.

1.5 Organization of the Dissertation

The organization of this dissertation is in the following. Chapter two describes the trend of palm oil and other vegetable oils in the world market, the emerging market for bio-fuel, and how is position held by Indonesia among other palm oil producers in the world market. Chapter three presents the trends of Indonesian palm oil in terms of production, plantation area, and production chain, the economic contributions of Indonesian palm oil on the whole national economy, environmental impacts of palm oil, and the Indonesian government policies to support palm oil expansion and reduction of carbon emission. Chapter four presents the result of export demand analysis on factors determining Indonesian palm oil export to the world market from January 1996 to July 2010. Chapter five describes socio-economic and environmental indicators which include land cover map, land use change and

carbon stock change in Jambi province and East Kalimantan province as a background chapter for the second analysis of this study. Chapter six presents the literature reviews of previous studies on the environmentally-extended social accounting matrix and the results of accounting multiplier analysis of analyzing the impacts of policies to support palm oil expansion and reducing carbon emission of palm oil on the whole economic structure using the 2005 Indonesian EIRSAM model. Finally, chapter seven presents the conclusion and how results of two analyses can be used in formulation of appropriate policy to achieve targeted palm oil expansion as well as to reduce carbon emission from palm oil sector.

Chapter II

World Market of Palm Oil Sector

2.1 Trends in Global Production and Consumption of Vegetable Oils and Fats

2.1.1 World Production of Vegetable Oils and Fats

From 2002 to January 2012, FAS Report shows there is an increase of production of vegetable oils in the world market. Table 2.1 presents more details of world production of vegetable oils and fats. The decreasing supply of crude oil, growing demand for agricultural products, and demand for food use contribute to production growth of vegetable oils. From year 2002 to 2003, Soybean oil is the largest vegetable oils produced in the world. In 2002, Soybean oil production has a nearly 32% share of total world production of vegetable oils and fats. However, since 2004 to present, palm oil tooks over the position of soybean Palm Oil oil is the largest produced of vegetable oil in the world market. Some researchers pointed out that palm oil has a higher productivity rate compared to soybean oil. This strongly contibuted to an increase of the growth of palm oil production in the world market. As in January 2012, Palm oil production has accounted about 33% of total world production of vegetable oils and fats.

Table 2.1 World Production of Vegetable Oils and Fats, 2002-January 2012 (thousand metric tons)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Coconut Oil	3.16	3.29	3.44	3.54	3.26	3.53	3.53	3.62	3.68	3.68	3.68
Cottonseed Oil	3.51	3.84	4.72	4.55	4.76	5.21	4.77	4.63	5	5.35	5.35
Olive Oil	2.51	3	2.74	2.28	2.85	2.78	2.78	3.05	3.01	3.02	3.02
Palm Oil	27.71	29.59	33.88	35.96	38.97	41.08	43.99	45.86	47.93	50.57	50.57
Palm Kernel Oil	3.36	3.67	4.13	4.36	4.69	4.88	5.17	5.5	5.66	5.7	5.7
Peanut Oil	4.62	5.03	5.04	5.19	4.85	4.86	5.02	4.67	5.14	5.16	5.16
Rapeseed Oil	12.21	14.14	15.72	17.17	17.88	18.43	20.49	22.32	23.33	22.81	22.82
Soybean Oil	30.57	29.97	32.49	34.31	35.66	37.83	35.91	38.87	41.23	42.91	42.73
Sunflower Oil	8.12	9.13	9.06	10.42	10.79	10.1	11.99	12.1	12.19	13.17	13.82

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
World	95.77	101.66	111.22	117.78	123.71	128.7	133.65	140.62	147.17	152.37	152.85

Source: FAS Statistics, Oil Seeds, "World Market and Trade": World Major Vegetable Oils (Commodity View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.1.2 World Consumption of Vegetable and Fats Oil

As presented on table 2.2, world consumption of palm oil is the largest among the other vegetable oils and fats starting from 2004 to January 2012. The world consumption of palm oil has increased rapidly due to some factors, which are: (1) increased world population, (2) increased demand for biofuel, and (3) trend of substitution use of soybean oil to palm oil because of new research on the health benefit of the usage of palm oil. From year 2002 to 2003, soybean oil has the largest of vegetable oils and fats consumed in the world market. In 2003, Soybean oil has a share of about 30% of total world consumption of vegetable oils and fats. However, starting from year 2004 to January 2012, the share of soybean oil on the world consumption of vegetable oils and fats decreased every year. As in January 2012, Palm oil has the largest share of world consumption of vegetable oils and fats by having a share of about 33% of total world consumption of vegetable oils and fats.

Table 2.2 World Consumption of Vegetable Oils and Fats, 2002-January 2012 (thousand metric tons)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Coconut Oil	3.24	3.28	3.38	3.56	3.45	3.43	3.39	3.88	3.92	3.88	3.92
Cottonseed Oil	3.52	3.79	4.60	4.56	4.80	5.12	4.76	4.63	4.84	5.24	5.24
Olive Oil	2.60	2.65	2.70	2.53	2.71	2.88	2.95	2.99	3.01	3.03	3.03
Palm Oil	27.69	29.59	32.86	35.24	38.13	39.32	42.11	44.52	47.38	49.48	49.64
Palm Kernel Oil	3.36	3.63	3.80	4.12	4.29	4.55	4.91	4.92	4.95	5.07	5.12
Peanut Oil	4.74	4.96	5.04	5.22	4.88	4.78	4.89	4.83	5.13	5.18	5.18
Rapeseed Oil	12.23	14.45	15.67	16.91	17.78	18.24	20.13	22.42	23.31	22.87	22.88
Soybean Oil	30.27	29.92	31.74	33.42	35.70	37.74	35.99	38.25	41.00	42.97	42.83
Sunflower Oil	7.85	8.40	8.64	9.86	10.33	9.07	10.61	11.36	11.34	12.41	12.86
World	95.50	100.67	108.43	115.42	122.07	125.13	129.74	137.80	144.88	150.13	150.70

Source: FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Commodity View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accesed on January 17,2012.

2.1.3 World Export of Vegetable Oils and Fats

The following table presents the percentage shares of export of vegetable oils and fats in the world market from 2002 to January 2012. Palm oil has the largest share of the world export of vegetable oils and fats. The share of palm oil is increasing significantly every year. As in 2002, the share of palm oil export is about 55% of the total world export of vegetable oils and fats. In January 2012, the share of palm oil of the total world export of vegetable oils and fats is about 62% of total world export of vegetable oils and fats. Soybean oil is the second largest of vegetable oils and fats export in the world market. It has a share about 14% of the total world export of vegetable oils and fats in January 2012. The increasing demand of palm oil export on the total world export of vegetable oils and fats indicates the growing world demand of palm oil compare to other vegetable oils and fats.

Table 2.3 Percentage Shares of World Export of Vegetable Oils and Fats, 2002-January 2012 (%)

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Coconut Oil	4.83	4.39	4.61	4.43	3.73	3.58	2.64	3.74	2.85	2.82	2.79
Cottonseed Oil	0.39	0.36	0.28	0.22	0.27	0.30	0.27	0.17	0.25	0.24	0.24
Olive Oil	1.35	1.74	1.49	1.37	1.43	1.26	1.16	1.21	1.26	1.00	1.00
Palm Oil	55.39	56.43	58.19	57.25	57.84	59.88	62.10	61.37	60.99	62.04	61.81
Palm Kernel Oil	4.10	4.19	4.54	4.30	4.33	4.30	4.64	5.01	5.19	5.10	5.00
Peanut Oil	0.42	0.62	0.43	0.37	0.39	0.30	0.36	0.33	0.28	0.30	0.30
Rapeseed Oil	2.56	2.99	2.69	3.71	3.62	3.52	4.34	4.72	5.74	5.50	5.51
Soybean Oil	24.61	22.43	21.80	20.18	20.47	20.37	16.38	15.72	15.77	14.05	13.88
Sunflower Oil	6.35	6.84	5.98	8.17	7.93	6.50	8.12	7.73	7.67	8.95	9.45
World	100	100	100	100	100	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Commodity View), December 2006 and January 2012 http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.1.4 World Price of Vegetable Oils

The following table presents the trend of world price of vegetable oils from October 2000 to September 2011. The average price of palm oil from October 2000 to September 2011 is the cheapest price among other vegetable oils in the world market. Peanut and Canola have the most expensive price among other vegetable oils in the world market. The average price of soybean oil is the second cheapest after palm oil. This indicates that palm oil is the most preferred oils consumed among other vegetable oils because of the cheapest price of palm oil in the world market.

Table 2.4 World Price of Vegetable Oils, October 2000-September 2011 (USD/metric tons)

Year Begin Oct 1	Soybean US	Cottonseed US	Peanut Rotterdam	Palm Malaysian	Canola Rotterdam	Coconut Rotterdam	Corn US
2000/01	311	352	685	235	372	323	299
2001/02	363	396	659	329	451	388	422
2002/03	486	832	1139	421	588	449	621
2003/04	661	688	1178	481	670	630	625
2004/05	507	609	1102	392	660	636	614
2005/06	516	649	931	416	770	583	55
2006/07	684	787	1219	655	852	812	701
2007/08	1147	1622	2018	1058	1410	1306	1529
2008/09	709	820	1339	633	868	735	722
2009/10	793	888	1291	793	927	921	866
2010/11	1173	1202	1751	1154	1367	1772	1331
Average	668	804	1210	597	812	778	708

Source: FAS Statistics, "Oilseeds: Market and Trade": World Price of Vegetable Oils, January 2012. http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf. Accesed on January 17, 2012.

2.1.5 World Major Producer of Vegetable Oils and Fats

From 2002 to January 2012, the share of Indonesia's production of vegetable oils and fats to total world production is increasing every year. From year 2002 to 2004, Malaysia is the largest producer of vegetable oils and fats in the world. As in 2004, Malaysia has a share of about 15% of total world production of vegetable oils and fats. However, starting from year 2005 to January 2012, Indonesia has the largest share of producer of vegetable oils and fats in

the world. This is mainly because starting from 2000, The Indonesian government implemented domestic and trade policies to support palm oil expansion in Indonesia. As in January 2012, Indonesia has a share of about 19% of total world production of vegetable oils and fats. In January 2012, Malaysia has a share about 14% of total world production of vegetable oils and fats.

Table 2.5 World Major Producer of Vegetable Oils and Fats, 2002-January 2012 (thousand metric tons)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Indonesia	12.37	13.77	16.49	18.09	20.09	20.98	23.69	25.59	27.3	29.1	29.1
Malaysia	14.88	15.12	17.13	17.46	18.58	19.73	19.43	19.94	20.44	20.96	20.96
China	11.83	11.96	13.75	14.7	15.21	14.69	16.11	17.88	18.99	20.06	20.06
EU-27	10.95	11.23	11.76	11.69	13.21	14.49	15.48	16.71	16.42	16.27	16.25
United States	9.18	8.77	9.76	10.4	10.34	10.55	9.67	10.07	9.8	9.68	9.58
Argentina	5.74	5.92	6.78	7.66	8.09	8.49	7.37	7.72	8.74	8.93	8.93
Brazil	4.82	6.67	6.45	6.86	6.88	6.85	6.78	7.14	7.75	7.96	7.89
Other	25.99	28.21	29.1	30.93	31.32	32.92	35.14	35.57	37.72	39.4	40.08
Total	95.76	101.65	111.22	117.79	123.72	128.7	133.66	140.61	147.16	152.35	152.84

Source: FAS Statistics, “Oil Seeds: World Market and Trade”: World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accesed on January 17, 2012.

2.1.6 World Major Consumer of Vegetable Oils and Fats

As shown in the following table, The world consumption of vegetable oils an dfats is increasing significantly from year 2002 to January 2012. China is also the largest consumer of vegetable oils and fats in the world market. In January 2012, China has a share of about 19% of the total world consumption of vegetable oils and fats. India and The European Union (EU) are on the second and third of major consumers of vegetable oils and fats after China. In January 2012, Indian consumption of vegetable oils and fats has a share of about 16% of total world consumption of vegetable oils and fats in the world. The European Union has a share of about 11% of total world consumption of vegetable oils and fats. In recent years, India and China are two emerging economies who have high economic growth in the world. This means

that India and China face the increase of demand for food and energy. Therefore, China and India have good prospects of being major destinations for vegetable oils and fats export.

Table 2.6 World Major Consumer of Vegetable Oils and Fats, 2002-January 2011 (thousand metric tons)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
China	17.41	18.96	20.44	21.45	22.6	23.34	24.74	26.91	27.66	29.09	29.11
EU-27	14.98	15.6	17.22	19.13	21.18	22.31	23.29	24.45	24.44	24.66	24.71
India	10.67	11.03	11.81	12.1	12.72	12.99	14.51	15.29	16.26	17.1	17.1
Indonesia	4.59	4.82	5.05	5.36	5.87	5.51	5.86	6.62	8.27	8.24	8.92
Malaysia	3.33	3.55	4.01	4.75	5.11	4.99	5	5.05	4.81	5.34	5.02
Other	44.53	46.69	49.89	52.62	54.59	55.97	56.33	59.48	63.44	65.69	65.84
World	95.51	100.65	108.42	115.41	122.07	125.11	129.73	137.8	144.88	150.12	150.7

Source:FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.1.7 World Major Exporter of Oils and Fats

The following table shows the major exporter of vegetable oils and fats in the world from 2002 to January 2012. Indonesia has the largest share of export of vegetable oils and fats from 2002 to January 2012. The share of Indonesian export of vegetable oils and fats increases significantly. As in January 2012, the share of Indonesian export of vegetable oils and fats is about 32%. Malaysia is the second largest of exporter of vegetable oils and fats in the world by having a share of about 30% of total world export of vegetable oils and fats. The main reason is policies of the Indonesian government to support palm oil expansion.

Table 2.7 World Major Exporter of Vegetable Oils and Fats, 2002-January 2012 (thousand metric tons)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Indonesia	12.6	12.46	13.64	13.86	14.49	16.07	18.09	18.72	18.46	20.98	20.02
Malaysia	7.42	9.0	11.3	12.87	13.94	15.57	16.53	16.91	18.02	17.73	18.41
Argentina	4.57	5.15	5.98	6.8	7.13	7.05	5.64	5.1	5.61	5.84	5.82
Other	11.0	11.85	11.41	12.5	12.77	9.76	9.03	10.55	10.83	9.75	9.72
Total	35.59	38.46	42.33	46.03	48.33	53.95	56.02	58.06	60.25	62.77	62.72

Source: FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accesed on January 17, 2012.

2.1.8 World Major Importer of Vegetable Oils and Fats

Table 2.8 shows that the EU, China, and India are the major importer of vegetable oils and fats in the world market from 2002 to January 2012. Chinese import of vegetable oils and fats is the highest among other importers from 2002 to 2003. As in 2003, China has a share of about 19% of total world import of vegetable oils and fats. Hower, starting from year 2004 to January 2012, Chinese import of vegetable oils and fats decreased. The share of Chinese import of vegetable oils and fats is on the second rank. As in January 2012, China has a share of about It has a share of about 15% of total world imported vegetable oils and fats. The share of EU import of vegetable oils and fats is about 19% of total world import of vegetable oils and fats in January 2012. India has also large share of total world import of vegetable oils, as in January 2012, India has a share of about 15% of total world import of vegetable oils and fats. This indicates that the EU, China, and India are the main destination countries for vegetable oils and fats in the world.

Table 2.8 Percentage Shares of World Major Importer of Vegetable Oils and Fats, 2002-January 2012 (%)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
EU-27	15.08	15.31	16.44	18.51	19.38	17.97	17.20	16.05	15.06	16.09	16.16
China	16.16	19.05	16.32	15.94	16.68	17.43	18.17	16.23	14.67	15.49	15.51
India	15.65	11.82	14.41	10.88	12.49	11.76	16.34	16.35	15.00	15.21	15.13
Other	53.11	53.83	52.83	54.67	51.45	31.06	26.92	29.39	30.72	29.15	29.14
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012.
(http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf
and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accesed on January 17, 2012.

2.2 Palm Oil in General

2.2.1 World Demand and Supply of Palm Oil

In recent years, palm oil becomes the most favorite oil among other vegetable oils in the world market. From 2002 to January 2012, there are increases in demand and supply of

palm oil in the world. As presented in the following table, the highest annual growth rate is shown on ending stock and export of world palm oil, which are 7.5% and 7.1% respectively. This is not surprising due to an increase of palm oil export from Indonesia and Malaysias as well as an increase of palm oil import from India, China and the European Union. Production and consumption of world palm oil also show a large increase. The annual growth rate for production of world palm oil is about 6.3%. This shows the increasing of world production of palm oil to meet the growing of world demand for palm oil. The annual growth of world palm oil consumption is about 7%. It is higher than the annual growth of world production of palm oil. This indicates there will be increasing of palm oil production in the world market mainly are from Indonesia and Malaysia.

Table 2.9 World Demand and Supply of Palm Oil, 2002-January 2012 (thousand metric tons)

Year	Production	Consumption	Export	Import	Ending Stock
2002	27.71	27.69	19.72	19.73	2.62
2003	29.59	29.54	21.71	21.75	2.66
2004	33.88	32.86	24.63	24.33	3.37
2005	35.96	35.24	26.35	25.62	3.35
2006	38.97	38.13	27.95	27.49	3.73
2007	41.08	39.32	32.31	30.29	4.14
2008	44.00	42.11	34.80	33.66	4.89
2009	45.86	44.52	35.64	34.80	5.38
2010	47.93	47.38	36.75	35.90	5.09
2011	50.57	49.48	38.95	37.95	5.32
Jan-12	50.57	49.64	38.79	37.95	5.18
Annual Growth (%)	**6.26**	**6.05**	**7.10**	**6.83**	**7.47**

Source: Author's Calculation Based on FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.2.2 World Palm Oil Producers

The following table presents the trend of production of world major palm oil producer from 2002 to January 2012. From 2002 to 2005, Malaysia has the largest share of

total world palm oil production. As in 2005, Malaysia has a share of about 43% of total world palm oil production. However, starting from year 2005, Indonesia took over Malaysia's position. Indonesia has the largest share of the total world palm oil production. The share of Indonesian palm oil production increases significantly every year. As in January 2012, Indonesian has a share of about 50% of total world palm oil production. This is because the Indonesian government has ambitious target to expand palm oil plantation area to be 9 million ha by 2025.

Table 2.10 Percentage Shares of Major Palm Oil Producers in the World Market, 2002-January 2012 (%)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Indonesia	37.18	38.87	41.33	42.83	44.13	43.81	46.60	47.97	49.24	50.23	50.23
Malaysia	47.57	45.36	44.85	43.07	42.34	42.76	39.23	38.73	38.00	36.98	36.98
Thailand	2.31	2.84	2.07	2.50	2.57	2.56	3.50	2.93	2.69	2.87	2.87
Nigeria	2.78	2.64	2.33	2.22	2.08	1.90	1.81	1.68	1.62	1.75	1.75
Colombia	1.95	2.08	1.91	1.92	1.92	2.00	1.93	1.85	1.77	1.68	1.68
Other	8.21	8.22	7.51	7.46	6.96	6.98	6.93	6.83	6.68	6.49	6.49
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oilseeds: Market and Trade": Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.2.3 Palm Oil Exporter in the World Market

The following table presents the trend of palm oil export by major palm oil exporter in the world market from 2002 to December 2011. Indonesia, Malaysia and Papua New Guinea are the countries who have the large share of palm oil export in the world. From 2002 to 2007, Malaysia is the largest palm oil exporter in the world. As in 2007, Malaysian palm oil export has a share of about 45% of total world palm oil export. The share of Malaysian palm oil export decreased from year 2002 to 2007. This is because the land availability in Malaysia is limited. Starting from 2008, Indonesia is the largest palm oil exporter in the world market by having a share of about 46% of total world palm oil export. The share of

Indonesian palm oil export increases significantly from 2007 to December 2011. This is because the Indonesian government implements policies to support palm oil expansion in Indonesia. As in December 2011, the share of Indonesian palm oil export on the total world palm oil export is about 49% of the total world palm oil export. In addition, report from USDA in November 2011 shows that almost 80% of palm oil production in Indonesia is exported to the world market. It is believed that the quantity of palm oil export from Indonesia to the world market will continue to increase in significant numbers due to palm oil expansion in Indonesia.

Table 2.11 Percentage Shares of Major Palm Oil Exporter in the World Market, 2002-January 2012

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Indonesia	33	36	39	43	44	43	46	46	45	49	46
Malaysia	59	53	51	49	48	45	45	44	44	41	43
Papua New Guinea	2	2	1	1	1	1	1	1	1	1	1
Other	7	9	8	7	7	8	7	6	7	7	7
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oilseeds: Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.2.4 Palm Oil Consumers in the World Market

The following table presents the percentage shares of major palm oil consumers in the world market from 2002- January 2012. India, Indonesia, China, EU and Malaysia are the major palm oil consumers in the world market from 2002- January 2012. As in January 2012, The share of India, Indonesia and China are about 16%, 14%, and 12% of the total world palm oil consumption respectively. Among these countries, only Indonesia is able to meet domestic consumption by self- production. India, China, and the EU imported large amount of palm oil to meet domestic consumption. As the result, India, China and the EU are the major palm oil importing in the world.

Table 2.12 Percentage Shares of Major Palm Oil Consumers in the World Market, 2002-January 2012 (%)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
India	15.58	12.16	11.01	8.64	9.72	12.91	14.80	14.47	15.06	15.56	15.51
Indonesia	13.02	12.77	12.22	12.17	12.42	11.96	11.53	12.18	14.08	13.12	14.34
China	12.73	12.54	13.28	14.12	14.69	13.28	13.34	13.32	12.24	12.51	12.47
EU-27	10.49	11.17	11.74	11.29	11.75	12.00	12.40	11.70	10.87	10.47	10.43
Malaysia	7.49	7.55	8.18	9.29	9.47	8.06	7.67	7.61	7.21	8.41	7.48
Others	40.68	43.82	43.57	44.48	41.96	41.79	40.27	40.72	40.54	39.94	39.77
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oilseeds: Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.2.5 World Major Palm Oil Importer

The growing supply of palm oil in the world market is followed by significant growth of palm oil demand from some importing countries. India, china and EU Union are major palm oil importing countries. India and China have the highest economic growth in recent years. The high economic growth happened in India and China causes an increase in demand for food and energy for those countries. The lack of crude oil supply pushes some countries to move on renewable energy sources. Several researchers found that palm oil is suitable source for bio- fuel. As presented in the following table, from 2002 to January 2012, India, China and the EU have the largest share of total world palm oil import. As in January 2012, India, China and the EU have share about 19%, 17%, and 14% of total world palm oil import respectively. The largest share of palm oil import in India and China are mainly due to an increase of food and vegetable oils and fats in India and China. However, EU uses palm oil imported not only for food but also for renewable energy.

Table 2.13 Percentage Shares of Major Palm Oil Importers in the World Market, 2002-January 2012 (%)

Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
India	20.04	16.02	15.33	11.01	13.64	16.55	20.40	18.98	18.56	19.10	19.10
China	17.90	17.05	17.93	19.42	20.37	17.25	18.17	16.56	15.91	16.60	16.60
EU-27	15.54	15.50	16.39	16.00	16.74	16.39	16.35	15.62	13.93	13.97	13.97
Pakistan	6.94	5.96	6.37	6.83	6.37	6.46	5.81	5.87	5.85	5.80	5.80
Other	39.58	45.46	43.98	46.73	42.88	30.82	25.48	27.73	28.86	27.60	27.60

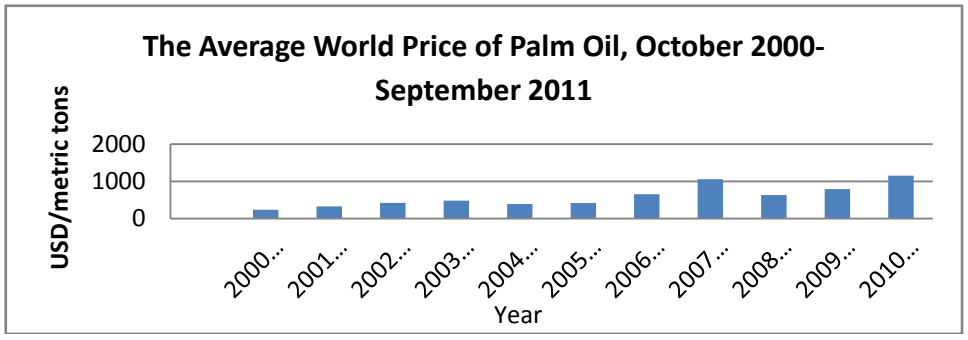
Country	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Jan-12
Total	100	100	100	100	100	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oilseeds: Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.2.6 World Price of Palm Oil

The following figure presents the trend of average world price of palm oil from 2000 to 2011. World price of palm oil fluctuated every year. In 2000, the world price of palm oil is at the lowest level, which is about 235 USD/ Metric Tons. In 2000, there is lack of supply of palm oil in the world market. One possible factor is due to what happened in Indonesia. In 2000, The Indonesian government faced difficult problems after the Asian Economic Crisis in 1997. Many palm oil plantation companies were bankrupt. Palm oil production in Indonesia decreased. Palm oil export from Indonesia to the world market decreased. The Indonesian government also implemented high rate of export tax. In 2007, the average world price of palm oil increased. This is happened due to lack of crude oil supply. It caused the increasing demand of palm oil. Ina ddition, the increasing of demand for palm oil in India, China and EU as food and alternative energy contributes to the increase demand for palm oil in the world market.

Figure 2.1 The Average of World Price of Palm Oil, October 2000-September 2011 (USD/metric tons)



Source: FAS Statistics, "Oilseeds: Market and Trade": World Price of Vegetable Oils, January 2012. http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

2.3 The Emerging Bio-fuel Market

The increase of global demand of palm oil in recent years is not only because of high demand of palm oil for food and non-food but also because of the demand to use as alternative fuels. The high price of crude oil contributes to increased demand for palm oil to be used as alternative bio-fuel. The types of biofuel are ethanol, bio-diesel, and other bio based liquid transport fuels. Ethanol is made from sugarcane, sugar beets, cereals, and grains and corn, cassava and wheat. Bio-diesel is made of oil crops such as soybean Palm Oil oil, rapreseed and jatropha; these are converted to liquid bio-fuels. Bio based liquid transport fuel is made from organic wastes such as cooking oil and animal fats. The potential use of palm oil as alternative for bio-diesel contributes to an increase of palm oil demand in the world market. This motivates the Indonesian government expand palm oil plantation in Indonesia to meet the world demand of palm oil.

Several countries promoted the use of bio-fuel actively in recent years through implemetantion of incentives and taxes. As presented in the following table, countries who are the member of the European Union mostly implemented some incentives and tax reliefs to encourage bio-fuel usage. Unfortunately, Indonesian palm oil export can not be exported to the European Union because of deforestation issue.

Table 2.14 Incentives and Targets of Bio-fuel in Consuming Countries

Country	Incentives for bio-diesel	Bio-fuel targets
European Union		Bio-fuels to be 10% of transport fuels by 2020
Germany	E0.09/litre tax relief on pure bio-diesel 4.4% mandatory blending	8% blend in 2015
France	E0.33/litre tax relief on bio-diesel	Bio-diesel quota increase to 3.2 million tons by 2010.
Spain	E0.29 litre tax relief on bio-diesel	
United Kingdom	E0.20 litre tax relief on bio-diesel 2.5% mandatory blending from April 2008	
US	US$1.00/gallon excise tax rebate on bio-diesel	350m liters of bio-fuel by 2010

Country	Incentives for bio-diesel	Bio-fuel targets
Australia	A$0.38 litre tax relief on bio-diesel	350m litres of bio-fuel by 2010
India	Plans to encourage Jatropha oil as feed stock for bio-diesel	Jatropha oil biodiesel: 5% blend by 2006-2007, 20% blend by 2012 and 60 million tons of bio-diesel by 2030
Indonesia	Government to invest US$22 billion over 5 years to promote bio-fuels from CPO, cassava, jatropha and sugar cane	15,000 ton of biofuel from jatropha by end 2007 and 1.5 million tons of bio-diesel by 2008
Malaysia	Proposed 5% mandatory blend of refined palm oil with fossil diesel	1 million tons of biodiesel in 2007 and 5% blend by 2007-2008
Japan	Planning stage	6 million of kl of bio-fuels will be meet through domestic production by 2030*
Philippines	Bio-fuels exempt from tax	5% blend by 2008 and 10% by 2010
Thailand	Ministry is considering adjusting the price of diesel (Bt100) to reflect prices of raw palm oil, ethanol and production costs	1.5bn liters of bio-diesel by end of 2011.

Source: Calle, et al (2009) and USDA (June, 2011)
Note: * revised based on USDA Report (June 2011)

2.4 The Importance of Indonesian Palm Oil among Other Vegetable Oils in the World Market

This section summarizes the importance of Indonesian palm oil in the world market. As presented in the following table, in 2011, palm oil has the largest percentage shares among other vegetable oils in the world market in terms of production, consumption, export, and import which are about 33%, 32%, 63%, and 62% respectively. Other vegetable oils which can be considered as competitors for palm oil are soybean oil and rapeseed oil. Soybean oil has second largest percentage shares in terms of production by having a share about 28%. Rapeseed oil has the percentage shares of production about 15% of total world major vegetable oils and fats. This emphasizes that in 2010, palm oil is the biggest oil which is consumed in the world market.

Table 2.15 Percentage Shares of Major Vegetable Oils in the World Market, 2011(%)

No	Vegetable Oils	Production	Consumption	Export	Import
1	Coconut Oil	2.42	2.58	2.82	3.11
2	Cottonseed Oil	3.51	3.49	0.24	0.08
3	Olive Oil	1.98	2.02	1.00	0.97
4	Palm Oil	33.19	32.96	62.04	63.14
5	Palm Kernel Oil	3.74	3.38	5.10	4.24

No	Vegetable Oils	Production	Consumption	Export	Import
6	Peanut Oil	3.39	3.45	0.30	0.27
7	Rapreseed Oil	14.97	15.23	5.50	5.74
8	Soybean Oil	28.16	28.62	14.05	14.18
9	Sunflower Oil	8.64	8.27	8.95	8.27
	Total World	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oil Seeds: World Market and Trade": World Major Vegetable Oils (Commodity View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

In addition, data FAS Statistics shows that in December 2011, Indonesia is the largest country among others in producing and exporting of vegetable oils in the world market. In 2011, Indonesia has percentage shares of vegetable oil production and export in the world market by 19% and 33% respectively. It means Indonesia is the largest producer and exporter of vegetable oils in the world market. But Indonesia consumes few amount of vegetable oil. The share of domestic consumption of vegetable oils in Indonesia is only 5%. Thus, most of Indonesian production of vegetable oils is exported to the world market. In terms of consumption of vegetable oils, EU, China and India are three largest consumers of vegetable oil in the world market. They have percentage shares of 16%, 15%, and 15% respectively.

Table 2.16 Percentage Shares of Each Major Countries of Vegetable Oils in the World Market, 2011 (%)

No	Countries	Production	Consumption	Export	Import
1	Indonesia	19.10	5.49	33.42	0.00
2	Malaysia	13.76	3.56	28.25	4.08
3	China	13.17	19.38	0.00	15.49
4	EU	10.68	16.43	0.00	16.09
5	India	0.00	11.39	0.00	15.21
6	Argentina	5.86	2.34	9.30	0.00
7	Others	37.43	41.41	29.03	49.13
	Total	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, Oilseeds: Market and Trade, World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

Specifically, Indonesia also has the largest percentage shares of production and export of palm oil in the world market. Indonesia palm oil production has a share of nearly 50% of total palm oil production and has share about 48% of total palm oil export in the world market. Furthermore, Indonesia and Malaysia together have percentage shares of palm oil production of 88% and about 90% of palm oil export in the world market. This strongly presents that Indonesia has an importance position of palm oil in the world market. In terms of palm oil import, India, China and EU are three major countries by having share of 19%, 17%, and 14% respectively.

Table 2.17 Percentage shares of Indonesian Palm Oil among other Countries in the World Market, 2011 (%)

No	Countries	Production	Consumption	Export	Import
1	Indonesia	50.23	13.12	48.60	0.00
2	Malaysia	36.98	8.41	40.80	4.51
3	China	0.00	12.51	0.00	16.60
4	EU	0.00	10.47	0.00	13.97
5	India	0.00	15.56	0.00	19.10
7	Thailand	2.87	0.00	0.00	0.00
8	Others	9.92	39.94	10.60	45.83
	Total	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, Oilseeds: Market and Trade, World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

As presented in the following table, India is one of the largest palm oil exporter and vegetable oil consumers. In 2010, Palm oil is main source for domestic consumption for cooking oil and food. The share of palm oil used for cooking oil and for food are about 44% for each. However, the main source for SME protein meals is from cottonseed oil. It has a share of nearly 30% of total SME protein meal consumption in India. Palm oil is not used for SME protein meal in India.

Table 2.18 Percentage Shares of India Vegetable Oils Composition in 2010 (%)

No	Vegetable Oils	Domestic Consumption for cooking oil	Food Use	SME Protein Meal
1	Cottonseed Oil	7.03	7.07	30.21
2	Palm Oil	43.99	44.18	0.00
3	Peanut Oil	8.60	8.87	18.35
4	Rapeseed Oil	14.70	15.33	18.28
5	Soybean Oil	16.03	16.71	29.92
6	Sunflower Oil	5.55	5.78	1.78
7	Other	4.10	2.06	1.46
	Total	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oilseeds: Market and Trade", World Major Vegetable Oils (Commodity View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.

In conclusion, FAS Statistics data in 2010 shows that palm oil is the largest produced and consumed oil among other vegetable oils in the world market. Indonesia has the biggest share of palm oil production and export in the world market. The share of Indonesian palm oil production and export to total world market are about 50% and 48% respectively. This highlighted the importance of Indonesian palm oil in the world market's position.

Chapter III

Indonesian Palm Oil Sector

Palm oil is one of important commodities for Indonesian economy. In recent years, palm oil plantation in Indonesia has expanded, as a result in 2010; Indonesia is the largest producer and exporter of palm oil in the world market. The Indonesian government planned to expand palm oil plantation to about 9 million ha in 2015. Two main reasons for large palm oil expansion in Indonesia are economic growth of India and China, and demand for bio-fuel energy alternative. Palm oil expansion in Indonesia brings economic benefits as well as environmental issues that will be discussed in this chapter.

3.1 Trend of Indonesian Palm Oil

This section presents the trend of Indonesian palm oil mainly on demand and supply side from 1993 to 2011. As shown in the following table, from 1993 to 2011, the demand and supply of Indonesian palm oil increased significantly. The production and export of Indonesian palm oil increase in large amount. The majority of palm oil production was exported than consumed in domestic market. The Indonesian government putted efforts to support palm oil expansion in Indonesia.

Table 3.1 Demand and Supply of Indonesian Palm oil Sector, 1993-2011 (thousand metric tons)

Year	Production	Import*	Export	Consumption	Ending Stock
1993	3.42	15	1.63	1.79	0.55
1994	4.00	124	1.63	1.99	0.38
1995	4.48	50	1.27	2.12	0.55
1996	4.90	108	1.67	2.53	0.88
1997	5.45	92	2.97	2.84	0.51
1998	5.93	18	1.48	2.83	0.70
1999	6.46	2	3.30	2.90	0.86
2000	7.00	4	4.10	2.93	0.75

Year	Production	Import*	Export	Consumption	Ending Stock
2001	8.40	1	4.90	2.86	0.98
2002	9.62	9	6.33	2.93	0.70
2003	10.60	4	6.39	3.17	1.73
2004	12.38	13	9.00	3.31	1.84
2005	13.92	22	10.48	3.56	1.75
2006	16.08	11	12.10	3.80	1.94
2007	18.00	0	14.00	4.70	0.48
2008	20.50	0	16.00	4.86	0.19
2009	22.00	0	16.57	5.42	0.24
2010	23.60	0	16.42	6.67	0.77
2011	25.40	0	18.93	6.49	0.73

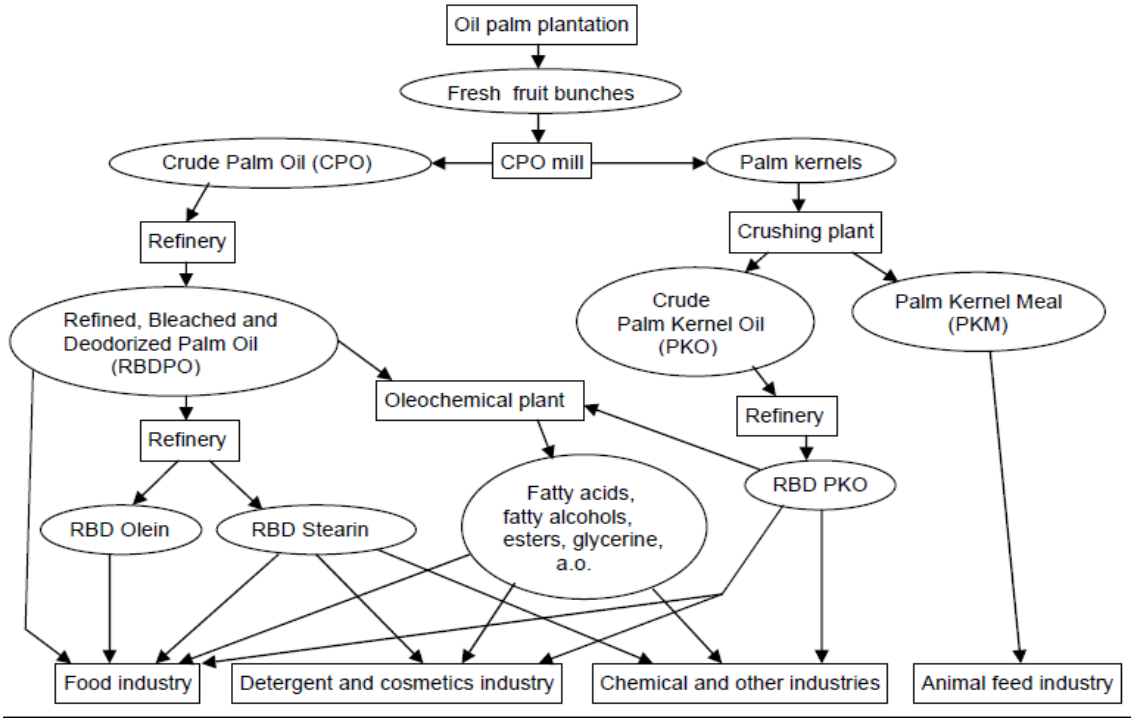
Source: FAS Statistics, "Oilseeds: Market and Trade": World Major Vegetable Oils (Country View), December 2006 and January 2012 (http://www.fas.usda.gov/oilseeds/circular/2006/06-12/oilseedsfull1206.pdf and http://www.fas.usda.gov/psdonline/circulars/oilseeds.pdf). Accessed on January 17, 2012.
Note: * means in tons

Indonesian palm oil has two main products which are CPO and PKO. The following figure presents the production chain of palm oil in Indonesia. Palm oil production can be consumed as crude palm oil (CPO) and Palm kernel oil (PKO). After the refinery process, CPO can be in form of RBD Olein and RBD Sterin and PKO can be in form of RBD PKO and Palm kernel meal. CPO is mainly used for food industry, detergent, and oleo- chemical plant. PKO is mainly used for chemical and animal feed industry. In detail, CPO and PKO are used as input in the following processing industries:

1. Food industry: There are two important reasons why food industry uses palm oil as raw material. The reasons are the competitive price of palm oil compared to other oils and fats and its nutritional advantages. Palm oil is used in food industry for margarine, frying fat, shortenings, mayonnaise, sauces, salad oil, potato chips, crisps, instant noodles, snacks, biscuit, bread, cakes, pastry, chocolate, confectionaries, ice cream, coffee whitener and many other food products.
2. Soap and detergent industry in forms of detergents, personal-care products and household-care products.

3. Cosmetics industry such as in beauty cream, lotions, shampoo, lipsticks, and so on. Palm oil is used in cosmetic industry because it is more easily absorbed by skin compared to other vegetable oils.
4. Leather and textile industry: such as for greasing and softening leather and as lubricant.
5. Metal industry: it is used for cold rolling of thin metal sheets and sharpening and polishing special steels.
6. Chemical industry: it is used for production of plasticizers, additives for plastics, rubber and textiles, production of paint and surface coating.
7. Compound feed industry which is especially for animal feed because it is an inexpensive source of vitamin.
8. Other industries such as for cultivating yeast, lubricant additives, component in ski wax and printing inks, and making candles.

Figure 3.1 Palm Oil Production Chain



Source: Gelder (2004) P. 3

In addition, the following table presents the number of palm oil processing industry for each province in Indonesia for 2008. Indonesia has about 608 of palm oil processing industries and the total capacity is about 0.03 mega ton per hour. The largest palm oil processing industry is located in Riau province, by having about 140 palm oil processing industries. This is mainly because mostly palm oil plantation area is located in Riau and other provinces in Sumatera region. However, the largest production capacity is found in West Kalimantan province by having production capacity about 0.06 mega ton per hour.

Table 3.2 Number of Palm Oil Processing Industry (CPO and PKO), 2008

No	Province	Number of Palm Oil Processing Industry	Capacity (thousand ton/hour)
1	NAD	25	0.98
2	North Sumatera	92	3.82
3	West Sumatera	26	1.65
4	Riau	140	6.66
5	Riau Island	1	0.04
6	Jambi	42	2.25
7	South Sumatera	58	3.56
8	Bangka Belitung	16	1.23
9	Bengkulu	19	0.99
10	Lampung	10	0.38
11	West Java	1	0.03
12	Banten	1	0.06
13	West Kalimantan	65	5.48
14	Central Kalimantan	43	3.10
15	South Kalimantan	15	0.77
16	East Kalimantan	29	1.55
17	Central Sulawesi	7	0.59
18	South Sulawesi	2	0.15
19	West Sulawesi	6	0.26
20	South East Sulawesi	3	0.26
21	Papua	3	0.14
22	Irian Jaya Barat	4	0.36
INDONESIA		608	34.28

Source: Directorate General of Plantation, “Indonesian Palm oil Statistics”, 2008

Domestic production for palm oil in Indonesia is mainly used as cooking oil. In 2008, Indonesia has about 94 cooking oil industries and about 15 thousand workers. The largest cooking oil industries are found in North Sumatera and West Kalimantan provinces. This is related to the largest of palm oil plantation area. However, West Java province has the largest workers by having about 2 thousand workers. This is because majority of people are living in Java island.

Table 3.3 Number of Cooking Oil Industry, 2008

No	Province	Number of Cooking Oil Industry	Number of Worker (thousand People)
1	NAD	2	0.4
2	North Sumatera	13	2.6
3	West Sumatera	3	0.2
4	Riau	8	1.0
5	Jambi	2	0.2
6	South Sumatera	5	0.7
7	Lampung	4	0.6
8	DKI Jakarta	8	1.0
9	West Java	8	2.1
10	Central Java	5	0.6
11	East Java	9	1.5
12	Banten	1	20*
13	West Kalimantan	11	1.6
14	East Kalimantan	2	0.4
15	North Sulawesi	5	1.0
16	Central Sulawesi	1	0.3
17	South Sulawesi	5	1.4
18	Gorontalo	1	0.2
19	Irian Jaya Barat	1	50*
INDONESIA		94	14.9

Source: Directorate of General Estate, "Indonesian Palm Oil Statistics", 2008
Note: * indicates the values are not in thousand People

The following table presents Indonesia has only six oleo-chemical processing industries and with capacity about one mega tons per hour in 2008. The oleo-chemical processing industries are located in North Sumatera, Riau, and DKI Jakarta provinces.

Table 3.4 Number of Oleo Chemical Processing Industry, 2008

No	Province	Number of Oleo chemical Processing Industry	Total Capacity (thousand tons/ hour)
1	North Sumatera	3	494.57
2	Riau Island	1	211.00
3	DKI Jakarta	2	245.50
	INDONESIA	6	951.07

Source: Indonesian Palm oil Committee, "Indonesian Palm Oil Statistics", 2008

In conclusion, There are still limited numbers of palm oil processing industries in Indonesia. Majority of palm oil processing industries are operated by large companies and located near palm oil plantation areas. The majority of domestic consumption for palm oil in Indonesia is used as cooking oil. Therefore, there is a need to improve the palm oil processing industries in Indonesia.

The Indonesian government supported palm oil expansion in Indonesia since many years ago. There was a shift of main raw material for cooking oil in Indonesia. In 1971, 93% of vegetable and cooking oil industry was from coconut oil. However, the production of coconut oil increased only for 1.2% during the period from 1979 to 1994. In the same period, the production of palm oil increased higher than the coconut oil, which was up to 76%. This caused the Indonesian government shifted palm oil as a main raw material for cooking oil. As result, palm oil plantation area increased since 1968. In detail, the historical development of Indonesian palm oil sector can be divided into six important decade as in the following:

1. 1848-1945 Dutch eras: In this period, the cultivation of palm oil in Indonesia began. In 1848, four seedlings of palm oil came from Africa to Indonesian Botanical Garden in Bogor, Java. Then, they were transferred to Deli, Sumatra. In 1870, state-owned-plantation companies started a palm oil plantation, under the control of Dutch Government. Later, in 1911, still under its control, there was the first large scale plantation of palm oil in Deli, Sumatra. As the demand of palm oil in the world market increased, the need of palm oil

stock raised. It was especially due to final processing industries which required more palm oil as a raw material for their production processes.

2. 1945-1968 Post colonial era: During this period, there were some significant changes in Indonesian political structure that also engendered changes in the Indonesian palm oil sector. In 1945, Indonesia declared its independence from the Dutch colonialization. In 1957, the Dutch palm oil plantation companies were nationalized; and under the control of The Indonesian government, they were changed into "New State Plantation Company (*Perusahaan Perkebunan Baru*)." In 1967, the plantation area of palm oil had been expanded to 106,000 ha: 65,573 ha of them belonged to State-owned-plantation companies.
3. 1968-1985: In this period, the area of palm oil plantation was still growing large. It is known as the first expansion era. The Indonesian government supported the investment and plantation of palm oil through some policies. In 1968, Suharto, the president of Indonesia, implemented direct investment by creating state-owned companies under the name of "*Perseroan Terbatas Perkebunan* (*PTPs*)". In this period, the government had planted on 176,408 ha area, mostly located in North Sumatra. Later, in 1979, the Indonesian government started inviting private investment in palm oil plantation with the help of the World Bank. The program was known as "PIR Scheme (Nucleus Plasma Scheme)". Under this scheme, PIR must purchase fresh fruit bunches (FFB) of palm oil from small owner's plantation companies, then sold them to domestic market in Indonesia. In the late 1980s, The Indonesian government started the investment in Kalimantan and Irian Jaya. Furthermore, from 1986 to 1994, the Indonesian government had promoted the "*PIR*-Transmigration Scheme and KKPA Scheme" to encourage the small owner's involvement in palm oil plantation. As a result, in 1999, they grew palm oil about 1.1 million in Riau, South Sumatera, North Sumatera, Jambi and West Kalimantan.

4. 1985-1998: In the second expansion phase, with a target to overtake Malaysia's position as the biggest palm oil producer in the world. During 1986-1996, the Indonesian government invited private sectors to invest in palm oil plantation in Indonesia through some programs, such as: granting access to credit at concessionary interest rates, providing the new crop and crushing facilities. Because of those benefits, Malaysia's plantation companies and other foreign investments invested in palm oil plantation in Indonesia.
5. 1998-2002 Investment Pause: This period is known as Investment Pause because the large investment during the second expansion period suffered a lot due to the Asian financial crisis in 1997. The condition was worsened because other problems also occurred during this period, such as: Indonesian currency's devaluation, financial problems of subsidiary companies, and the reluctance of foreign investors to invest in Indonesia. As a result, the Indonesian government failed to achieve the target of becoming the largest palm oil producer in the world.
6. 2002-present: Starting from 2002, the Indonesian government has been recovering from the crisis and trying to invest in palm oil plantation. The plantation companies have restructured their debts and the Indonesian currency is also improving. The production of palm oil in Indonesia has been recovering and increasing. The price of palm oil in the world market has been fluctuating so many times, resulting in the raise of export volume, more than the increase in the supply in the domestic market. As a result, domestic price of palm oil and its edible and non-edible oils also increased. In 2007, the world price of palm oil increased again to a higher price. As the result, the price of palm oil and its edible and non-edible oils increased. The Indonesian governments tried to control and stabilize the domestic price of palm oil and its edible and non edible oil through an increase of the

export tax. In 2008, the Indonesian government implemented the new type of export tax, changing from ad valorem tax to progressive export tax.

In detail, the following table presents the area of palm oil plantation by region from 2004 to 2009. It is shown that the area of palm oil plantation in Indonesia increased significantly over time. In 2009, total area of palm oil plantation in Indonesia is about 7 million ha. The largest area of palm oil plantation is located in Riau and North Sumatera province. Riau province has an area of palm oil plantation of about 2 million ha in 2009. North Sumatera province has about 1 million ha area of palm oil plantation. There are still large of land available in Kalimantan island and in Papua which are considered as targeted areas for palm oil expansion by the Indonesian government.

Table 3.5 Areas of Palm oil Plantation by Region, 2004-2009 (million ha)

Provinces	2004	2005	2006	2007	2008	2009**
Indonesia Total	5.28	5.45	6.55	6.77	7.01	7.32
Nangroe Aceh D.	0.25	0.25	0.31	0.27	0.20	0.29
North Sumatera	0.84	0.89	0.98	1.00	1.03	1.08
West Sumatera	0.28	0.28	0.32	0.30	0.31	0.32
Riau	1.34	1.28	1.55	1.60	1.63	1.68
Riau Islands	0.69	0.01	6,933*	6,678*	547*	547*
Jambi	0.37	0.40	0.57	0.45	0.46	0.48
South Sumatera	0.50	0.55	0.63	0.68	0.72	0.75
Bengkulu	0.13	0.15	0.17	0.17	0.16	0.18
Lampung	0.15	0.15	0.16	0.15	0.16	0.17
Bangka Belitung	0.20	0.13	0.13	0.17	0.17	0.18
West Java	0.08	0.01	0.09	0.01	0.01	0.01
Banten	0.01	0.01	0.01	0.02	0.02	0.02
West Kalimantan	0.36	0.38	0.49	0.45	0.48	0.50
Central Kalimantan	0.40	0.43	0.57	0.62	0.80	0.73
South Kalimantan	0.17	0.13	0.24	0.28	0.27	0.27
East Kalimantan	0.17	0.20	0.24	0.99	0.37	0.39

Provinces	2004	2005	2006	2007	2008	2009**
Central Sulawesi	0.05	0.05	0.05	0.05	0.05	0.05
South Sulawesi	0.00	0.02	0.02	0.02	0.02	0.02
Southeast Sulawesi	0	440*	2,966*	0.02	0.02	0.03
Papua	0.05	0.04	0.03	0.03	0.03	0.03
West Irian Jaya	0.01	0.02	0.03	0.03	0.03	0.03

Source: Indonesian Directorate General of Estate, "Indonesian Palm Oil Statistics", 2009
Note: * indicates the value is in ha, ** indicates the estimation.

Most areas of Indonesian palm oil plantation are located in Sumatera and Kalimantan islands. The following table presents the percentage shares of total areas of palm oil plantation by province in Sumatera and Kalimantan islands. The total area of palm oil plantation in Sumatera and Kalimantan islands has a share of 54% of total area of palm oil plantation in Indonesia for 2009. Sumatera island has a share of about 40% and Kalimantan island has a share of 14%. The largest area of palm oil plantation in Sumatera island is located in Riau province having a share of 12%. North Sumatera province has a share of 8% of total area of palm oil plantation in Indonesia. This is because the land availability in Riau province is still large compared to other provinces in Sumatera island. The largest area of palm oil plantation in Kalimantan province is located in Central Kalimantan province by having a share of about 5% of total area of palm oil plantation in Indonesia. Kalimantan island becomes one of targeted areas for palm oil expansion in Indonesia in recent years.

Table 3.6 Percentage Shares of Total Area of Palm Oil Plantation in Sumatera and Kalimantan Islands, 2009*

Province	Share (%)
Nangroe Aceh Darussalam	5%
North Sumatera	8%
West Sumatera	2%
Riau	12%
Riau Islands	2%
Jambi	3%
South Sumatera	5%
Bangka Belitung	1%

Province	Share (%)
Bengkulu	1%
Lampung	1%
Total Sumatera	**40%**
West Kalimantan	4%
Central Kalimantan	5%
South Kalimantan	2%
East Kalimantan	3%
Total Kalimantan	**14%**

Source: Directorate General of Estate, "Indonesian Palm Oil Statistics, 2008
Note : * estimation

Indonesia has comparative advantage in terms of land availability, labour, and low salary compare to other palm oil producing countries. Based on data of Hasibuan (2006), the largest share of land availability are found in Papua, East Kalimantan provinces. East Kalimantan, Central Kalimantan and Papua provinces have a share about 24%, 18%, and 14% respectively. The Indonesian government also announced that the current palm oil expansion in Indonesia will take a place in Papua and Kalimantan.

Table 3.7 Percentage shares of Land Availability of Each Provinces in Indonesia, 2006

Province	Percentage
Nanggroe Aceh Darussalam	1%
North Sumatera	1%
West Sumatera	1%
Riau	10%
Jambi	7%
South Sumatera	6%
Bangka Belitung	1%
Bengkulu	1%
Lampung	1%
Banten	1%
West Java	1%
West Kalimantan	6%
Central Kalimantan	14%
South Kalimantan	4%
East Kalimantan	18%
Central Sulawesi	1%
South Sulawesi	1%

Province	Percentage
Southeast Sulawesi	0%
Papua	24%

Source: Author's calculation based on Data of Hasibuan (2006)

The following table presents the share of palm oil production of Indonesia and Malaysia in total world palm oil production from August 2007 to December 2011. The share of palm oil production of Malaysia decreased from August 2007 to December 2011. In August 2007, Malaysia has a share of palm oil production of about 43%. However, in December 2011, Malaysia has a share of about 37% of total world palm oil production. Indonesia has the largest share of palm oil production in the world market. In August 2007, Indonesia has a share of about 44%, and in December 2011, the share becomes about 50% of total world palm oil production. It indicates that there is the palm oil expansion in Indonesia which is larger than in Malaysia. This is due to better land availability and labor conditions in Indonesia.

Table 3.8 Percentage shares of Palm Oil Production of Indonesia and Malaysia on Total World Palm Oil Production, August 2007 to December 2011 (%)

Countries	Aug-07	Sep-08	Oct-09	Nov-10	Nov-11	Dec-11
Indonesia	44	47	48	49	50	50
Malaysia	43	39	39	38	37	37
Thailand	3	4	3	3	3	3
Colombia	2	2	2	2	2	2
Nigeria	2	2	2	2	2	2
Other	6	6	6	6	6	6
Total	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, "Oilseeds: Market and Trade": World Major Vegetable Oils (Country View), December 2011. http://www.fas.usda.gov/oilseeds/circular/2011/Dec/oilseeds_full_12-11.pdf. Accessed on December 10, 2012.

Based on the data of FAS, starting from September 2008 to December 2011, Indonesia has the largest share of palm oil export among other palm oil exporting countries. In December 2011, Indonesia has a share of 49% of total palm oil export in the world. In August 2007, Malaysia has the largest share of about 45% of total world palm oil export.

However, starting from September 2008 to December 2011, Malaysia became the second largest palm oil exporting country. In December 2011, Malaysia has a share of 49% of total world palm oil export. Other palm oil countries such as Papua New Guinea, Benin and The United Arab Emirates have a small percentage shares of total world palm oil export.

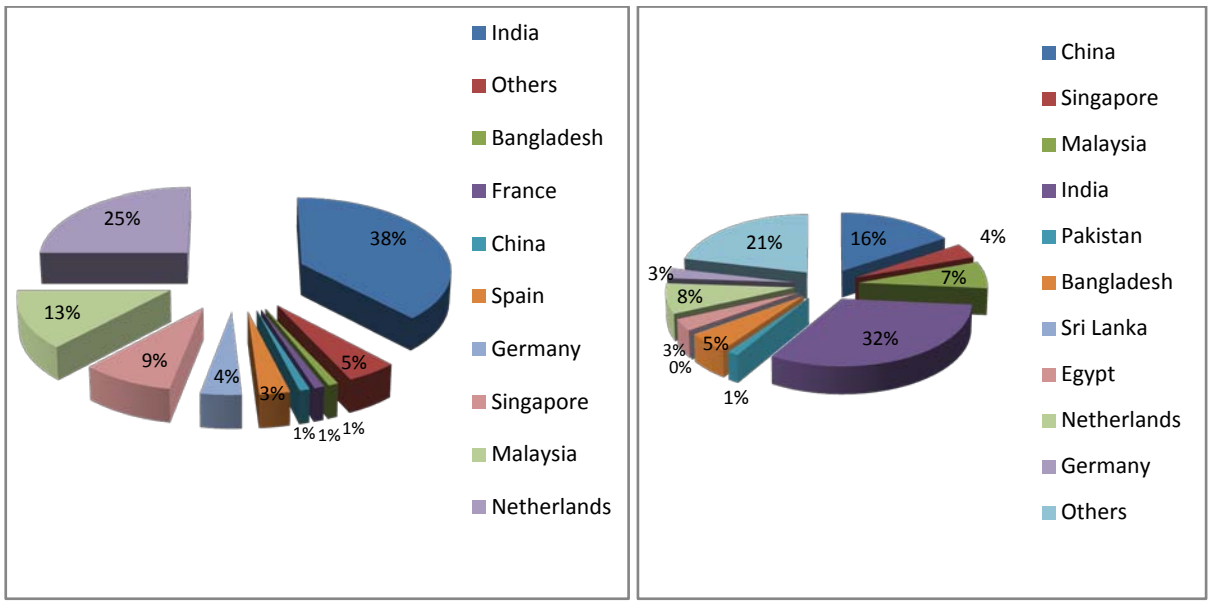
Table 3.9 Percentage Shares of Major Palm Oil Exporting Countries, August 2007 to December 2011 (%)

Countries	Aug-07	Sep-08	Oct-09	Nov-10	Nov-11	Dec-11
Indonesia	43	46	46	46	49	49
Malaysia	45	45	44	44	41	41
Papua New Guinea	1	1	1	1	1	1
Benin	1	1	1	1	1	1
United Arab Emirates	1	1	1	1	1	1
Other	9	6	7	7	7	7
Total	100	100	100	100	100	100

Source: Author's Calculation Based on FAS Statistics, Oilseeds: Market and Trade, World Major Vegetable Oils (Country View), December 2011. http://www.fas.usda.gov/oilseeds/circular/2011/Dec/oilseeds_full12-11.pdf. Accesed on December 10, 2011.

As presented in the following figures, the market destination of Indonesian palm oil export changed from 2002 to 2009. The major destinations of Indonesian palm oil export in 2002 were India, Netherland, and Bangladesh. The share of India, Netherland and Bangladesh on Indonesian palm oil export in 2002 were about 38%, 25%, and 13% respectively. China had only a small share of Indonesian palm oil export. However, in 2009, the major destinations for Indonesian palm oil export were India, China and Pakistan. The share of India, China, and Pakistan in Indonesian palm oil export in 2009 were about 32%, 16%, and 12%. China imported a larger share of Indonesian palm oil export in 2008 than in 2002. The share of Netherland in Indonesian palm oil export in 2009 decreased to about 8%. This is because of the EU's restrictions on Indonesian palm oil export due to deforestation and degradation issues. The share of India and China in total Indonesian palm oil export increased mainly because of economic growth of these countries.

Figure 3.2 Percentages of Exports of CPO by Country Destination, 2002&2009



Source: Directorate General of Estate Plantation, "Indonesian Palm oil Statistics", 2009

The following table presents the main Indonesian exporting companies for CPO and Its derivative in 2007. The largest CPO exporting company was Karya Prajona Nelayan or Wilmar Corporation which is having a share of about 34% of total CPO export of Indonesia in 2007. Musimas and Permata Hijau are two other largest CPO exporting companies that have a share of about 17% and 11% respectively. Other main CPO exporting companies are Asian Agri and Sinar Mas. These CPO exporting companies have a share of about 11% and 9% respectively. Other exporting companies for CPO and Its derivative are shown in the following table.

Table 3.10 Main Exporter of CPO and Its Derivative, 2007

No	Corporation	Percentage (%)
1	Karya Prajona Nelayan/Wilmar	34
2	Musimas	17
3	Permata Hijau Sawit	11
4	Asian Agri	11
5	Sinar Mas	9
6	Berlian Eka Sakti Tangguh	3
7	PT Perkebunan Nusantara	2
8	Duta Palma Nusantara	2

No	Corporation	Percentage (%)
9	Pasific	2
10	Salim Ivomas Pratama	1
12	Others	4

Source : Directorate General of Estate, IPOC Statistics, 2008

3.2 Economic Contribution of Palm Oil to The Indonesian Economy

Palm oil is one of strategic agricultural commodities for Indonesia. For the last decade, palm oil was the most significant agricultural export. Statistic from FAS (2010), the share of Indonesian palm oil production and export in total world palm oil is about 50% and 48% in 2010 respectively. Indonesia has expanded palm oil plantation since 2002, recovered from the Asian economic crisis in 1997. The strong increasing world demand of palm oil contributes to more increasing palm oil production in Indonesia. In 2009, Indonesia has become the largest producer and exporter of palm oil in the world market. The major palm oil plantation area in Indonesia is in Sumatera and Kalimantan Island. Sumatera has the largest contribution (about 80%) to palm oil production in Indonesia. Palm oil plantation in Sumatera island is located in North Sumatera, South Sumatera, West Sumatera, Jambi, and Riau. Currently, the location of palm oil expansion in Indonesia is located in Kalimantan island because of the large availability of land.

Specifically, the economic contribution of palm oil sector to Indonesian economy in three fold, which are on GDP, rural development, and smallholder. In terms of economic contribution of palm oil to the Indonesian GDP, Table 3.11 shows between 2000 and 2009 palm oil had a significant increase in share of agricultural sectors, non- oil and gas sector, total export value and GDP. The highest share of palm oil on agriculture sectors, non- oil and gas sector, total export value and GDP are found in 2007. Palm oil has a share of agricultural sectors, non- oil and gas sector, total export value and GDP in 2007 are about 19%, 12%, 11%,

and 2% respectively. It because starting from 2007, the Indonesian economy is growing and the world demand of palm oil is increasing.

Table 3.11 GDP Contribution of Indonesian Palm oil, 2000-2009

No	Sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Palm oil Export Value (in million US$)	1.09	1.08	2.09	2.46	3.44	3.76	4.82	7.87	12.38	10.37
2	Agriculture (in Million US$)	22,.60	24.20	31.50	36.12	35.43	37.05	48.03	57.54	65.39	91.30
3	Non Oil and Gas Export Value (in Million US$)	47.76	43.68	45.05	47.41	55.94	66.43	79.60	92.01	107.90	97.49
4	Total Export Value (in Million US$)	56.32	57.16	61.06	71.58	85.66	100.80	114.10	137.02	116.51	79.88
5	GDP (in Million US$)	158.30	203.75	237.88	247.13	282.23	370.20	419.46	452.18	495.14	597.18
6	Share in Agriculture (%)	4.81	4.47	6.64	6.80	9.71	10.14	10.03	13.68	18.92	11.36
7	Share in Non Oil and Gas (%)	2.28	2.47	4.65	5.18	6.15	5.65	-6.05	8.55	11.47	10.63
8	Share in Total Export Value (%)	1.93	1.89	3.43	3.43	4.02	3.73	4.22	5.74	10.62	12.98
9	Share in GDP (%)	0.69	0.53	0.88	0.99	1.22	1.01	1.15	1.74	2.07	1.74

Source: Bureau of Central Statistics, Statistical Year Book, 2010 and Asian Development Bank Key Indicator (various years)

The second contribution of palm oil is on the rural development in Indonesia. Palm oil expansion in Indonesia provides job opportunities for many poor people which are mostly located in rural areas. In some areas, palm oil is the dominant sector which contributes largely to GDP of local economies such as in Sumatera and Kalimantan regions. Moreover, palm oil industry is a labor intensive sector, so it contributes significant to employment in rural areas. As Goenadi (2008) stated that palm oil industry in Indonesia can generate employment over 6 million and reduce poverty of poor people in rural areas. Furthermore, Sheil et al (2009) mention of that palm oil industry in Indonesia can also provide secure income, health care and education for poor people.

The third contribution of palm oil is on the economies and smallholders in the regions of palm oil planted. In 2010, Palm oil industry contributes to state crops production of

Jambi province and East Kalimantan province are about 37% and 75% respectively. The Indonesian government implemented various supporting programs for rural people who engage in palm oil plantation. The well known program is called “plasma or nucleus“ which is the program to establish network and cooperation between smallholders and private estate companies of palm oil plantation. Zen et al (2006) find the program established by a Sumatran private company which gives cow to farmers who are working in palm oil plantation as an incentive. This program was successful as in 2003 the number of farmers who work in palm oil plantation increased.

3.3 Environmental Impacts of Indonesian Palm Oil Sector

In recent years, Indonesian palm oil expansion is criticized for environmental impacts such as causing deforestation and green house emission. The critics come firstly from the European Union that accused palm oil export from Indonesia, and these are supported by many International NGOs and domestic NGOs as well. This seems that there is a trade-off between palm oil expansion and environmental impacts caused by expansion. The environmental impacts of any economic activity can’t be avoided fully but it can be minimized by some policies to support environmental protection. In the case of Indonesian palm oil expansion, the net environmental impacts depend on where palm oil is planted. The main challenge is to strengthen the Indonesian government to guide private companies to plant palm oil on the appropriate land and process that can cause the less of environmental impact of palm oil.

Moreover, Lord and Clay (2007) classified the environmental impact of palm oil plantation into impacts on air quality, land, habitat conversion (biodiversity) and water. The detailed explanation for each type of impact is explained as follows:

(1) environmental impacts on air quality

Clay (2004), Rosenburg (1999), and Sargeant (2001) have concluded in their studies that palm oil plantations (along with rubber and pulp plantations) in Indonesia (Sumatera and Kalimantan) have a significant impact on air pollution in the Southeast area. In detail, Sargeant (2001) has found that haze and air pollution have directly affected palm oil production with the estimated of total cost of loss of palm oil plantation in Sumatera in 1997 about US$ 16.25 million. Ismail et al (2005) stated that many palm oil plantations in Indonesia still use slashing and burn method to clear new land although it is prohibited by the Indonesian government regulation.

Furthermore, the environmental impact of palm oil plantation on air quality can be categorized into new development of palm oil plantation impacts on air quality and existing plantation and processing impacts on air quality. Rosenburg (1999) estimated that 20 million people affected by new development of palm oil plantation in Sumatera in 1997 through burning land clearing and Kamal (2001) stated that it also caused economic loss for agriculture, health, and tourism, etc of US$ 9.3 billion. Khor (2005) found that in 2005, the haze from fires of land clearing for new development of palm oil plantation in Malaysia has reached the crisis point.

Although the Indonesian government issued a law on prohibition of using fire for land clearing, Casson et al (2007) stated that smallholders still use fire for land clearing because it is the cheapest source. Sheil et al (2009) argued that using fire for land clearing is not only limited to palm oil plantation but also for other land use mainly for the traditional land management practices in Indonesia. Recently, many researchers pointed out that Palm Oil plantation contributes to greenhouse gas emission mainly for Palm Oil planted in the forest and peat land. Page et al (2002) stated that tropical peat

lands is one of the world largest places which has high carbon stock. As cited in Hartemink (2005), Wosten (1997) stated that logging, draining and clearing peat land can release large amounts of carbon to the atmosphere. Moreover, Hirano et al (2007) partially drained peat land releases over 4 tons of carbon per hectare per year. Fargione et al (2008) estimated that the carbon released from well drained peat lands is about 55 tons of CO_2/ha per year.

Clay (2007) pointed out that the environmental impact of palm oil plantation on air quality also comes from existing plantation and palm oil processing through the usage of fire for land clearing and for phyto-sanitary control during replanting and the mill emission during palm oil processing and methane production from farm vehicle emission and burning.

(2) environmental impact of palm oil plantation on land

Palm oil plantation causes environmental impact on land, both on soil quality and quantity. Soil erosion is the most popular impact. The most soil erosion risk comes from new plantation and replanting process. The channel of Palm Oil plantation has an impact on the soil erosion through land clearing and road construction as stated by Sidle et al (2006). Furthermore, Glastra, et al (2002) has also found that palm oil plantation in Indonesia has caused deforestation through fires and burning practices of palm oil plantations. In 1997 and 1998, Indonesia has experienced the worst fires in the world. It was also along with El Nino-Southern Oscilation. As a result, the impact on human health, biodiversity, habitat and global warming happened (Simorangkir, 2007). Moreover, Murdiyarso and Adiningsih (2006) estimated that the total area burned is about 11.6 million hectares, and released about 0.73 million volume CO_2 into the atmosphere. In addition to this, Tacconi (2003) also estimated the economic cost of the fire accident

which was about US$ 2.3–3.5 thousand, and was about US$ 2.8 thousand for carbon emission. Other factor is the use of fertilizer which also contributed to the soil erosion cause by pal oil conversion (Hardtler and Fairhurts 2003).

Moreover, report written by the World Bank (2007) stated that the negative impacts of deforestation is causing the watershed degradation and drying land that increase risk of fire, erosion and soil degradation, biodiversity loss, resource limitation, and greenhouse gas emission. Koh and Wilcove (2008) found that more than 56% of Indonesian palm oil expansion for the period bewtween 1990 and 2005 came from natural forest converted to palm oil. Another study which was conducted by Casson et al (2007) stated that about 70% or 4.2 million ha of palm oil plantation area in Indonesia was forest area before. The increase of palm oil plantation in Indonesia not only caused deforestation as a main result but also illegal logging activities such as in Kalimantan and in Papua. WWF (2008) also reported that some of palm oil expansions are happened in the national parks such as in the Batang Karihun National Park, in West Kalimantan province.

In 2009, Indonesian Ministry of Agriculture issued the regulation about palm oil expansion on peat lands (PP 14/Permentan/PL.110/2/2009). This regulation caused critics from some NGOs who concern about the environmental impacts of palm oil. The expansion of palm oil on peat land can cause the decrease in benefits of peat land as the carbon sink and the source of fresh water through year. As a result, the negative impact will be flood, drainage, fire, and reduction of carbon stock. The main reasons of are due to the limitation of land available and deforestation issue. Indeed, the profit of palm oil plantation on peat land is larger but the cost to establish and maintain by company is also higher than the plantation cost on mineral soil. To limit the negative impact of palm oil

expansion on peat land, there will be needs for company to have strong management capacity, the hydrological scientist, and large capital for the long-term. Therefore, Casson et al (2007) suggested strategies to reduce carbon emission from land use of palm oil expansion in Indonesia which (1) revise the allocation permit to plant palm oil on specific areas, (2) reallocate the peat land and forest for carbon storage project, (3) develop accurate database of spatial data of degraded land in Indonesia which is potential to be planted by palm oil expansion, (4) optimize land by improving the quality of the yield, and (5) replant over mature palm oil with new palm oil plantation. These proposed strategies are expected to minimize the environmental impacts of palm oil expansion in Indonesia.

(3) environmental impact of Palm Oil on habitat conversion

This impact comes from the conversion of natural forests to Palm Oil plantations. Henson (2003) and Clay (2004) found that Palm Oil caused an average 15-25% less mammals per hectare than tropical forest. The report from Friends of the Earth (2005) stated that palm oil expansion in Indonesia has caused habitat fragmentation in Borneo and Sumatera especially on the Sumateran Tiger, Borneo and Sumatran orangutans, Asian elephant and Sumatran rhinoceros. The other impact is a decrease in ground vegetation. Moreover, Gillison and Liswanti (1999) found that there is loss of biodiversity at the huge portion due to the expansion of Palm Oil in Jambi and Central Sumatera.

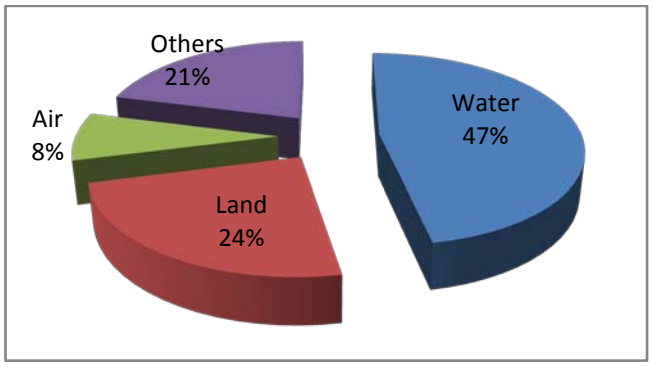
(4) environmental impact on water

Lord and Clay (2007) stated that the environmental impact of palm oil plantation on water comes from the usage of pesticides and other agrochemicals, runoff, sedimentation, pollution by liquid waste discharge and hydrocarbon. In addition to the

previous studies, Hayashi (2007) found that palm oil companies in Indonesia already utilized to use bio-waste as energy input for processing industries but it is still in-efficient and need to be improved.

In conclusion, the proportion of any kinds of environmental impact of palm oil plantation can be summarized on the following figure. Based on the following figure, the biggest proportion of environmental impact is on water, land, air, and other are 47%, 24%, 8%, and 21% respectively.

Figure 3.3 Proportion of Environmental Impact of Palm Oil Plantation



Source: Lord and Clay (2007)

3.4 The Indonesian government Policy on Indonesian Palm Oil Sector

The Indonesian government implemented various policies to support palm oil sector as well as to control price of cooking oil in domestic market. The Indonesian government policies on palm oil sector can be categorized into economic policies and environmental policies which will be discussed in this section.

3.4.1 Economic Policies of the Indonesian Government on Palm Oil Sector

The economic policies implemented by the Indonesian government on palm oil sector from year 1994 to the present situation are in the following:

1. Policies to increase revenue of local government using income tax and value added tax for enterprises involved in palm oil industry.
2. Policies to control export of palm oil from Indonesia to the world market which aimed to secure domestic needs of palm oil for cooking oil and control domestic price of cooking oil in Indonesia. The policies are resulted from the increase in palm oil export from Indonesia to the world market since 1969. At the time, cooking oil industry in Indonesia uses coconut as a main input for cooking oil industry. In 1973, the Indonesian government started to implement policy of domestic allocation control to private companies. Since year 1987 to 1990, policies to control palm oil export are implemented which are aimed at supply more on domestic market and reduce high price of cooking oil in Indonesia. In 1990, regulation of annual export permit is implemented. The volume of palm oil increases every year. In August 1994, The Indonesian government introduced export tax on palm oil and related products because there was lack of domestic supply of palm oil and high domestic price of cooking oil. In December 1997, the Indonesian government banned the palm oil export from Indonesia to the world market. In April 1998, palm oil export is permitted again but with very high export tax imposed which is about 40%. However, since year 2004 to 2007, the export tax of palm oil and its related products were lowered to 1.5%. In February 2008, The Indonesian government introduces new progressive export tax which the export tax of CPO and its related products will be based on the world price of palm oil. In detail, the regulation mentions if price of palm oil in the world market is between US$ 1,100 and US$ 1,200 per ton in Rotterdam market, the export tax rate is 15%, and if the price is between US$ 1,200 to US$ 1,300, the tax rate is 20%, and it becomes 30% if the price exceeds US$ 1,300 per ton. The new progressive export tax for palm oil and its related products are presented on the following table:

Table 3.12 Progressive Export Tax Regulation

Description	Export Tax level (%) for Base of Export price							
	<US$500	**>=US$ 550 & <650**	**>=US$ 650 & 750**	**>= US$ 750 & <850**	**>=US$ 850 & <1100**	**>=US$ 1100 & <1200**	**>=US$ 1200 & < 1300**	**>US$ 1300**
Palm oil Fruit	40	40	40	40	40	40	40	40
Crude Palm oil (CPO)	0	2.5	5	7.5	10	15	20	25
Crude Olein	0	2.5	5	7.5	10	15	20	25
Crude Stearin	0	1.5	4	5.5	9	13	18	23
Crude Palm Kemel Oil (CPKO)	0	1.5	4	5.5	9	13	18	23
Crude Kernel Stearin	0	1.5	4	5.5	9	13	18	23
Crude Kernel Olein	0	1.5	4	7.5	9	13	18	23
RBD Palm Olein	0	2.5	5	7.5	10	15	20	25
RBD Palm Olein on package maximum 10 ltr	0	0	0	2.5	5	10	15	20
RBD Palm Kernel Olein	0	2.5	5	7.5	10	15	20	25
RBD Palm Kernel Oil	0	1.5	4	5.5	9	13	18	23
RBD Palm Stearin	0	0.5	3	4.5	8	11	16	21
RBD Palm Kernel Straerin	0	0.5	3	4.5	8	11	16	21
RBD Palm oil	0	1.5	4	5.5	9	13	18	23
Bio-fuel from Palm oil	0	0	0	2	2	5	5	5

Source: IPOC, “Industry and Trade of Indonesian Palm Oil”, 2010

The table above shows the export tax rate for 15 products of palm oil. Tariff charges are stated in percent. There are eight specific export reference prices. The largest export tax are on the products of fruit and palm kernel, which are equal to 40% for each export price. The CPO export tax rate is generally higher than other palm oil products, except fruit and palm kernel. There are only three other products whose export tariffs are equal to CPO: crude olein, RBD palm olein and RBD palm kernel olein. As a sample, if the export price of crude palm oil (CPO) is U.S. $ 700, the export tax will be U.S. $ 35. It is because the price is between the scale of more than equal to US$ 650 and 750.

Futhermore, the Indonesian goverment through the ministry of trade announced the new regulation No. 56/M-DAG/PER/10/2209 about the increasing HPE (Export Price Standard) for CPO and its derivated products. This new HPE will be based on the average price of FOB (free on board) in a certain month at some Indonesian ports. The following table presents standard price for export of CPO and its derivated products:

Table 3.13 Standard Price for Export of CPO and its derivated products, 2009

No	Description	New HPE (US$/metric ton)
1	Palm fruits and kernel	259
2	Crude Palm Oil (CPO)	595
3	Crude Olein (CRD Olein)	644
4	Refined Bleached Deodorized Palm Oil (RBD-PO)	655
5	Refined Bleached Deodorized Kernel Olein (RBD Olein)	687

Source: IPOC, “Industry and Trade of Indonesian Palm Oil”, 2010

3. Policies on supporting palm oil expansion in Indonesia. The Indonesian government targeted palm oil expansion since 1965. The Indonesian government supported the investment of palm oil expansion through various policies which can be divided into two phases of expansion. Firstly, in 2002, the Indonesian government invited foreign investment to invest on palm oil plantation in Indonesia. Many foreign investors are interested in this mainly Malaysian investors who invest in palm oil plantation in Sumatera island and Kalimantan island. The Indonesian government also supported palm oil expansion through providing subsidy and incentives to farmers who work on palm oil plantation. Secondly, starting in 2005, the Indonesian government announced a long term plan to expand palm oil plantation from 2006 to 2025. Palm oil sector is included in important sectors for accelarating economic development in Indonesia. It is mentioned in the Master Plan for Acceleration and Expansion of Indonesia Economic Development. The Indonesian government also plans to develop sustainable development of palm oil industry.

This simply means that palm oil expansion must have three benefits which are firstly, economic benefits (e.g. providing appropriate income for farmers, supply of domestic industries, bringing benefit for enterprise and increasing of government revenue, investment and productivity), secondly, social benefits (job opportunity, cooperate the cooperative of small farmers and enterprises and other social benefits), and thirdly, environmental protection (such as a use of the bio-waste as fuel and electricity, try to use other land types for palm oil conversion, and implement the policy to develop bio-fuel as an alternative policy). The long term targets of The Indonesian government are:

a. Area of palm oil plantation will become 9 million ha with the assumption that for food and oleo-chemical is 6 million ha and for bio-diesel is 3 million ha).
b. CPO production becomes 30.2 million tones.
c. Average of productivity for palm oil increases to be 24 million tons FPB per ha per year.
d. Using the pesticide-resistant plant to increase the production.
e. Allocation for domestic consumption is 8.2 million tones which are distributed to biodiesel consumption is 15%, and food and oleo-chemical is about 85%.
f. Palm Oil export will be 21.3 million tons.
g. Increase income of farmers to be 3,000 US$-4,000 US$ per farmer per year with the assumption that each farmer owns plantation for 2 ha to 4 ha.
h. Job opportunity for people on farm will increase to be 4.5 million.
i. There is synchronization between plantation area and factory's capacity.
j. Using the stem of palm oil for beneficial purpose.

Palm oil expansion targeted in Indonesia is expected not only to meet demand for palm oil export but also to meet domestic demand for bio- fuel energy policy. To meet

targeted amount of palm oil expansion, The Indonesian government announced some regulations related to palm oil sector and bio-fuel energy policy. Regulations to support palm oil sector for the current expansion period are first, Presidential Regulation No. 5 in year 2006 which is about national energy policy to increase the usage of bio-fuel to be more than 5% by 2025, second, Presidential Instruction No. 1 year 2006 and Presidential Decree No. 10 in 2006 about establishment of experted team to research bio-fuel, third, Regulation of the Ministry of Agriculture of Indonesia No 26 year 2007 about land alocation for estate crops, fourth, Presidential Regulation No 1 year 2007 about providing incentive for bio-fuelsector, and fifth, Decree of Ministry of finance Indonesia about lower interest rates for loans to farmers in palm oil sector and bio-fuel. The Indonesian government also tries to provide other supporting programs such as developing good business climate for private sector and domestic companies to invest in palm oil industry in Indonesia as mentioned in Government Regulation No 62 year 2008 about providing incentive income tax for companies who provides input for bio-fuelsector, supporting the small holder plantation as part of revitalization of estate crops sector, increasing the productivity, socializing good seeds, introducing the integrated system to support the sustainability of palm oil, developing research on utilization of all parts of palm oil to beneficial products (diversification products), developing supporting infrastructure, developing cooperatives between farmers and companies, developing human resource skill, and establishing accurate information system about Indonesian palm oil industry. In 2009 and 2010, the Indonesian government announced another regulation to push palm oil expansion in Indonesia such as Government Regulation No 31 Year 2009 about protection of regions that have state crops such as palm oil and rubber and Government Regulation No. 10 year 2010 about procedures of forest conversion and Government Regulation No. 15 and No. 18 year 2010 which support land conversions for palm oil plantation. Those regulations mentioned

above show strong ambitions of Indonesian palm oil to become the largest producer and exporter of palm oil in the world market.

3.4.2 Environmental Policy of the Indonesian Government on Palm Oil Sector

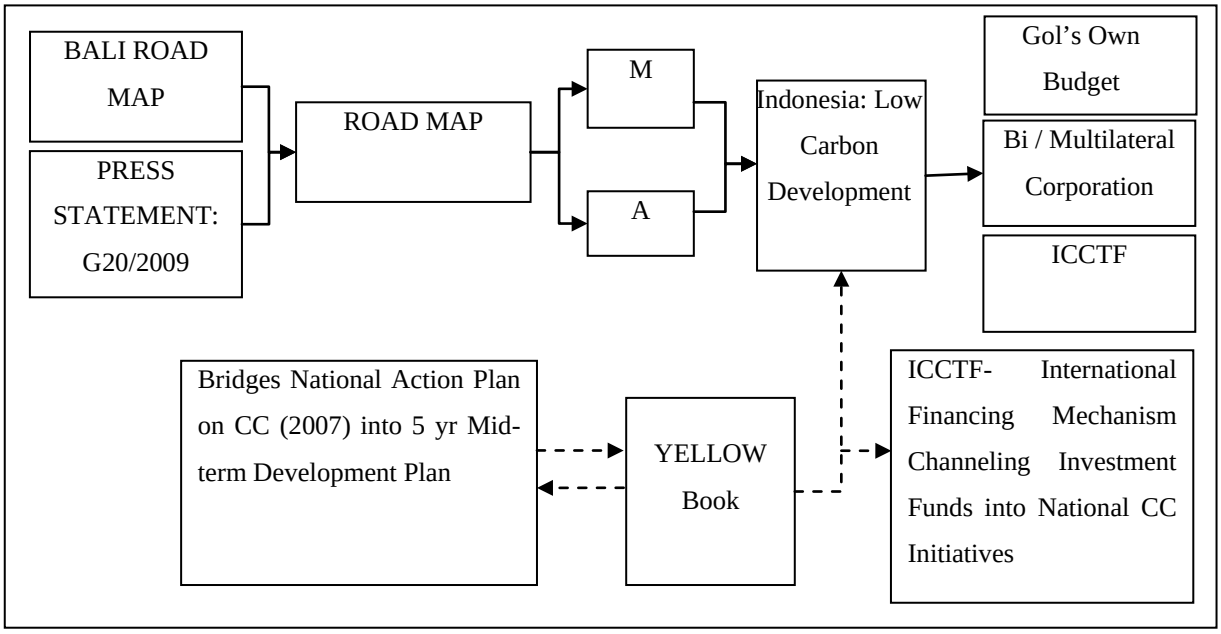
The Indonesian government implemented environmental policy related to palm oil sector in early June, 1998 and in recent years. These following environmental policies implemented by the Indonesian government are in the following:

1. In early June, 1998, the Indonesian government through the Ministry of Forestry and Estate Crops issued the regulation on forest-use prohibition and conversion license. In October, 1998, the Ministry of Forestry and Plantation Estate Crops issued regulation on terminating a license and a permission to use a forest. Furthermore, In March, 1999, the Ministry of Forestry and Estate Crops implemented regulation of limiting the number of plantation land or forest area in provinces to a maximum of 20,000 ha, and a maximum of 100,000 ha for the whole country for defined companies (the law of forest No. 41).
2. Policies related to environmental issues of palm oil in Indonesia which aim to encounter negative campaign of palm oil that was raised by European countries. Palm oil exporter to European countries must meet the standard which is called European Directive on the use of renewable energy. The regulation was approved in the European Parliament on April 23, 2009. The Indonesian government finds the standard too high to be achieved by Indonesian palm oil. As a result, Indonesian palm oil is restricted to be imported by European countries because of destroying tropical forest to open palm oil plantation. Moreover, to encounter negative campaign relative to environmental issues of palm oil, the Roundtable of Sustainable Palm Oil (RSPO) was firstly created by some policy decision makers of palm oil in the world. The committee included all agents who had contributed in the process of palm oil from states, farmers, producers, industries, and the secondary sectors of

distributors, consumers, NGOs, environmentalists, exporters and importers of palm oil in the world market. The purposes of RSPO are to increase growth and usage of palm oil through cooperation in the production cycle of palm oil, and to develop the dialog process among the agents. The first conference of RSPO was held in Kuala Lumpur, in August, 2003. Some agreements were: that there had been a clear and concrete definition about palm oil production for sustainable development, or the long term purpose would be conducted in the next meeting. RSPO also had comments from external views as some principles and standard of RSPO were questioned. Indonesian palm oil already met the standard of RSPO but it is accused for exported to the European countries due to destroying forest.

To undestand about the Indonesian government policies related to reduce environmental impact of palm oil expansion in Indonesia, it is needed to overview the Indonesian government policies on reducing carbon emission on the national level. To realize the letter of intent signed between Indonesian and the Norwegian Government in May 2011 about REDD project, the Indonesian President announced “the green economic growth policy”. The main objective of this policy is to reduce emission about 26% by 2020, and about 41% if usingternational assistance. In addition, the National Development Planning of Indonesia developed the National Action Plan for Reducing Greenhouse Gas Emission (RAN-GRK). This national action plan has main objectives so that the mitigation and adaptation of climate change reduction should be pro-poor, pro-job, pro-investment, pro-growth, and pro-environment. The following figure shows the relationship among policies, guidelines, road maps of low carbon development projects of Indonesia.

Figure3.4 Process of Mainstream of Climate Change into National Plan of Indonesia

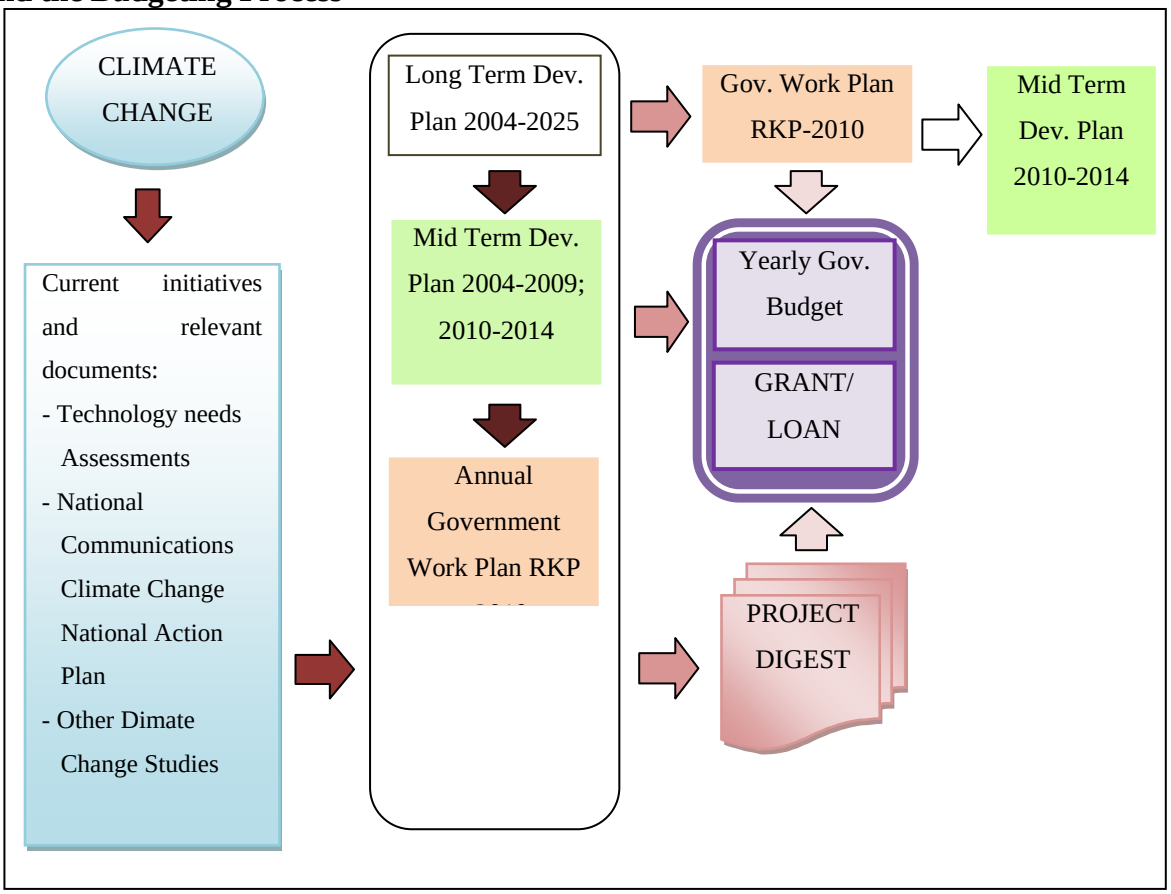


Source: SNC (2010). "Indonesian Second National Communication Under The United Nation Framework Convention on Climate Change (UNFCC)". http://unfccc.int/files/national_reports/non-annex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf. Accessed on November 3, 2011.

Note: - M stands for mitigation
- A stands for adaptation
- ICTTF stands for Indonesian climate change trust fund

For further steps, to link between climate changes and national development plans, BAPPENAS (Indonesian national development agency) as the authorized organization created a guide book which is called "yellow book". This book integrates the purpose to achieve the low carbon economic growth into long-term development plan, then it is described into mid-term development plan (2004-2009) and then is actualized into the annual work plan as presented on the following figure. All ministries, local government and international organizations should follow this book.

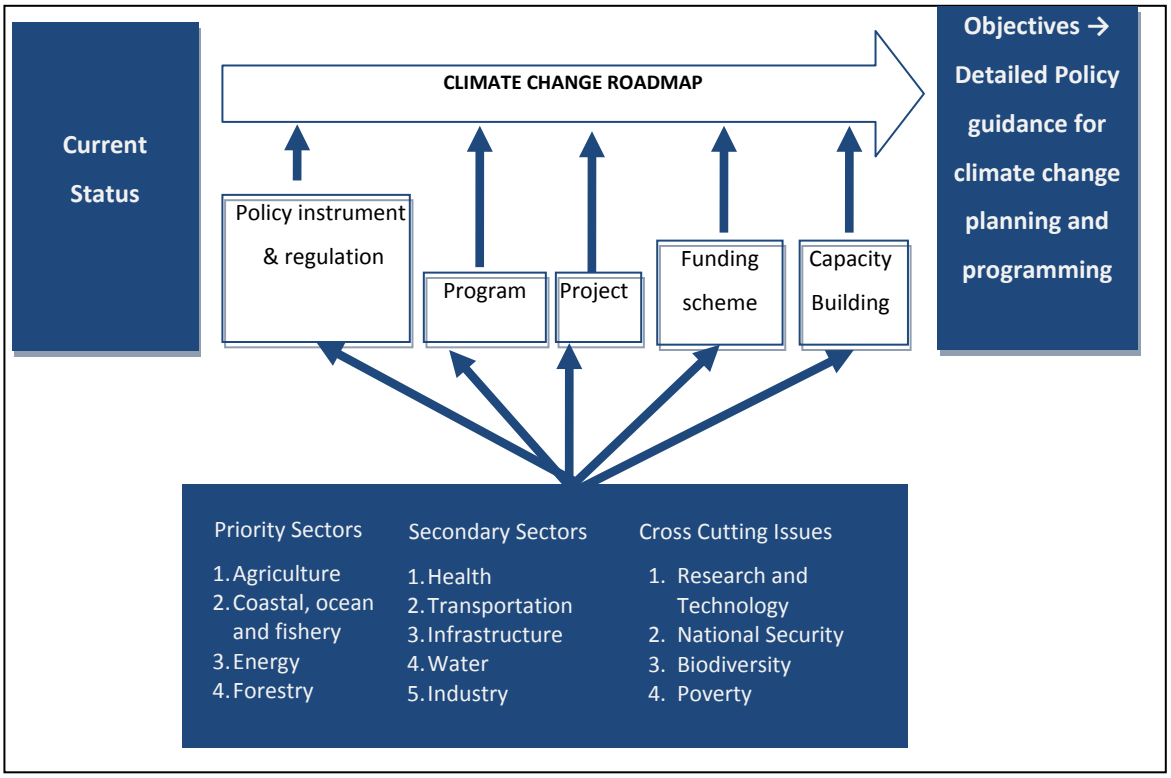
Figure 3.5 Linkage between Climate Change Related Documents, Development Planning and the Budgeting Process



Source: SNC (2010). "Indonesian Second National Communication Under The United Nation Framework Convention on Climate Change (UNFCC)". http://unfccc.int/files/national_reports/non-annex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf. Accessed on October 10, 2011.

Therefore, the following figure presents the roadmap of climate change status. The Indonesian government sets four priority sectors and four secondary sectors as the main target of reducing GHG emission. The four priority sectors are agriculture, coastal, ocean and fishery, energy and forestry. The climate change roadmap has six steps, which are policy instrument and regulation, program, project, funding, capacity building, and detailed policy guidance for climate change planning, and programming.

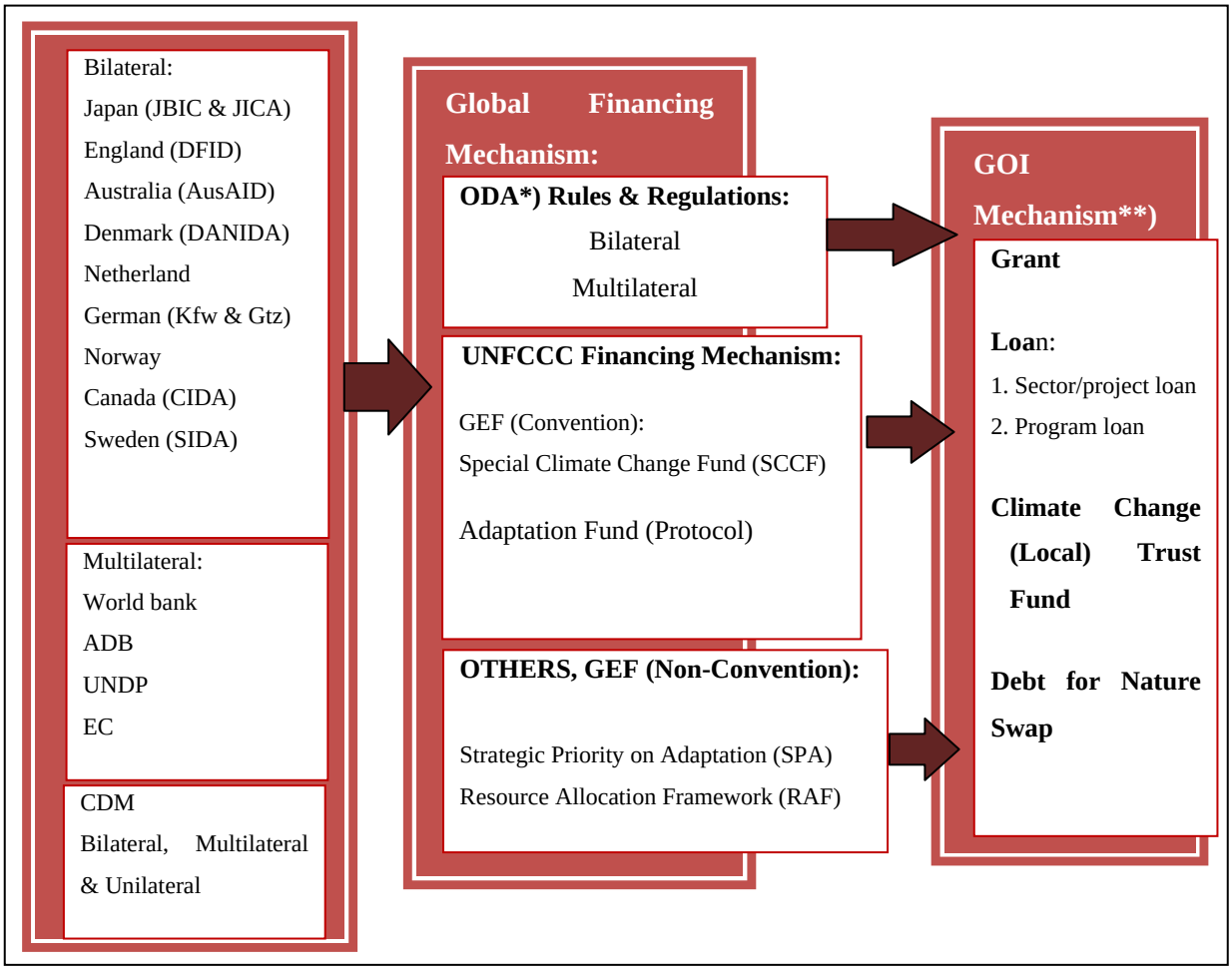
Figure3.6 Climate Change Roadmap



Source: SNC (2010). "Indonesian Second National Communication Under The United Nation Framework Convention on Climate Change (UNFCC)". http://unfccc.int/files/national_reports/non-annex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf. Accessed on October 10, 2011.

For financial source of any projects to reduce GHG emission, the Indonesian government will utilize all available sources to finance climate change reduction projects. As presented in the following figure, the Indonesian government will utilize financial sources from domestic as well as from bilateral and multilateral sources. Therefore, the Indonesian government will prioritize to use grant than loan with the requirement that the grant should focuses on prioritized sectors, meet regulations of the Indonesian government, and must be recorded in state budget and follow the related regulation on procedures on registration and legalization of foreign grant.

Figure 3.7 Climate Change Financing Scheme



Source: SNC (2010). "Indonesian Second National Communication Under The United Nation Framework Convention on Climate Change (UNFCC)". http://unfccc.int/files/national_reports/non-annex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf. Accessed on October 10, 2011.
Note: *) expected come from additional ODA commitment from Monetary Consensus (ODA+)
**) comply with Government Regulation No. 2/2006, Climate Change Program Loan

It is important to understand which sector of Indonesian economy who contributes a large share to total GHG emissions and removal. Based on Data from SNC (2010) as presented in the following table, GHG emission and removal can be categorized into four types, which are CO_2, CH_4, N_2O, and PFC. In term of CO_2, land use change and forestry have the largest share of CO_2 emission and removal in Indonesia in 2000 which is about 74%. The second place is held by energy that has a share at 24%. Industrial process and waste have

share of only 4% and 0.2% respectively. In terms of CH_4 emission and removal, waste has the largest share, which is about 65%. The second rank is agriculture that has share about 22%. Energy and industrial process have shares of only about 13% and 1% respectively. In term of N_2O, agriculture is the largest source that has a share an approximately 79%. Energy and waste have shares of about 12% and 9%. Land use change, forestry, and industrial process only produce small shares of N_2O emission and removal. In term of PFC emission and removal, only industrial process produces this type of GHG emission and removal.

Table 3.14 Percentage shares of GHG Emission and Removal of Indonesia, 2000 (%)

	CO_2	CH_4	N_2O	PFC
Energy	23	12.75	11.43	0.00
Industrial Process	3.63	1.02	0.47	100.00
Agriculture	0.20	21.47	79.18	0.00
LUCF[1]	73.79	0.02	0.09	0.00
Waste	0.15	64.73	8.83	0.00
Total	100	100	100	100

Source: Author's Calculation Based on data of SNC (2010). "Indonesian Second National Communication Under The United Nation Framework Convention on Climate Change (UNFCC)". http://unfccc.int/files/national_reports/nonannex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf.
Accessed on September 5, 2011.
Note: [1] emission from peat fire was included

Moreover, land use change and forestry is the sector that has the largest share of total GHG emission from 2000 to 2005. In 2000, land use change and forestry has a share of GHG emission which is about 47%. Then it decreases in 2001 to have a share of about 42%. But it increases in 2002 by having a share of about 50%. The large share of land use change and forestry between 2000 and 2002 is caused by the Indonesian government program to expand palm oil plantation. In 2003 and 2004, the share of land use change and forestry on total GHG emission decreases. But it increases in 2005; the share is about 37%. Energy sector is the second largest sector that produce a large amount of GHG emission between 2000 and 2005. In 2000, energy sector has a share of about 20%, and increases in 2001 by having a share of

about 23%. But it decreases in 2001; the share is about 13%. In 2005, energy sector has a share of GHG emission which is about 21%. Other sector that has a large share of GHG emission between 2000 and 2005 is peat fire. The share of GHG emission by peat fire has increased every year, from 13% in 2000 to 25% in 2005. Three sectors that have a decreasing share of GHG emission are waste, agriculture and industrial process. In 2005, waste, agriculture and industrial process have shares on total GHG emission which are about 10%, 5%, and 3% respectively.

Table 3.15 Percentage shares of GHG Emission between 2000 and 2005 by sector (%)

Source	2000	2001	2002	2003	2004	2005
Energy	20.39	22.73	12.72	27.43	21.62	20.64
Industrial Process	3.12	3.69	1.70	3.94	2.79	2.72
Agriculture	5.47	5.74	2.99	6.56	4.52	4.48
LUCF	47.12	41.54	49.96	28.38	35.87	37.67
Peat Fire	12.48	14.38	26.31	20.21	25.56	25.18
Waste	11.42	11.92	6.32	13.48	9.63	9.31
Total With LUCF & peat fire	100	100	100	100	100	100

Source: Author's Calculation Based on data of SNC (2010). "Indonesian Second National Communication Under The United Nation Framework Convention on Climate Change (UNFCC)". http://unfccc.int/files/national_reports/nonannex_i_natcom/submitted_natcom/application/pdf/indonesia_snc.pdf.
Accessed on September 5, 2011.

Since the largest share of GHG emission in Indonesia occured in land use change and forestry, peat fire and energy, it is important to review the Indonesian government policies on land use change and forestry, peat fire, and energy. In detail, the policies on each sector will be presented as follows:

a. **Policy Framework on Land Use Change and Forestry (LUCF)**

The Indonesian government has set forest or LUCF as one of prioritized sectors for mitigating emission. Some regulations have been issued on the purpose of reducing emission from forestry. Five main objectives to this sector as mentioned in SNC Report (2010) are:

1. Combating illegal logging and its associated trade
2. Revitalization of the forestry sector, particularly forestry industries
3. Conservation and rehabilitation of forest resources
4. Empowering the economy of community who lives in a surrounding forested area
5. Stabilization of forest area for promoting and strengthening sustainable forest management.

Therefore, the mitigation targets to achieve objectives which are mentioned above are as in the following:

1. Specify the targeted of forested area about 60 million ha by 2014
2. Rehabilitation and conversion of forest to industrial forest plantations, community plantation forest, community forest, and social forestry about 7.2 million ha, 5.4 million ha, 4 million ha and 2 million ha as the targeted areas by 2012
3. The targeted area of forest protection and natural resources conservations about 120.3 million ha
4. Development of economic and social function of forest
5. Establishment of institutions
6. Expansion of research and development to forest

To achieve target of emission reduction from forest and land use change, The Indonesian government needs external financing sources such REDD Fund, private investment, grants from bilateral and multilateral such as ODA, Adaptation Fund for under the Kyoto Protocol, Global Forest Fund (GFF), and Debt for Nature Swaps (DNS), and Debt Reduction under the Tropical Forest Conservation Act of the USA for forest conservation projects.

b. Policy Framework on Peat Land

There are seven major regulations which have issued to control fires or burning cases on peat land areas. It also includes two regulations on sanctions on use of fires in forest with the penalty maximum of 10 years in prison or paying about 100 million Rupiah. One major regulation on protecting peat land is regulation issued by the Ministry of Agriculture No. 14/Permentan/PL. 110/2/2009 for the guidance for utilization of peat land for palm oil. This regulation states that the Indonesian government permits peat land to be converted or used as palm oil plantation with some rules such as only peat land on the society of cultivated area and on peat land that has deep less than 3 meters and should consider environmental rules. However, it is assumed that emissions from peat land will reach four times in 2020 than emissions in 2000 because the permission to use peat land for palm oil plantation.

c. Policy Framework on Energy

The Indonesian government announced Green Energy Policy on 2004. This policy is aimed to encourage the use of renewable energy than natural gas energy. In detail, the green energy policy has targets to be achieved in 2025 as follows:

1. To reduce the share of oil from 55% in 2005 to less than 20%
2. To increase the share of natural gas from 22% in 2005 to 30%
3. To increase the share of coal from 17% in 2005 to more than 33%
4. To increase the share of geothermal energy from 3% in 2005 to more than 5%
5. To increase the share of other new and renewable energy such as biomass, nuclear, hydropower, solar and wind to more than 5%

6. To develop bio-fuel to have liqued share of at least 5%
7. To develop liqued coal to achieve at least 28%.

Specifically to achieve the target on bio-fuel, the Indonesian government implemented some supporting policies such as subsidy on bio-fuel and domestic supply for biodiesel, income tax facility and support investment on renewable industries, credit facility for development of bio-energy, investment and working capital to support food and energy security.

d. Policy Framework on Agriculture

The Indonesian government has set some regulations on agriculture sector with the main focus is on the implementation of non-burning technology for land clearing and land preparation, development of early fire warning system, and introduction of ICEF (developing carbon efficient farming) through bio-gas technology, low methane emitting technology and organic fertilizer and bio-pesticides, and research on low emission technologies, and expansion of agriculture sectors in unproductive land, and increase in the productivity.

In summary, the reviews of the Indonesian government policies on land use and forestry, energy, and agriculture are important as a starting point to understand the Indonesian government policies on reducing environmental impacts of palm oil expansion in Indonesia. In March 2011, the Indonesian government announced the implementation of ISPO, Indonesian Standard of Palm oil for Companies operating in palm oil sector. ISPO standard has similar contents with RSPO standard. It requires palm oil companies in Indonesia to meet eight principles of RSPO which are tranparency, compliance with applicable law and regulations, commitment to long term economic and financial viability, use of appropiate best practices by growers and millers, environmental

responsibility and conservation of natural resources and biodiversity, responsible considerations of employee and of individuals and communities affected by growers and millers, responsible development of new plantings, and commitment to continous improvement in key areas of activities. Then in 2011, the Indonesian President announced moratorium on giving licenses to permit new conversion for palm oil which is stated on President Instruction No. 10 year 2011 (INPRES no 10/ 2011). This moratorium was an response to critics of research institutes and NGOs about regulations on using peat lands with 3 meters depth to be converted to palm oil. Therefore, land limitatiton is the main problem of the Indonesian government to achieve targeted palm oil expansion. To overcome this constraint, the World Bank (May 2010) and Reuters (2010) suggested to use degraded land to be converted to palm oil expansion. The Indonesian government through the Ministry of Forestry developed an effort to improve spatial planning projects to conduct maps of degraded land available in Indonesia. In September 2011, the Indonesian government legally annouced details of the National Action Plan for GreenHouse Gas Emissions Reduction in Presidential Regulation of the Republic of Indonesia No. 61 year 2011. In this regulation, the Indonesian government targeted to reduce CO_2 emissions from palm oil sector about 75 million tons by 2014. To achieve this target, the Indonesian government plans to use non-forest, abandoned, degraded, and other uses of land to palm oil expansion. The detailed objective of this plan is that plantations are developed and production productivity, and the quality of perennial plants are improved with targeted 860,000 ha in 19 provinces. In supporting to reduction of CO_2 emission of palm oil, the Indonesian government also implemented some action plans in forestry sector which are taken in threefold. First, development of REDD projects in two provinces which are in Jambi and Central Kalimantan provinces to reduce about 3.67

million CO_2 emission in 2014. The main purpose of these REDD projects is to conserve peat forested areas in Jambi and Central Kalimantan provinces. REDD project in Jambi province is the first REDD project in Indonesia. This project also gets the financial assistance from the Australian government and other donor countries. The main reason is that peat forested areas contain large of carbon stock. Second, implentation of non-burning for land clearing of area of 1.8 thousand ha in 19 provinces. The main purpose of the second action is to reduce CO_2 emission of burning for land clearing. The main responsible institution is the Indonesian Ministry of Environment. Third, controlling fire use in 11 provinces to reduce about 22 million tons of CO_2 emission. The last action is considered as the complement action to achive carbon emission reduction of palm oil sector. Detailed plans of the Indonesian government to reduce carbon emission of palm oil are presented in the following table:

Table 3.16 The Indonesian Government Plans to Reduce CO_2 Emission of Palm Oil Sector

No	Action Plan	Activity/ Objective	Period	Location	CO_2 Emission Reduction (million tons)	Responsible Institution
1	Development of plantation (Palm Oil, rubber, cacao) on no forest/ abandoned/ degraded/other use area.	Plantations are developed; production, productivity and quality of perennial plants are improved, with target oil for palm of 860,000 ha and rubber of 105,200 ha	2011-2014	Palm Oil in 19 provinces: NAD, North Sumatra, West Sumatra, Bangka Belitung, Bengkulu, Riau, Jambi, South Sumatra, Lampung, West Kalimantan, Central Kalimantan, East Kalimantan, South Kalimantan, Central Sulawesi, South Sulawesi, West Sulawesi, North Sulawesi, Papua and West Papua Rubber in 14 provinces: North Sumatra, Riau, South Sumatra, West Sumatra, Jambi, Riau Islands, Bengkulu, Bangka Belitung, Lampung, Central Java, West Kalimantan, Central Kalimantan, South Kalimantan and East Kalimantan	Palm Oil: 74.53 Rubber: 2.38	Ministry of Agriculture
2	Development of the utilization of environmental services	Demonstration activities of REDD in conservation	2010-2014	2 provinces: Jambi and Central Kalimantan	3.67	Ministry of Forestry

No	Action Plan	Activity/ Objective	Period	Location	CO_2 Emission Reduction (million tons)	Responsible Institution
		areas (peat forests) are implemented				
3	Implementation of land clearing without burning	Land clearing without burning is done through making composts, charcoals, charcoal briquettes, on an area of 1,800 ha	2010-2020	7 provinces : Riau, North Sumatra, Jambi, West Sumatra, East Kalimantan, Central Kalimantan and West Kalimantan		Ministry of Environment
4	Forest fire control	Decreased number of hotpots in Kalimantan, Sumatra and Sulawesi islands by 20% on average from 2005-2009, with level of success 67.20%	2010-2014	11 provinces: North Sumatra, Riau, Riau Islands, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan, South Sulawesi and West Sulawesi	21.77	Ministry of Forestry

Source: Presidential Regulation of The Republic Indonesia No. 61 Year 2011 as is stated on the homepage of the National Planning Agency of Indonesia (BAPPENAS). http: http://www.bappenas.go.id/. Accessed on November 10, 2011.

Therefore, looking on how the economic benefits and environmental impacts of palm oil expansion, this study aims at examining determinants of Indonesian palm oil export to the world market, using export demand approach as well as the impact of Indonesian policies to support palm oil expansion and to reduce carbon emission of palm oil expansion using accounting multiplier analysis. The results of two analyses of this study are expected to provide a comprehensive analysis for policy makers to formulate a win-win policy to achieve sustainable development of palm oil plantation in Indonesia. The environmental analysis of palm oil expansion will be focused on CO_2 emission of land use change because of two reasons; the share of CO_2 caused by LUCF in total Indonesian CO_2 emission is the largest, and deforestation and peat land issues are two majors of environmental impact of palm oil expansion. REDD and carbon tax are two environmental policies of the Indonesian

government chosen to be analyzed the impact in this study. This study uses Jambi and East Kalimantan provinces as two study sites because these provinces are located in Sumatera and Kalimantan regions which are the main areas of palm oil plantation and REDD pilot project in Indonesia.

Chapter IV

Economic Analysis of Palm Oil Expansion in Indonesia

This chapter will present the result of economic analysis of palm oil expansion in Indonesia. The focus of economic analysis is on determinants of Indonesian palm oil export in the world market. The major argument is that most of palm oil production in Indonesia is exported to the world market. For example, As stated in Rifin (2010), in 2008, about more than 70% of Indonesian palm oil production was exported. Assuming that Indonesia has potential to expand its palm oil plantation due to its abundant land and labor, the focus of economic analysis is mainly on factors determining foreign consumer demand on palm oil from Indonesia. Palm oil plantations spread in various regions in Indonesia, especially in Sumatra, Java, Kalimantan and the Papua islands. Furthermore, there are also potential lands for expansion by more than 50 million hectares (Indonesian Bureau of Statistics, 2009). More job opportunities also will be available because various jobs in palm oil plantation do not require very high skills. This is a good alternative to overcome with un- employment problems due to moratorium of sending house- maid program to abroad. Further details are presented in the following:

4.1 Theoretical Framework for Export Determinant

Trade modeling has been interested topic for researchers since many years ago. The most commonly used for trade modeling is a work by Goldstein and Khan (1985, P. 1041). In their theoretical framework, they mention that modeling trade depends on many factors such as the type of goods, the usage of goods (whether it is as an input, intermediate or final use), the type of institutional framework, modeling purpose, and data availability. However, in general, the imperfect substitute model is the mainstay used in trade modelling. This study

uses the imperfect substitute model to examine determinants of Indonesian palm oil export to the world market from January 1996 to July 2010. As stated in Goldstein and Khan (1985), the main characteristic of the imperfect substitute model is the existing of price difference. In addition, the imperfect substitute model can be taken in form either between two different goods or substitute between domestic and exported good using a country.

Economic modelling approach to estimate trade can be categorized into threefold. First, export demand approach which is mainly based on assumption that consumer will maximize their utilities based on budget constraint. In this theoritical review, export demand model based on Goldstein and Khan (1978) is presented. Export demand model is represented by export quantity is a function of income in importing countries, exported price and domestic price in the importing country for the same good.

Goldstein and Khan (1978) explain more in the form of export demand equation as follows:

$X_i^d = g\ (Y^*e, PX_ie, P^*e);\ g_1, g_3 > 0, g_2 < 0$……(4.1)

Where X_i^d = quantity of export demanded, Y^* = income level of importing country, PX_i = exported good's own price, P^* = domestic price of same goods in the importing country, and e = exchange rate.

Moreover, equations above represents the positive relationship between X_i^d and two independ variables (Y^* and P^*), and the negative relationship between X_i^d and PX_i. Therefore, the income elasticity and cross-price elasticity are expected to be positive while the own-price elasticity is expected to be negative.

Second is export supply approach which basically assumes that export supply will increase when there is a possibility of producing and selling exports. In export supply model,

export quantity has a positive relationship with domestic prices. The export supply function is written in the following form:

$X_i^s = j\,[PX_i\,(I + S_i), P_i],\ j_i > 0, J_2 < 0$ …….(4.2)

Where X_i^s = quantity of export supplied, PX_i = export price, S_i = subsidy rate, and P_i = domestic price in exporting country.

Domestic price (P_i) in export supply function has two roles. First, in the case of given level of export price, domestic price will influence the profitability of producing export. It means that when factor cost, which usually moves along domestic price, increases, then the profitability of producing will decrease. Second, in the context of resources involved for production of export, it can be transferred to others. Domestic price will influence the profitability of selling export. It means that when domestic price increases, the profitability of selling export will decrease.

The last approach for export modeling is a simultaneous approach. Orcutt (1950) and Harberger (1953) mention that most empirical work using time series data on export used only export demand approach, with assumption that export supply is infinite. They argue that assumption on supply side in the export case is possible when there is a large portion of unemployed resources in the export industry itself, or other sectors. Therefore, the simultaneous approach means using export demand and export supply to estimate export.

In this study, the imperfect substitute model means there is price difference between two different goods, which are Indonesian palm oil export and world soybean oil. This study assumes that export supply for Indonesian palm oil is infinite elastic. The logical arguments to support are based on twofold. First, about 70% of palm oil production in Indonesia is exported to the world market. Second, there are still large land availability and unemployement resources available in Indonesia to supply more to meet increasing world

demand for palm oil. Therefore, the following section will present the empirical research on determinants of export which are mainly based on export demand approach.

4.2 Empirical Research on Determinants of Export

A number of studies have been carried out to analyze determinants of export either on palm oil sector or other agricultural sectors both in the case of aggregate level or single country. In the case of other agricultural sectors during 1990s to 2000s, War and Wollmer (1996) and Omonona et (2007) find that the elasticities of price and income for other agricultural exported goods (rice, spices and nut) are elastic both in the short- run and in the long- run. Warr and Wolmer use quartely data for Thailand rice export since year 1976 to 1990. This study also conclude that Thailand is the large country case for rice export in the world market. In the study conducted by Warr and Wolmer (1996), world price of rice was used as substitution good for exported price of Thailand rice. Similarly to this, Omonona et al (2007) use annual data from year 1998 to 2002 using Auto-Regressive Distributed Log (ADL). However, the authors use domestic price and export price for the same good to estimate prices of exported good and subsituted good. Both studies conclude that price and income elasticity for those goods are elastic both in the short-run and in the long-run.

In the case of palm oil sector, several studies have been carried out using the export demand model to analyze the palm oil export from Indonesia, either at the level of an individual country or comparison in with Malaysia. In example, studies by Yulismi and Siregar (2007) and Rifin (2009 and 2010) are conducted to estimate elasticity for Indonesia and Malaysia's palm oil export. Yulismi and Siregar (2007) calculate the price elasticity and import response elasticity for palm oil export from Indonesia and Malaysia using annual data from year 1990-2004 through export demand model. The authors report that in India and

China,the price and income elasticity of Indonesian palm oil export are inelastic and elastic respectively. For the Malaysian palm oil exports, India and China have the price and income elastic while EU has price elastic but income inelastic. Furthermore, Rifin (2009) examines the export competitiveness for Indonesia and Malaysia palm oil export using constant market share Analysis (CMSA) for the cases of three regions, are Asia, Europe and Africa. The conclusion is Indonesia has gained an increasing market share or strong market competitiveness over Malaysia in Asia and Africa except in the EU market. In addition to this study, Rifin (2010) who utilizes AIDS, Almost Ideal Demand System estimates the price elasticity and income elasticity for Indonesian and Malaysian palm oil export using annual data from 1964 to 2006. The result of second stage of AIDS shows that Indonesia has in-elastic of price elasticity both in the short-run and in the long-run. But the income elasticity is in-elastic in the short-run and is elastic in the long-run. In the conclusion, Indonesia gets benefit more than Malaysia from increasing of world income due to her higher income elasticity. In addition to case of Malaysian palm oil export, Shariff et al. (2006) find similar result which is elastic of price elasticity for Malaysian palm oil export to China, India, Pakistan, Egypt and South Korea using annual data from 1980 to 2003. Furthermore, the authors also find that malaysian palm oil export and soybean oil is highly substituted. In summary, three previous studies on comparing Indonesia and Malaysia palm oil exports suggest that Indonesia is more income sensitive while Malaysia is more prices sensitive.

In line with the previous studies, a study of single country case which is conducted by Susila (2004) also find the export price for Indonesian palm oil sector is in-elastic. Different with previous studied, the author also examines the impact of export tax of Indonesian palm oil export on quantity exported. In conclusion, he proposes an effective CPO export tax rate, which was 18% of difference between world price and minimum price to be

taxed for Indonesian palm oil export for the period 2001. However, a study conducted by Niemi (2003) on estimating of ASEAN Agricultural export to European Countries finds different result. She finds that price elasticity for Indonesian palm oil export in the long-run is elastic (1.14) and income elasticity for Indonesian palm oil export is in-elastic in the short-run and is perfectly elastic in the long-run. She uses import demand approach to estimate price and income elasticities of Indonesian palm oil export to European countries. The annual data from 1960 to 2000 is used in this study.

In conclusion, since previous studies use quartely and annual data to estimate price and income elasticity of palm oil and other agricultrural export either from Indonesia or other countries, this study bases export demand approach and uses monthly data from January 1996 to July 2010 to estimate price and income elasticity in the short-run and in the long-run of Indonesian palm oil export to the world market using ECM, error correction model. It is expected that estimation result of using monthly data is more appropiate result.

4.3 Methodology

This study examines the determinants of Indonesian palm oil export using export demand model and relies on imperfect substitute model assumption. The export demand model is utilized with the assumption that export supply is infinitely elastic. In this study, the dependent variable is the quantity of palm oil export from Indonesia to the world market, and our independent variables are Indonesian palm oil export price, world soybean oil price as one of substitute prices for palm oil and income of five key importing countries for Indonesian palm oil. Soybean oil price is chosen because soybean is ranked second after palm oil, as a large amount of it is imported by the world market.

Since the data were taken from a series, a seasonal adjustment form, stationary, co-integration, and lastly an error correction model are conducted. The export demand model for Indonesian palm oil export is calculated as follows:

$$\Delta Q_t^d = e_0 - e_1 \Delta EPPO_t + e_2 \Delta WPSO_t + e_3 \Delta I_t + e_4 \Delta ECM_{t-1} + e_t \ldots\ldots\ldots\ldots\ldots\ldots (4.3)$$

Where

Q_t^d = quantity of Indonesian CPO Export to the world market (tons)

$EPPO_t$ = Real export price of Indonesian palm oil (USD/t)

$WPSO_t$ = Real world price of soybean oil as one of substitute goods (USD/t)

I_t = Weighted average of real value of monthly palm oil import of five key importing countries (USD/t). The real value of monthly palm oil import of five key importing countries is choosen as proxy for monthly income because the monthly data of GDP is not available.

e_1 = own-price elasticity for Indonesian palm oil

e_2 = substitute price elasticity

e_3 = income elasticity

Δ indicates the difference form and all data are in the log form, real values and seasonal adjusted form (normalized version).

4.4 Data, Sources and Measurement

This study starts from December 2009 to November 2010 and uses monthly data from January 1996 to July 2010. The data sources were taken from World Trade Atlas database, IDE JETRO, Nagoya (2010) Office and International Financial Statistic, and IMF. Starting period is in 1996 because year 1996 was before the Asian economic crisis, and still included on the second expansion period of palm oil in Indonesia. India, China, Pakistan,

Singapore, and Malaysia were five key importer countries of Indonesian palm oil which were taken as representative of income variable indicator. In this equation, Q_t^d is the volume of Indonesia palm oil export (CPO and other palm oil); $EPPO_t$ is the real value of Indonesian palm oil exports in US Dollars; $WPSO_t$ is the real price of soybean oil at Dutch ports in US dollars per tons; and I_t is the weighted average of real value of monthly palm oil imports of five key importer countries and were deflated by a world import price index. The result is multiplied by weight. Weights used in this study are average monthly share of Indonesia Palm oil exports to five key importer countries. All of data, sources, and measurement are presented on the table 4.1.

Table 4.1 Variable Measurement and Data Source for Econometric Analysis of Determinant of Indonesian Palm Oil Export

Variable	Variable Measurement	Data Source
1. Q_t^d	Export Demand Quantity of Indonesian Palm Oil (tons)	World Trade Atlas Database, IDE JETRO, Nagoya
2. $EPPO_t$	Unit value of Indonesian Palm Oil Export (US$/ton) deflated by the world consumer price index	a. World Trade Atlas Database, IDE JETRO, Nagoya b. IFS, IMF 2010
3. $WPSO_t$	World Price of Soybean Oil at Dutch Port (US$/ton) deflated by the world consumer price index	IFS, IMF 2010
4. I_t	Total monthly palm oil import value of five key importing countries deflated by the world import price index and multiplied by weight (calculated from average monthly shares of palm oil import of five key importer countries)	a. IFS, IMF 2010 b. World Trade Atlas Database, IDE JETRO Nagoya

Source: Author Compilation

Since data comes from monthly data, first, a unit root test to test the stationary of the variables was conducted. One of the methods in testing unit root is the ADF test. Three different ADF equations were calculated to test the presence of a unit root; the first equation did not include either constant or trend (none), the second equation included constant variable, while the last equation included constant and trend. The results showed that all the variables were stationary at the 1% significance level at the first difference (Table 4.2). Then the co-integration test was appropriate to be conducted on all variables.

Table 4.2 Augmented Dickey Fuller (ADF) Test

Variable	ADF Test	ADF Test	ADF Test
	None	Constant Included	Constant and Trend Included
Level			
Export Quantity	0.86	-1.40	-4.79***
Export Price	-0.34	-1.76	-1.73
Soybean Oil Price	-0.32	-1.95	-2.13
Income	1.74	-0.47	-3.93**
First Difference			
Export Quantity	-10.23***	-10.27***	-10.24***
Export Price	-10.86***	-10.83***	-10.89***
Soybean Oil Price	-5.07***	-5.06***	-5.09***
Income	-9.48***	-6.65***	-6.64***

Source: Author's Calculation
Note: ***, ** = significant at 1% and 5% probability levels, respectively

Since all variables were stationary on the first difference; thus, the next step was to test co-integration between the three variables utilizing Engle-granger method by testing stationary on residual. The co-integration test is reported on Table 4.3. The result revealed that residual was stationary, so there was co-integration among three variables (EPPO, WPSO, and I).

Table 4.3 Co-Integration Test Using ADF Test on Residual

Variable	ADF Test	ADF Test	ADF Test
	None	Constant Included	Constant and Trend Included
Level			
Residual (u)	-10.35***	-10.32***	-10.34***

Source: Author's Calculation
Note: *** = significant at 1% probability levels.

4.5 Result and Discussion

The next step was to calculate the export demand function using ECM after considering the results of stationary test and co-integration test. The results of export demand model of Indonesian palm oil export both in the short-run and the long-run are presented in the following table.

Table 4.4 The Short-Run and Long-Run Estimations of the Export Demand

Period	Constant	Export Price	Soybean Oil Price	Income	Error Correction	Result
Short-run	-0.01	-0.54**	0.31	0.61***	-0.69***	R2 = 0.74
	(-0.31)	(-1.96)	(0.94)	(16.83)	(-9.38)	DW = 2.1
Long-run	10.68	-0.41***	-0.31	0.49***	-	
	(-22.68)	(-2.71)	(-1.62)	(39.80)		

Source: Author's Calculation
Note: Numbers in parenthesis are t-values.
***, ** = significant at 1% and 5% probability levels, respectively

Table 4.1 shows the estimated export demand for Indonesian palm oil export in the short-run and long-run. Both in the short-run and in the long-run, the sign of export price are negative as theory of demand stated; when the price of Indonesian palm oil export increases, the quantity demanded for Indonesian palm oil export will decrease. Or when the price of Indonesian palm oil export decreases the quantity of demanded for Indonesian palm oil export will increase. The results showed that the value of export price elasticity was 0.54 in the short-run which means that if there is increasing of Indonesian palm oil export price by 1%, the quantity demanded for Indonesian palm oil export will increase by less than 1% (0.54). In the long-run, the export price elasticity is smaller than in the short-run which the value is only 0.41. The result of price elasticity found in this study is similar to what is expected (hypothesis). Even though results cannot simply be compared to the previous studies (this study was on aggregate level while the previous studies were based on annual data and focused on the cases of specific importing countries), it is also useful to see their findings. The export price elasticity result differs from those which were reported by the previous studies. Shariff et al (2006) for example, found that the own price elasticity for Malaysian palm oil, in the case of India, was elastic both in the short-run and in the long-run. While in the case of China, it was not significant in short-run but was elastic in long-run. Moreover, Yulismi and Siregar (2007) found that the estimated export price elasticity for Indonesian

palm oil export, in the case of India, was inelastic both in the short-run and in the long-run and elastic for the case of China. A study conducted by Niemi (2003) also found that Indonesian palm oil export has income elasticity of export demand in the short-run was 0.89 and was perfectly elastic in the long-run. The price elasticity of export demand in the short-run was not found and in the long-run was 1.14. Moreover, Ernawati et al (2006) also found that Indonesian palm oil export has elastic price elasticity for the cases of India, China, and the rest of the world and inelastic for the case of EU, European Union.

In addition, the price elasticity of demand for Indonesian palm oil export on this study is similar with results were found by Susila (2004) and by Rifin (2010). Both studies found that Indonesian palm oil export has in-elastic price elasticity both in short-run and in long-run. The price elasticity of Indonesian palm oil export demand implies the response of quantity demanded to the price change for palm oil export from Indonesia while the income and other factors are constant. When the price elasticity of demand is less than 1 (in-elastic), it means that if the price for Indonesian palm oil export changes by 1%, the quantity demanded for Indonesian palm oil export will change by less than 1%. Theoretically, the effect of the price change can be categorized into two kinds: income effect and substitution effect. The income effect of the price change simply means there is change of purchasing power due to the change of price while others factors are constant. The in-elastic price elasticity of demand for Indonesian palm oil implies that the proportion of total expenditure for palm oil in the total expenditure of the foreign consumer is small. The change in purchasing power parity, due to the price change, will not cause so much change in quantity of Indonesian palm oil demanded. Furthermore, the substitution effect of the price change illustrates what happens to the purchase of other products when there is change in the price of Indonesian palm oil export. Inelastic price elasticity for Indonesian palm oil export implies that the substitution effect due

to the price change is not so large. It suggests that the choice of other products to be used as substitute goods for Indonesian palm oil, are not in numerous number. Another important concern is that a theory suggesting that price elasticity of demand in the long-run is larger than in the short-run. This is related to the adjustment period which suggests two things. They are, first, the longer adjustment period, the larger magnitude of price elasticity should-be; and second, the short-run price elasticity is larger than in the intermediate period. The result of this study is opposite to what the theory suggests. The price elasticity of demand for Indonesian palm oil export in the long-run is smaller than in the short-run. Theoretically, the price elasticity of demand in the long-run is supposed to be larger than in the short-run, because consumers will have more substituted good choices. The logical argument is our econometric result shows that soybean oil price as one of substitute goods for palm oil does not significantly determine the quantity of palm oil export demanded from Indonesia both in the short-run and the long-run. The own price elasticity of demand will increase in the long-run as the quantity demanded for substitute oil increases as the price for palm oil increases. Furthermore, the commonly used assumption for the increasing own price elasticity in the long-run than in the short-run is because in the long-run the consumer has more available substitute good to be chosen. Moreover, in the case of Indonesian palm oil export, the price elasticity of Indonesian palm oil export in the long-run is smaller than in the short-run. It can be pointed out that as there is no substitution effect of soybean oil price both in the short-run and in the long-run, the own price elasticity in the long-run is smaller than in the short-run; this reflects that foreign consumers preference and greater demand for palm oil over soybean oil.

The other important elasticity of export demand result is income elasticity of demand for Indonesian palm oil export. Income elasticity of demand predicts the response of quantity

demanded for Indonesian palm oil export when there is a change in income of foreign consumer, with the assumption that price and other factors are constant.The sign of foreign income in the short-run and in the long-run are positive sign as were expected. This means that when the foreign income decreases, the quantity demanded for Indonesian palm oil export will also increase. The results of this study show that the income elasticity of demand for Indonesian palm oil export are in-elastic both in the short- run and in the long- run. The sign is positive, both in short-run and long-run. The positive sign of coefficient of income elasticity of demand affirms that Indonesian palm oil export is normal good. The interpretation of inelastic income elasticity means that the change of quantity demanded for Indonesian palm oil export will be less than 1% when the foreign income changes by 1%. It implies that the change of budget share spent on palm oil decreases as the foreign consumer's income increases. These concords with Engel's law that describes the relationship between income and quantity demanded.The income elasticity in the short-run has value 0.61 which is larger than its value in the long-run. This means if there is increasing of income of five key importing countries of Indonesian palm oil export; the quantity demanded will increase only by 0.61 in the short-run and only by 0.31 in the long-run. In short, the results of this study suggest that the price and income elasticity for Indonesian palm oil export in the short-run are larger than in the long-run. The results are interesting because previous research has suggested that the elasticity of export demand in the long-run should be larger than in the short-run. Furthermore, the econometric result showed that soybean oil price was insignificant both in the short-run and in the long-run. It can be pointed out that as there is no substitution effect of soybean oil price both in the short-run and in the long-run, the own price elasticity in the long-run is smaller than in the short-run reflects that foreign consumer has preference and taste to demand palm oil more than soybean oil.

The domestic structure of importing countries also influences the price and income elasticity of demand for Indonesian palm oil export. The in-elastic elasticity of demand for Indonesian palm oil export suggests three characteristics of the domestic structure of importing countries for Indonesian palm oil export. The in-elastic elasticity indicates, firstly, that the availability of number substitutes to Indonesian palm oil is small; secondly, that the share of the budget for palm oil on the total expenditure of consumer in importing countries is small; thirdly that foreign consumers considers palm oil as a non-luxury good and fourth is the there are time and transaction cost which must be borne by consumer to switch from Indonesian palm oil export to others. Other factors in domestic structure of importing countries that can influence the elasticity of demand for Indonesian palm oil export are population, consumer's taste and preference. However, these are not captured in our econometric model.

Turning to the market share factor for Indonesian palm oil export, for the period 2000 to December 2011, Indonesia's market share for palm oil export is increasing significantly every year. As in December 2011, Data of FAS Report (January 2012) stated that Indonesian palm oil export has a share about 51% of total world palm oil export. Indonesia is the largest palm oil exporter in the world market. Theoretically, if a country has a large market share of total world exports, the elasticity of demand for the commodity from the country should be smaller or less elastic. The reasonable argument to support this theory is that the importer faces less opportunity to change the exporter due to the price change. The analytical result is in agreement with what the theory suggests. This study found that the price and income elasticity of demand for Indonesian palm oil export are in-elastic. This is confirmed with market share that Indonesia has nearly a half of the market share of total world palm oil export.

4.6 CONCLUSION

Indonesia is the largest of palm oil producer and exporter in the world market. Export is the major use of palm oil production. Therefore, estimating price elasticity and income elasticity of demand for Indonesian palm oil export is important. Through this study, the price elasticity and income elasticity of demand for Indonesian palm oil export were inelastic both for the short-run and the long-run. The findings of this study are in agreement with what theory suggested in terms of market share, budget share, and the usage of palm oil as input for other final goods such as cosmetic, cooking oil, margarine and the availability of substituted good for Indonesian palm oil export. These findings are important for (1) marketing strategies such as the differentiation of products (value added products), creating special services for loyal consumers and improving the quality standard and (2) government policies (trade policies and domestic policies) should be implemented by the Indonesian government to support the palm oil expansion in Indonesia. Export tax is one of trade policies implemented by Indonesia on palm oil to control domestic price of cooking oil. For domestic policies can be implemented in various forms such as production subsidies, incentives programs on research on the differentiation of products (value added products) and upgrading quality standards for Indonesian palm oil export. In the future, there is a need to analyze the price elasticity and income elasticity of products which use palm oil as input, looking at the disaggregate sectors (differentiate between CPO and refined palm oil), on specific importing country cases and analyzing using the export supply and simultaneous models.

Chapter V

Socio-Economic and Environmental Indicators for Jambi and East Kalimantan Provinces

This study focuses on Jambi and East Kalimantan Provinces as representatives for the Sumatera and Kalimantan regions. This chapter will describe study sites, socio-economic and environmental indicators related to the study sites. The environmental indicators presented in this study are related to land use change, carbon stock and carbon emission caused by land use change in the Jambi and East Kalimantan provinces. The definition of carbon emission is limited only on the change of carbon stock caused by land use change in the Jambi and East Kalimantan provinces.

5.1 Study Sites

Jambi and East Kalimantan provinces were selected as study sites for this study. Jambi province and East Kalimantan province are taken as representative for Sumatera region and Kalimantan Region respectively. The main reasons of Jambi and East Kalimantan to be used as study sites are described as follow:

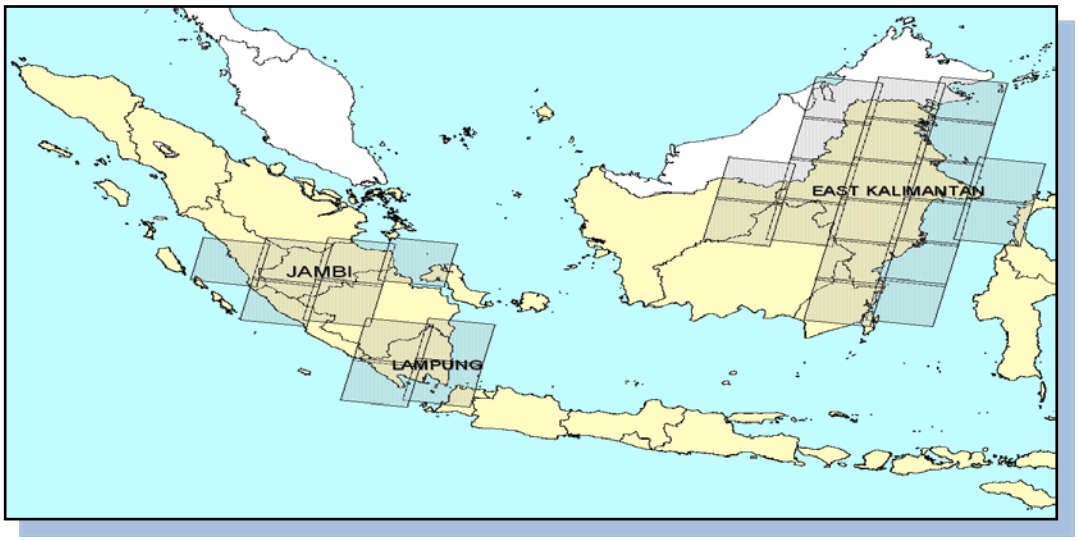
1. Jambi province has nearly an 11% share of the total area in Sumatera region. It is not the largest province in Sumatera region. But palm oil plantation in Jambi province was the second largest share of total estate crops in Jambi. Data from Estate Crops Agency in Jambi province shows that about 41% of the farmers in Jambi work for rubber producers, and about 28% of the farmers work for palm oil plantations. ICRAF data also shows that palm oil plantation is the largest percentage share of land use change in Jambi province since 1990 to 2005. In 1990, 3% of the land was used for palm oil plantations.This increased to 10% in 2000 and 11% in 2005. Moreover, starting in 1993, Jambi became

one of the transmigration areas chosen by the Indonesian government. This caused large forest conversion to be used as rubber plantation, palm plantation, settlement. The greatestnegative effect of this transmigration program is illegal logging. Therefore, it is appropriate to choose Jambi province as one of study site.

2. East Kalimantan province is the largest province in Kalimantan region. It occupies about 36% of total area in Kalimantan region. In 2005, 4% of the land was used for palm oil plantation. East Kalimantan has still large land availability to convert to estate crops and other economic activity's purpose. In 2009, about 75% of total estate crops in East Kalimantan province are palm oil. Furthermore, the Indonesian government selected the Kalimantan area as one of the targeted areas for palm oil expansion in Indonesia.

In addition, this study utilizes land sat image data from ICRAF (2005). The source of dynamically spatial data is time series of satellite imageries (Land sat Image with 30 m resolution) that cover the period of study from year 1990 to 2005. The following figure shows the Land sat image of material.

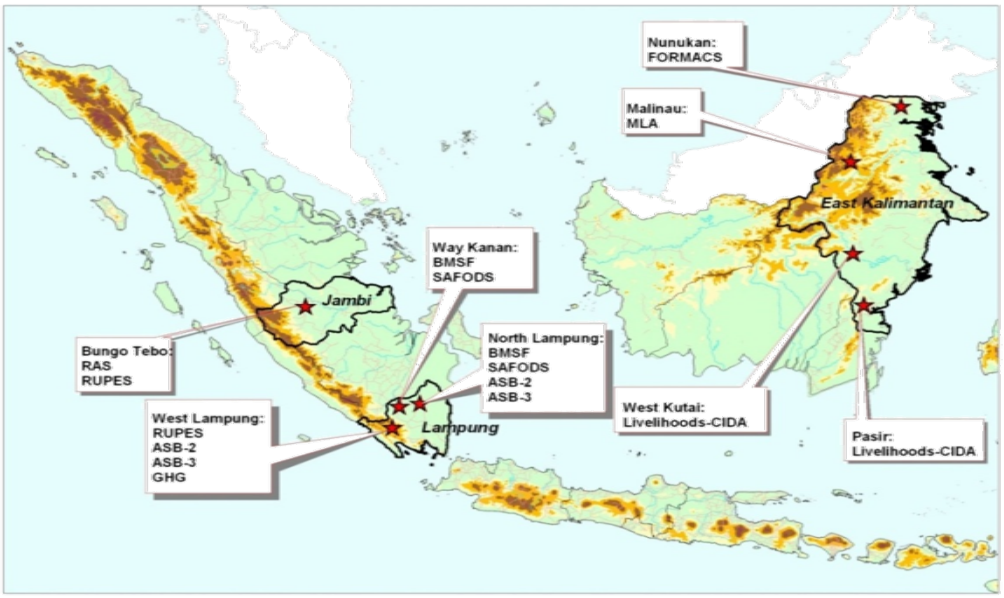
Figure 5.1 Land Sat Image of ICRAF Study Site



Source: ICRAF, Southeast Regional Office, 2007

The study site of ICRAF was in Jambi, Lampung, and East Kalimantan Province as shown on the figure 5.2. East Kalimantan Province has area approximately 220,400 sq km which is 4 times larger than total area of Jambi Province.

Figure 5.2 Map of Study Site of ICRAF



Source: ICRAF, Southeast Regional office, 2007

Table 5.1 shows the total area and percentage share of area of Jambi Province and East Kalimantan Province on total Region. Jambi is one of provinces which has 11 % share of total Sumatera Region's area. Riau province occupies 20% of the total area of the Sumatera region. In case of Kalimantan Region, East Kalimantan Province occupies 37%, and on the second rank is Central Kalimantan Province which occupies 29% of the total area of the Kalimantan region.

Table 5.1 Share of Total Area in Jambi Province and East Kalimantan Province

No	Province	Total Area (thousand sq. km)	% to Total Sumatera Area	Total Peat (thousand sq. km)	% Province Area	% to Sumatera Peat
						SUMATERA
1	Bangka Belitung	15.73	3.43	589.93*	3.70%	0.80%
2	Bengkulu	20.85	4.55	457.58*	2.20%	0.70%

No	Province	Total Area (thousand sq. km)	% to Total Sumatera Area	Total Peat (thousand sq. km)	% Province Area	% to Sumatera Peat
3	D.I Aceh	55.58	12.12	2.68	4.80%	3.90%
4	**Jambi**	**47.97**	**10.47**	**7.03**	**14.70%**	**10.10%**
5	Lampung	32.65	7.12	759.38*	2.30%	1.10%
6	**Riau**	**93.27**	**20.35**	**39.18**	**42%**	**56.40%**
7	West Sumatra	40.66	8.87	2.10	5.20%	3.00%
8	**South Sumatra**	**82.21**	**17.94**	**13.33**	**16.20%**	**19.20%**
9	**North Sumatra**	**69.44**	**15.15**	**3.39**	**4.90%**	**4.90%**
TOTAL		**458.37**		**69.51**		**100%**
KALIMANTAN						
1	West Kalimantan	143.61	27.53	17.17	12%	30%
2	South Kalimantan	36.10	6.92	3.21	9%	6%
3	**East Kalimantan**	**190.56**	**36.53**	**6.62**	**3%**	**12%**
4	**Central Kalimantan**	**151.44**	**29.03**	**29.63**	**20%**	**52%**
TOTAL		**521.71**		**56.62**		**100%**

Source: ICRAF, Southeast Regional Office, 2007

5.2 Socio-Economic Indicators of Jambi province and East Kalimantan Province

This section will present descriptive statistics of general characteristics and some economic indicators for Jambi province and East Kalimantan province. General characteristics will cover map, geographical location, population, economic structure and trends of export and sector's composition. This section will present the descriptive statistics for Jambi province as well as for East Kalimantan province.

5.2.1 Social Indicators of Jambi province

Jambi is located on the Sumatera Island, west of Indonesia. It borders Riau Province and Riau Islands Province in the north, South Chinese Sea in the east, Sumatera Selatan Province in the south, Sumatra Barat Province and Bengkulu Province in the west. Geographically, Jambi is located between 00 45' to 20 45' south latitude and 1010 10' to 1040 55' east longitude. The area of Jambi Province is 50,160.05 km^2.The province consists of nine regencies and two municipalities. They are Kerinci, Merangin, Sarolangun,

Batanghari, Muaro Jambi, Tanjung Jabung Timur, Tanjung jabung Barat, Tebo, Bungo, Jambi, and Sungai Penuh.

Figure 5.3 Map of Jambi

Source: http://baliwww.com/jambi/map.htm. Accessed on June 15, 2011.

The population of Jambi has been increasing from year 2005-2009. It reachs about 2.9 million people in 2009. Jambi City, the capital city of Jambi Province, had the highest population and smallest area, making it the densest regency with 2.3 thousand people / km². The population of Sungai Penuh City is the smallest among the 11 regencies, but the population density is second highest after Jambi.

Table 5.2 Population Density by Regency/Municipality, 2009

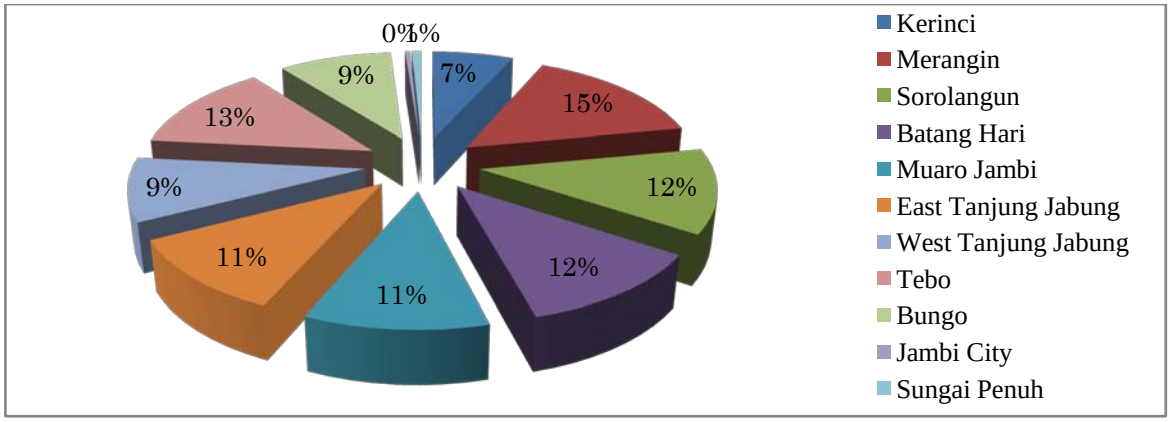
No.	Regency/ Municipality	Area (thousand km²)	Population (million people)	Population Density (people/km²)
1	Kerinci	3.36	0.23	69.66
2	Merangin	7.68	0.29	38.03
3	Sarolangun	6.18	0.22	35.29
4	Batang Hari	5.80	0.22	38
5	Muaro Jambi	5.37	0.31	59
6	East Tanjung Jabung	5.45	0.21	39
7	West Tanjung Jabung	4.65	0.26	55
8	Tebo	6.46	0.26	40
9	Bungo	4.60	0.27	58
10	Jambi City	0.02	0.48	2.32*
11	Sungai Penuh City	0.0	0.07	200
Total 2009		**50.16**	**2.83**	**57**
2008		53.44	2.79	52

No.	Regency/ Municipality	Area (thousand km²)	Population (million people)	Population Density (people/km²)
	2007	53.44	2.74	51
	2006	53.44	2.68	50
	2005	53.44	2.66	50

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2009
Note: * indicates the value is in million people

The area of Jambi province is 50,160.05 km^2. In 2009, Jambi has 11 regencies. Merangin occupied 15% of the total area, the largest percentage of any regency. Jambi city and Sungai Penuh are two smallest regencies in Jambi province. The following figure shows the share of each regency on total area of Jambi Province.

Figure 5.4 Total Area and Number Administrative by Regency/Municipality, 2009



Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers, 2009

In 2009, Jambi province had 128 districts spread among 11 regencies and municipalities. Every districts consists of rural and urban villages. Merangin, the largest regency, has 24 districts. It comprises about 200 rural villages and 10 urban villages. Jambi City is 205.43 km^2 and has only 62 urban villages in eight districts. The number of districts and villages by regency in Jambi is shown in table below.

Table 5.3 Number of Districts and Villages by Regency/Municipality in Jambi Province, 2009

No.	Regency/ Municipality	Number of Districts	Number of Rural Villages	Number of Urban Villages	Number of Urban& Rural Villages
1	Kerinci	12	207	2	209

No.	Regency/ Municipality	Number of Districts	Number of Rural Villages	Number of Urban Villages	Number of Urban& Rural Villages
2	Merangin	24	200	10	210
3	Sarolangun	10	132	9	141
4	Batang Hari	8	100	13	113
5	Muaro Jambi	8	145	5	150
6	East Tanjab	11	73	20	93
7	West Tanjab	13	64	6	70
8	Tebo	12	100	5	105
9	Bungo	17	133	12	145
10	Jambi City	8	-	62	62
11	Sungai Penuh	5	65	4	69
Total 2009		128	1219	148	1367
Total 2008		128	1179	150	1329

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2009

In Jambi, the population of people 15 years of age and over who work in Jambi Province has grown 9.91% since 2007 reaching approximately 1.3 thousand people in 2009. The amount that is not economically active also increased, but the percentage is smaller than economically active population. Jambi City had highest population of people working (15.54%), looking for work (22.21%), and not economically active (22.61%).

Table 5.4 Population 15 Years of Age and over who Worked and Not Economically Attainment by Working Status and Regency/Municipality, 2007-2009 (thousand people)

Regency/Municipality	Working	Looking for Job	Not Economically Active
Kerinci	0.12	9.72	69.00
Merangin	0.12	10.08	70.93
Sarolangun	0.09	2.76	47.95
Muaro Jambi	0.10	4.45	47.94
Batang Hari	0.14	8.76	72.56
Tanjung Jabung Timur	0.10	2.42	49.42
Tanjung Jabung Barat	0.13	5.52	48.41
Tebo	0.12	8.02	51.58
Bungo	0.11	5.77	58.20
Kota Jambi	0.20	16.41	151.01
Total	1.26	73.90	667.86
Feb 2009	1.27	69.86	643.25
August 2008	1.22	66.37	666.56
Feb 2008	1.18	74.22	675.01
August 2007	1.15	76.1	653.40

Regency/Municipality	Working	Looking for Job	Not Economically Active
Feb 2007	1.23	85.18	584.33

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2009.

As presented on the following table, population 15 years of age and over which worked in agriculture industry increased 1.73% between 2007 and 2009. In 2009, the greatest percentage of the working population (55.12%) worked in agriculture.in 2009. The second highest working population are came from trading sector which had number of 201,979 and contributed 15.89%. Meanwhile, the lowest percentage of the population, only 6,778 people, worked in the financing industry.

Table 5.5 Population 15 Years of Age and over who Worked by Industrial Origin (million people)

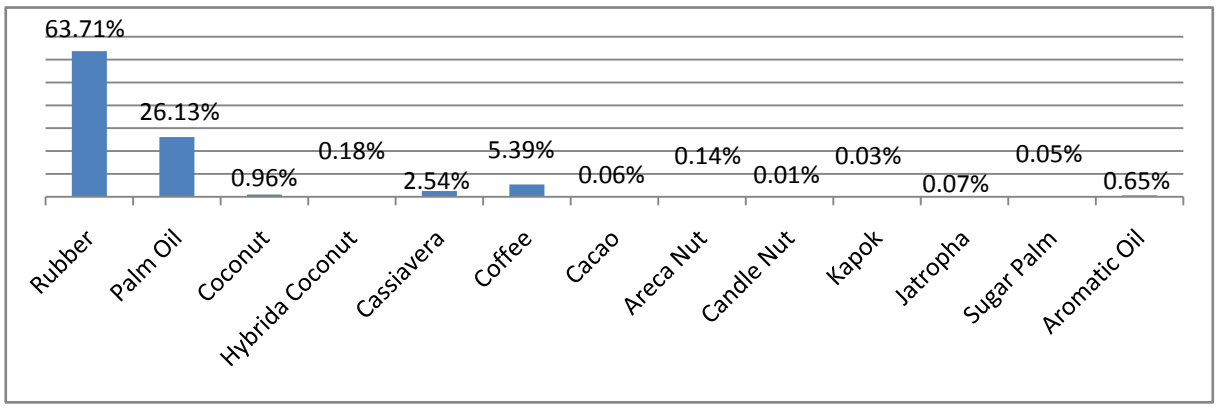
Main Industry	Feb 2007	Feb 2008	Feb 2009
Agriculture	0.69	0.69	0.70
Manufacture	0.05	0.04	0.05
Construction	0.05	0.04	0.06
Trading	0.20	0.18	0.20
Transportation	0.05	0.07	0.06
Financing	0.00	0.00	0.00
Public Services	0.13	0.13	0.17
Others	0.01	0.03	0.02
Total	1.17	1.18	1.27

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2009.

5.2.2 Economic Indicators of Jambi Province

In Jambi, farmers work mostly in the agriculture sector. The following figure shows that the highest percentage of farmers by kind of plants in Jambi province was the farmer of rubber crops, accounting to 63.71%. The second was the farmer of palm oil, which was 26.13%, coffee 5.39% and cassiavera by 2.54%.

Figure 5.5 Percentage Shares of Estate Farmers by Kind of Plants in Jambi Province, 2009



Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2009.

Jambi contributed about 16 billions rupiah or 3.67% of Sumatera Real Gross Domestic Product in 2009. The value of Jambi's RGDP rose 28.93% from year 2005. Table 5.6 also shows that the percentage share of Jambi real GDP on Sumatera and Indonesia increases annually.

Table 5.6 Percentage Shares of Real Gross Domestic Product (RGDP) of Jambi Province, 2005-2009 (%)

No	Real GDP	Year				
		2005	2006	2007	2008	2009
1	Share of Jambi on Sumatera (%)	3.41	3.43	3.50	3.57	3.67
2	Share of Jambi on Indonesia (%)	0.72	0.72	0.73	0.73	0.75

Source: Author's Calculation Based on Data of Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2009.

Furthermore, North Sumatera province had the highest percentage share of real Gross Domestic Product (GDP) to Sumatera region during 2005-2009 and was followed by Riau province. Both of them always had percentage share more than 20% each year. Jambi included to the lowest three after Bengkulu and Bangka Belitung Island. South Sumatera's share declined sharply from 13.55% in 2008 to 4.61% in 2009.

Table 5.7 Percentage Shares of Real GDP Jambi to Sumatera Region, 2005-2009 (%)

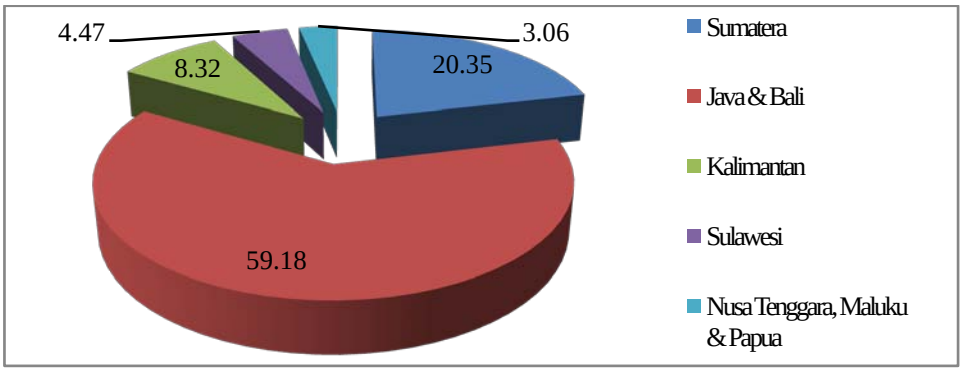
No	Percentage Share	2005	2006	2007	2008	2009
1	Nangroe Aceh Darussalam	9.82	9.47	8.81	7.96	7.26
2	North Sumatera	23.78	23.99	24.44	24.78	25.18

No	Percentage Share	2005	2006	2007	2008	2009
3	West Sumatera	7.89	7.95	8.06	8.17	8.23
4	Riau	21.45	21.43	21.11	21.26	21.15
5	Jambi	3.41	3.43	3.50	3.57	3.67
6	South Sumatera	13.43	13.42	13.53	13.55	4.61
7	Bengkulu	1.69	1.70	1.72	1.72	1.73
8	Lampung	7.95	7.93	8.01	8.03	8.16
9	Bangka Belitung Islands	2.36	2.33	2.32	2.31	2.31
10	Riau Islands	8.22	8.34	8.50	8.64	8.65
11	Sumatera Region	21.11	21.06	20.79	20.57	20.35

Source: Author's Calculation based on data from Bureau of Central Statistics,"Real GDP by Regions", 2010

Among provinces in Indonesia, Java and Bali region had the highest percentage share on total Indonesia real GDP. Its share was about more than 50% per annum and reached 59.18% in 2009. The second highest was from Sumatera region which reached more than 20% each year. Nusa Tenggara, Maluku, and Papua region had the lowest contribution of total real GDP. It had 3.06% share in 2009 and the percentage fluctuated per year.

Figure 5.6 Percentage Shares of Real GDP Provinces on Total Indonesia, 2009



Source: Bureau of Central Statistics, "Real GDP By Regions", 2010

In term of export value, Jambi province has export value fluctuated since 2000 to 2009. Its value was keep decreasing in 2001 before rose again for about 100% in 2006. In 2009, Jambi's export value decreased 31.64% from a year before, eventhough the share on Indonesia export value significantly was rising from 1.02% to 10.19%. That was because export value of Indonesia declined sharply about 99.99%.

Table 5.8 Percentage Shares of Export value of Jambi Province to Indonesia Export Value, 2002-2009 (%)

No	Export Value	Year									
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Jambi Province (in thousands US$)	455.75	511.378	416	469	450.91	418.88	838.80	1.08*	1.19*	813.44
2	Indonesia (in million US$)	56.32	57.160	61.60	71.59	85.66	100.80	114.10	137.02	116.51	79.84
3	Share of Jambi Export on Indonesia (%)	0.81	0.89	0.68	0.66	0.53	0.42	0.74	0.79	1.02	10.19

Source: Buraeu of Central Statistic, "Statistical Year Book " (various years)
Note: * indicates the values are in million US$

Therefore, the economic structure of Jambi province can be seen on the real GDP components. Real GDP of Jambi province was dominated by agriculture, livestock, forestry, and fishery sector. In general, the percentage share increased each year but was stable about 31% during 2007-2009. Meanwhile, the other sector also had stable percentage of GDP share.

Table 5.9 Percentage Shares of Sectoral Composition of Real GDP Jambi Province, 2005-2009 (%)

No	Percentage Share	Year				
		2005	2006	2007	2008	2009
1	Agriculture, Livestock, Forestry and Fishery	30	32	31	31	31
2	Mining and Quarrying	13	11	11	12	12
3	Manufacturing Industries	14	14	14	13	13
4	Electricity, Gas and Water Supply	1	1	1	1	1
5	Construction	4	4	5	5	5
6	Trade, Hotel and Restaurant	17	17	17	17	17
7	Transport and Communication	8	8	8	8	8
8	Finance, Real Estate and Business Services	4	4	4	5	5
9	Services	9	9	9	9	9
10	Real GDP	100	100	100	100	100

Source: Author's Calculation based on data from Bureau of Central Statistics, "Statistical Yearbook and Jambi in Numbers", 2010

Furthermore, the highest share of agriculture sector in Jambi Real GDP was 47.05% from estate crops sub sector. It increased significantly about 5.37% from year 2005. Food

crops was in second rank. The percentage share fluctuated each year and was about 37.29% in 2009 as shown in table 5.11.

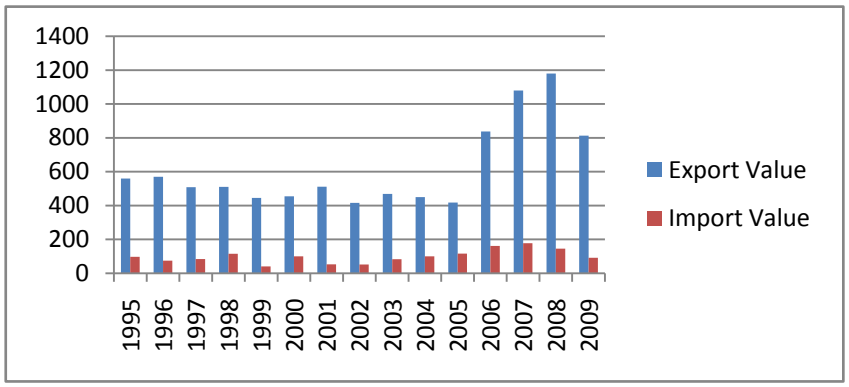
Table 5.10 Subsector Composition of Agriculture, Livestock, Forestry and Fishery in Real GDP of Jambi Province (2005-2009)

No	Percentage Share	Year (%)				
		2005	2006	2007	2008	2009
1	Food Crops	38.61	36.59	36.49	36.92	37.29
2	Estate Crops	41.68	46.87	46.70	46.83	47.05
3	Livestock	7.84	6.90	6.74	6.52	6.36
4	Forestry	6.98	6.39	6.20	5.78	5.28
5	Fisheries	4.88	3.25	3.88	3.94	4.02

Source: Author's Calculation

The Value of export in Jambi province since 1995 to 2008 has fluctuated. In 1995, Jambi province had value of export was only 560 thousand US$, and it decreased in 2005 and value of export was 418 thousand US$, and it increased in 2008 became 1.2 million US$. The similar situation was also happened on the import value. It fluctuated from year 1995 to 2009. The import value of Jambi province in 1995 was 96 thousand US$, and it increased become 146 thousand US$. The highest import value was in 2007 by having import value 179 thousand US$.

Figure 5.7 Value of Export and Import of Jambi Province, 1995-2009 (thousand US$)



Source: Bureau of Statistics of Jambi Province, “Jambi in Numbers”, 2010

Table 5.11 shows the export value for some commodities for the period of 2008-2009. In total, the export value of Jambi Province in 2009 decreased from its value in 2008. The export value in 2008 was 1.2 million US dollars and decreased to 813 thousand US dollars in 2008. Rubber and its processing products have the highest export value. In 2008 and 2009, export value of rubber and its processing products was 544 thousand US$ and 301 thousand US$ respectively. Oil and Gas is on the second rank by having export value 334 thousand US$ in 2008 and 293 thousand US$ in 2009. Another commodity which has high export value is vegetable oil and fats. It has export value 124 thousand US$ in 2008 and 101 thousand US$ in 2009.

Table 5.11 Value of Type Commodity in Jambi Export, 2008-2009

No	Kind of Commodity	Value of Export (thousand US$)	
		2008	2009
1	Fruits	13.14	17.57
2	Fats and vegetable Oil	124.19	100.64
3	Oil and Gas	332.91	292.88
4	Rubber and its processing products	543.25	301.06
5	Wood and its processing products	72.95	28.26
6	Pulp	52.84	36.64
7	Cartoon	40.74	32.78
8	Others	9.89	3.55
Total		**1.19***	**813.37**

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2010
Note: * indicates the value is in million US$

As shown on table 5.12, Singapore is the major destination for Jambi exported commodities. In 2008, About 31% of total Jambi's export are going to Singapore. It is mainly because of geographical location of Singapore. Two major partner countries are Malaysia and Japan. In 2009, Malaysia has share about 19% and Japan has 13% on total export of Jambi province.

Table 5.12 Shares of Major Destination Countries on Jambi's Total Export, 2008-2009

No	Country of Destination	Total Export (%)	
		2008	2009
1	America	7.67	6.41
2	Others	23.97	23.82
3	Japan	13.40	12.82
4	Australia	9.71	4.78
5	Singapore	30.64	25.26
6	Thailand	1.33	8.47
7	Malaysia	13.27	18.44
Total (000$)		**1.19***	**747.93**

Source: Author's Calculation Based on Data of Bureau of Statistics of Jambi Province, "Jambi In Numbers", 2010.
Note: * indicates the value is in million US$

In addition to economic structure of Jambi province, the local revenue has the highest share about 44%, tax revenue and non tax has share 24%, and the rest of the budget calculation over the past year is 32% on total government budget of Jambi province in 2009.

Table 5.13 Percentage Shares of Realization of Government Budget of Jambi Province, 2009 (%)

		Revenue	Percentage Share
1.		The rest of the budget calculation over the past year	32
2.		Local Revenue	44
	2.1	Local taxes	83
	2.2	Retribution	7
	2.3	Profits of State-Owned Enterprises	2
	2.4	Proceeds from Agencies	0
	2.5	Other Receipts	8
3.		Tax Revenue / Non-Tax	24
	3.1	Tax Revenue	46
	3.2	Non Tax Revenue	54
4.		Donations and Help	0
	4.1	Donations	0
	4.2	Help	0
5.		Acceptance of Development	0
	5.1	Local Government Loan	0
	5.2	Loans to enterprises	0
Total			100

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers",2010

Since 2001, the number of palm oil plantations has increased each year especially in Sumatera. The share of Jambi's palm oil plantation on total Indonesia reached the highest percentage in 2006. After that year, the share decreased to 9.44% in 2009. The lowest share of Jambi's palm oil plantation happened in 2008 which was about 9.29% on total Sumatera and 6.49% on total Indonesia.

Table 5.14 Percentage Shares of Jambi's Palm Oil Plantation, 2004-2009

No	Provinces	2004	2005	2006	2007	2008	2009**
1	Jambi (thousand Rupiah)	0.37*	0.40*	0.57*	0.45*	0.46*	0.49*
2	Total Sumatera (thousand Rupiah)	3.99*	4.10*	4.81*	4.81*	4.90*	5.13*
3	Indonesia Total (thousand Rupiah)	5.29*	5.45*	6.60*	6.77*	7.01*	7.32*
4	Share of Jambi on total Sumatera (%)	9.36	9.84	11.80	9.33	9.29	9.44
5	Share of Jambi on total Indonesia (%)	7.05	7.40	8.61	6.63	6.49	6.62

Source: Author's Calculation Based on Data of Bureau of Central Statistics, "Statistical Year Book", 2010

The following table presents the shares of each type of plantations in Jambi Province in 2010. Rubber has the highest share in Jambi province. Palm oil is on the second rank, by having 36% of total plantation. Coconut had the third highest percentage of area of plantation, amounting to nine percent. Other crop residues had a percentage of not more than three percent.

Table 5.15 Percentage Shares by Each Type of Plantations in Jambi Province, 2010 (%)

Type of Plantation	Share
Rubber	48%
Palm Oil	36%
Coconut	9%
Others	7%

Source: Author's Calculation Based on Data of Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2010

In addition, the following table presents the palm oil production in regencies in Jambi province. In 2009, about 1.23 Mega tons were produced from eight regencies

including Merangin, Sarolangun, Batang Hari, Muaro Jambi, West Tanjab, East Tanjab, Tebo, and Nungo. West Tanjab regency contributed highest share of palm oil production about 0.23 Mega tons or about 21%. The Second highest production was rubber plant which was about 0.3 Mega tons were produced in nine regencies.

Table 5.16 Production of Plantation by Kind of Plant and Regency/Municipality (tons), 2009

Kind of Plant	Regency/Municipality										Total
	Kerinci	Merangin	Saro-langun	Batang Hari	Muaro Jambi	West Tanjab	East Tanjab	Tebo	Nungo	Jambi City	
Rubber	242	49,598	51,169	61,989	33,796	7,385	1,992	48,915	27,800	-	0.28*
Palm oil	-	157,269	100,528	161,461	29725	256,746	33,385	86,089	145,221	-	1.24*
Coconut	38	871	310	606	629	57,824	51,871	552	441	-	0.11*
Hybrida Coconut	-	107	-	106	32	-	14	-	-	-	259
Cassiavera	52,490	4,024	-	-	-	-	-	-	12	-	0.06*
Coffee	1,989	5,775	22	73	53	944	1,727	287	64	-	0.01*
Pepper	2	1	4	21	1	2	3	-	-	-	34
Clove	37	-	-	-	-	-	-	-	-	-	37
Cacao	2	30	-	92	210	21	150	21	-	-	526
Areca Nut	154	208	157	-	3	12,266	5,032	77	28	-	0.02*
Candle Nut	184	16	1	9	6	-	-	-	-	-	216
Kapok	-	38	-	12	3	-	-	-	-	-	53
Sugar Palm	-	23	2	36	23	-	-	-	-	-	84
Vanily	1	-	-	-	-	-	-	-	-	-	1
Tea	5,925	-	-	-	-	-	-	-	-	-	0.01
Sugar Cane	2,435	-	-	-	-	-	-	-	-	-	0.02
Tobacco	48	-	-	-	-	-	-	-	-	-	48
Aromatic Oil	12	126	5	-	-	-	-	-	-	-	173

Source: Bureau of Statistics of Jambi Province, "Jambi in Numbers", 2010
Note: * indicates the value is in mega tons

5.2.3 Social Indicators of East Kalimantan Province

The map of East Kalimantan Province is shownbelow. The areas of East Kalimantan which comprise 198,441.17 km^2 of land areas and 40,693.92 km^2 of ocean management areas is located between 113°44' East Longitude and 119°00' East Longitude and between 4°24'

North Latitude and 2°25' South Latitude. By the existence of growth and rising area, East Kalimantan province is divided into ten regencies, four municipalities, 136 sub districts and 1,445 villages. Those regencies are Pasir by the capital is Tanah Grogot, West Kutai by the capital is Sendawar, Kutai Kartanegara by the capital is Tenggarong, East Kutai by the capital is Sangatta, Berau by the capital is Tanjung Redeb, Malinau by the capital is Malinau, Bulungan by the capital is Tanjung Selor, Nunukan by the capital is Nunukan, Penajam Paser Utara by the capital is Penajam and Tana Tidung by the capital is Tideng Pale (expansion of Bulungan). While the four municipalities are Balikpapan, Samarinda, Tarakan and Bontang.

Figure 5.8 Map of East Kalimantan Province

Source: http://sunborneo.blogspot.com/2010/05/east-kalimantan-tourism-borneo.html. Accessed on July 7, 2011.

From 2005 to 2009, the total population of East Kalimantan Province increased yearly, as shown on the following table. This increasing trend was present in every regency in East Kalimantan Province, as populations in each regency

increased each year from 2005 through 2009. Regency which had the largest population in 2009 was Samarinda that was equal to 609,380 people.

Table 5.17 Population by Regency (million person)

No	Regency/City	2005	2006	2007	2008	2009
1	Paser	0.12	0.17	0.18	0.18	0.18
2	West Kutai	0.15	0.16	0.16	0.16	0.16
3	Kutai Kertanegara	0.50	0.51	0.52	0.53	0.54
4	East Kutai	0.17	0.18	0.19	0.19	0.20
5	Berau	0.15	0.16	0.16	0.17	0.18
6	Malinau	0.05	0.05	0.06	0.06	0.06
7	Bulungan	0.10	0.11	0.11	0.12	0.12
8	Nunukan	0.11	0.12	0.13	0.13	0.14
9	North Penajam Paser	0.12	0.12	0.13	0.13	0.13
10	Balikpapan	0.48	0.49	0.50	0.51	0.52
11	Samarinda	0.58	0.59	0.60	0.60	0.61
12	Tarakan	0.16	0.17	0.18	0.18	0.20
13	Bontang	0.12	0.13	0.13	0.13	0.14
Total		**2.89**	**2.96**	**3.03**	**3.09**	**3.17**

Source: Bureau of Statistics of East Kalimantan Province, " East Kalimantan Province in Numbers", 2010

The following table presents the distribution and growth rate of population by regency/city in East Kalimantan Province from year 2005 to 2009. The total population distribution in East Kalimantan province from year 2005 to 2009 was stable. However, the population distribution in each regency fluctuated.

Table 5.18 Distribution and Growth Rate of Population by Regency/City, 2005-2009 (%)

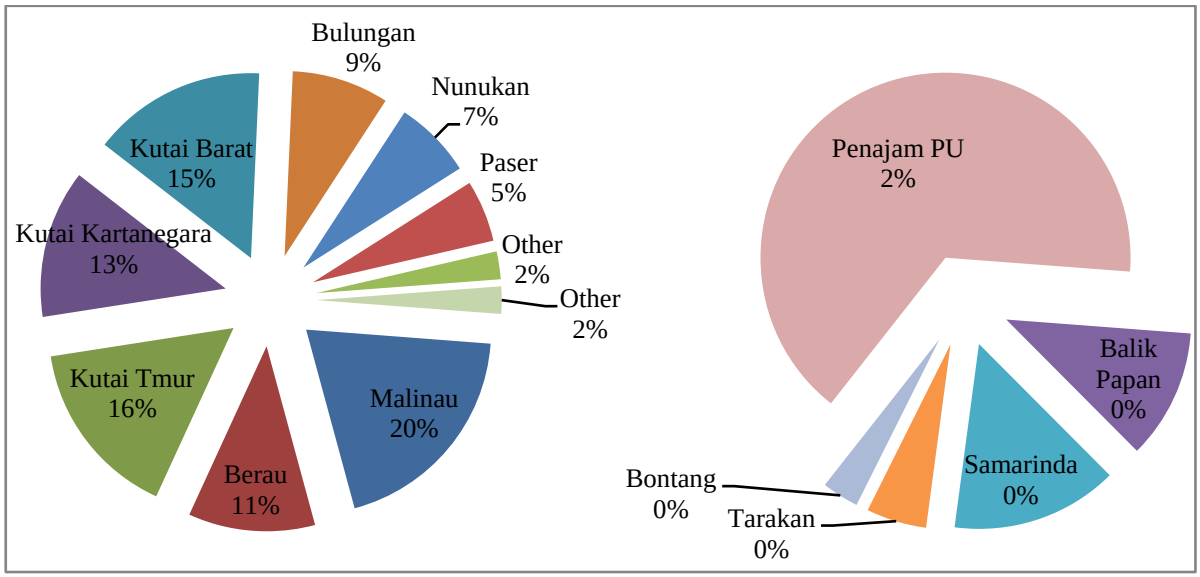
No	Regency/City	Population Distribution					Growth			
		2005	2006	2007	2008	2009	2006	2007	2008	2009
1	Paser	6.14	6.06	5.98	5.91	5.83	1.07	1.02	0.97	0.91
2	Kutai Barat	5.32	5.27	5.22	5.17	5.11	1.37	1.32	1.27	1.20
3	Kutai Kartanegara	17.27	17.21	17.15	17.08	17.02	2.02	1.98	1.92	1.86
4	Kutai Timur	6.13	6.15	6.17	6.20	6.22	2.78	2.73	2.68	2.61
5	Berau	5.23	5.31	5.40	5.49	5.57	4.07	4.02	3.39	3.90
6	Malinau	1.74	1.80	1.85	1.91	1.97	5.62	5.57	5.51	5.44
7	Bulungan	3.59	3.63	3.67	3.71	3.75	3.50	3.46	3.40	3.34
8	Nunukan	3.86	4.00	4.15	4.29	4.45	6.05	6.01	5.59	5.89
9	Penajam P. U	4.24	4.19	4.14	4.08	4.03	1.09	1.05	1.00	0.93

No	Regency/City	Population Distribution					Growth			
		2005	2006	2007	2008	2009	2006	2007	2008	2009
10	Balikpapan	16.54	16.49	16.44	16.38	16.32	2.06	2.01	1.96	1.90
11	Samarinda	20.22	19.98	19.74	19.50	19.25	1.15	1.11	1.06	0.99
12	Tarakan	5.48	5.64	5.80	5.96	6.12	5.27	5.22	5.17	5.10
13	Bontang	4.24	4.27	4.30	4.33	4.36	3.14	3.10	3.05	2.98
Total		**100**	**100**	**100**	**100**	**100**	**2.37**	**2.34**	**2.31**	**2.27**

Source: Bureau of Statistics of East Kalimantan Province, "East Kalimantan in Numbers", 2010

The total area and number administrative in East Kalimantan is presented in figure 5.14. Malinau regency occupies the largest area on the east Kalimantan province, amounting to 20%. The share of other regencies can be seen on the following figure:

Figure 5.9 Total Area and Number Administrative by Regency/Municipality, 2009



Source: Bureau of Statistics of East Kalimantan Province, "East Kalimantan In Numbers", 2010

The following table presents the number of districts in East Kalimantan province is less than the number of villages. The most districts is found in West Kutai, as many as 21 districts. Compared to West Kutai, Malinau in fact has a larger area, specifically 39799.88 km^2. However, the number of districts and villages in the regency is far below the number in West Kutai.

Table 5.19 Number of Districts and Villages by Regency/Municipality in East Kalimantan Province, 2009

No	Regency/City	Number of Districts	Number of Villages	Land Area (thousand km^2)	%
1	Paser	10	130	10.94	5.51
2	West Kutai	21	238	30.94	15.59
3	Kutai Kartanegara	18	227	26.33	13.37
4	East Kutai	18	135	31.89	16.07
5	Berau	13	107	22.52	11.35
6	Malinau	12	108	39.80	20.06
7	Bulungan	10	81	17.25	8.69
8	Nunukan	9	227	13.86	6.99
9	Penajam P.U	4	54	3.21	1.62
10	Tana Tidung	3	23	4.83	-
11	Balikpapan	5	27	560.70*	0.28
12	Samarinda	6	53	718.23*	0.36
13	Tarakan	4	20	215.81*	0.13
14	Bontang	3	15	163.39*	0.08
Total		**136**	**1,445**	**203.27**	**100**

Source : Bureau of Statistics of East Kalimantan Province, "East Kalimantan Province", 2010
Note: * indicates the values are not in thousand km^2

As shown on the following table, from 2007 to 2009, the number of 15 year olds working has 67 % share of total people. The amount of the working population had a positive improvement trend from 2007 to 2009. In 2009, the population of working and seeking work were not much different, where the working population was at 64.41% and a population looking for work was at 57.44%. In 2007, the working population was at 54.30% and looking for work was at 7.45%.

In the not-economically active group, the number of people doing house keeping chores at home was larger than the number attending school. The population of the house keeping increased from 2007 to 2009. However, the number of people doing activities other than those listed fluctuated from 2007 until 2009.

Table 5.20 Shares of Labor Populations Aged 15 Years According to Main Activity, 2007-2009 (%)

Activity	2007	2008	2009
	%	%	%
I. Economically Active	67.76	64.31	64.41
a. Working	54.30	57.16	57.44
b. Seeking Work	7.45	7.14	6.98
II. Not Economically Active	38.24	35.69	35.59
a. Attending School	9.90	9.06	9.16
b. House Keeping	23.55	22.47	22.58
c. Others	4.79	4.16	3.85
Total	**100**	**100**	**100**

Source: Bureau of Statistics of East Kalimantan Province, "East Kalimantan Province in Numbers", 2010

5.2.4 Economic Indicators of East Kalimantan Province

As shown in following table, East Kalimantan give the biggest contribution to the real GDP Kalimantan region. It produced 58.26% of real GDP in 2009 but its production has been declining gradually for 4 years from 60.68% in 2005.Conversely, the contribution of West Kalimantan and South Kalimantan has increased every year. They become the second and third highest after East Kalimantan.

Table 5.21 Percentage Shares of Real GDP East Kalimantan Province to Kalimantan Region, 2005-2009 (%)

No	Percentage Share	Year				
		2005	2006	2007	2008	2009
1	West Kalimantan	15.21	15.41	15.79	15.81	16.01
2	Central Kalimantan	9.07	9.24	9.47	9.56	9.74
3	South Kalimantan	15.05	15.22	15.59	15.73	15.97
4	East Kalimantan	60.68	60.12	59.15	58.90	58.26
Kalimantan Region		8.84	8.70	8.47	8.41	8.32

Source: Author's Calculation Based on Data of Bureau of Central Statistics, "RGDP By Regions", 2010

Export value of East Kalimantan fluctuated each year since 2000 to 2009. In 2009, Jambi's export value decreased 23.39% from a year before, eventhough the share on Indonesia export value significantly was rising from 21.2% to 237%. That was because export

value of Indonesia declined sharply about 99.99%. During 2008-2009 total Indonesia export value decreased from 117 million US$ to only 80 million US$.

Table 5.22 Shares of Export Value of East Kalimantan Province to Indonesian Export Value, 2005-2009 (%)

No	Export Value	Year									
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Kalimantan Province (in thousands US$)	8.51	8.86	7.75	9.03	10.91	14.23	16.27	16.66	24.70	18.92
2	Indonesia (in million US$)	56.32	57.16	61.06	71.58	85.66	100.80	114.10	137.02	116.51	80
3	Share of Kalimantan Export on Indonesia (%)	15.12	15.50	12.69	12.61	12.74	14.11	14.25	12.16	21.20	23.70

Source: Author's Calculation based on data from Bureau of Statistics of East Kalimantan Province, 2010

Looking on the economic structure of East Kalimantan Province, the composition of real GDP consisted by nine sectors. Mining and Quarrying, Manufacturing industries, and agriculture are three important sectors for the economic structure of East Kalimantan province. In 2009, these sectors have share in Real GDP of East Kalimantan Province about 41%, 30%, and 7% respectively. Many large companies of manufacturing and plantations are located in Kalimantan region.

Table 5.23 Sectoral Composition of Real GDP East Kalimantan Province, 2005-2009 (%)

No	Percentage Share	Year				
		2005	2006	2007	2008	2009
1	Agriculture, Livestock, Forestry and Fishery	6.72	6.76	6.76	6.57	6.49
2	Mining and Quarrying	38.14	38.60	38.95	39.32	40.84
3	Manufacturing Industries	36.28	34.39	32.47	31.98	29.97
4	Electricity, Gas and Water Supply	0.29	0.30	0.31	0.31	0.32
5	Construction	2.93	3.07	3.39	3.48	3.72
6	Trade, Hotel and Restaurant	7.00	7.73	8.26	8.15	8.46
7	Transport and Communication	4.48	4.81	5.14	5.29	5.58
8	Finance, Real Estate and Business Services	2.31	2.45	2.79	2.92	3.10
9	Services	1.86	1.88	1.93	1.98	2.05
10	Real GDP	100	100	100	100	100

Source: Author's Calculation Based on East Kalimantan In Numbers, 2010

Agriculture sub sector composition in real GDP highest share come from forestry which had 27.87% in 2009. But forestry share was declining gradually about 2.38% each year. Other sectors rose during 2005-2009 as shown on table below. Fisheries had 22.79% share of agriculture real GDP and got second rank. The lowest share was livestock which about 11.89% in 2009.

Table 5.24 Subsector Composition of Agriculture, Livestock, Forestry and Fishery in East Kalimantan Real GDP, 2005-2009 (%)

No	Percentage Share	Year				
		2005	2006	2007	2008	2009
1	Food Crops	18.23	18.97	19.29	20.56	21.06
2	Estate Crops	12.66	14.20	14.58	15.18	16.41
3	Livestock	10.71	10.76	11.28	11.62	11.89
4	Forestry	37.37	35.35	32.81	30.59	27.87
5	Fisheries	21.03	20.72	22.04	22.07	22.79

Source: Author's Calculation Based on East Kalimantan in Number, 2010

Manufacturing sector has two sub sectors which are oil and gas along with non-oil and gas. In general, oil and gas share of East Kalimantan real GDP declined each year. It was about 85.92% in 2005 then decreased to 82.04% in 2009. Petroleum refinery and Liquified Natural Gas (LNG) as part of oil and gas manufacturing had fluctuated share.

Table 5.25 Subsector Composition of Manufacturing in East Kalimantan Real GDP, 2005-2009(%)

No	Sub Sector	Year				
		2005	2006	2007	2008	2009
A	Oil and Gas Manufacturing	85.92	84.97	83.49	83.12	82.04
	1. Petroleum Refinery	19.52	18.33	18.02	20.42	19.44
	2. Liquefied Natural Gas (LNG)	80.48	81.67	81.98	79.59	80.56
B	Non-Oil and Gas Manufacturing	14.08	15.03	16.51	16.88	17.96

Source: Author's Calculation Based on Data of Bureau of Statistics of East Kalimantan Provimce, "East Kalimantan In Number", 2010

Non-oil and gas contributed highest share of East Kalimantan mining sector real GDP. The contribution reached 51.44% in 2009 and has increased per year since 2005. Oil

and gas mining, on the other hand, get significant decreasing percentage share during 2005-2009 as can be seen in table 5.25.

Table 5.26 Subsector Composition of Mining Sector in East Kalimantan Real GDP, 2005-2009 (%)

No	Sub sector	Year				
		2005	2006	2007	2008	2009
1	Oil and Gas Mining	61.91	55.07	49.52	48.66	47.06
2	Non-Oil and Gas Mining	36.75	43.57	48.98	49.86	51.44
3	Quarrying	1.34	1.36	1.50	1.48	1.50

Source: Author's Calculation Based on Data of Bureau of Statistics of East Kalimantan Province, "East Kalimantan RGDP", 2010

The following table presents foreign trade balance for East Kalimantan province from the year 2000–2010. Since 2000 to 2008, East Kalimantan province has increasing value of export, and then as a result, the surplus also increased. The highest value of export was in 2008, it was 24 million US$ and the import value was 19 million US$.

Table 5.27 Foreign Trade Balance of East Kalimantan Province, 2000-2010 (thousand US$)

Year	Export Value	Import Value	Surplus
2000	8.51	1.30	7.22
2001	8.86	1.78	7.08
2002	7.75	1.86	5.88
2003	9.03	2.22	6.81
2004	10.91	2.74	8.17
2005	14.28	3.51	10.77
2006	16.26	4.25	12.01
2007	16.66	4.26	12.40
2008	24.70	5.33	19.47
2009	18.92	4.88	14.04

Source : Bureau of Statistics of East Kalimantan Province, "East Kalimantan in Numbers", 2010

Therefore, since 2004 to 2008, export value for oil was higher than export value of non oil. The export value of oil was twice as large than non oil. But in 2009, the value changed. The export value of non oil was higher than oil. It has export value 50 thousand US dollars while the export value of oil was 49 thousand US$.

Table 5.28 Export Value of Oil and Non-Oil Products, 2004-2009 (thousand US$)

Year	Oil	Non Oil
2004	78.32	21.68
2005	75.79	24.20
2006	71.36	28.64
2007	70.85	29.15
2008	68.93	31.07
2009	50.00	50.90

Source: Author's Calculation Based on Data of BPS, East Kalimantan Province, 2010

East Kalimantan's value of imports oil and non oil was fluctuated as shown in table below. The value of oil imports declined in 2005 and 2008. The value has declined about 19.27% from 2004 to 2009. Non oil import value was also not stable because it decreased 30.2% in 2007. But in general, the value had significant increasing about 89.16% during 2004-2009.

Table 5.29 Import Value of Oil and Non Oil, 2004-2009 (thousand US$)

Year	Oil	Non Oil
2004	82.21	17.79
2005	71.50	28.50
2006	71.91	28.09
2007	80.40	19.61
2008	66.45	33.55
2009	66.37	33.64

Source: Author's Calculation Based on Data of BPS, East Kalimantan Province, 2010

Liquid natural gas had highest share of main commodities on total export value of East Kalimantan province. The share was about 45% in 2008 and decreased to 34% in 2009. Crude oil to be refined share which was in third highest also decreased about 2% in 2009. Meanwhile, increasing percentage share happened to other coal and methanol commodities. Both of them had 4% of increasing.

Table 5.30 Percentage Shares of Main Commodities on Total Export Value of East Kalimantan Province, 2008-2009 (%)

No	Commodities	Percentage Share	
		2008	2009
1	Liquid Natural Gas	45	34

No	Commodities	Percentage Share	
		2008	2009
2	Bituminous Coal (cooking coal)	22	22
3	Crude Oil to be Refined	17	15
4	Other Residues of Petroleum Oils or Oils Obtained from Bituminous Min	7	9
5	Other Coal	3	7
6	Methanol (Methyl Alcohol)	1	5
7	Anhydrous Ammonia	2	1
8	Plywood with at least one outer ply of tropical wood Lt. 6 MM Thicken	1	1
9	Others	3	5
Total		**100**	**100**

Source: Author's Calculation Based on Data of Bureau of Statistics of East Kalimantan Province, "East Kalimantan in Numbers, 2010

In 2009, he value of exports to Japan increased sharply and Japan became the leading importer of commodities from East Kalimantan. From 2008 to 2009, the value increased from 6.83% to 34.22%.Conversely, export value to other country such as China, Republic of Korea and Australia was declining. Highest declining was export value to others which was about 12.2%.

Table 5.31 Export Value by Main Destination Country, 2008-2009

No	Destination Country	Share (%)	
		2008	2009
1	Japan	6.83	34.22
2	China	25.30	13.82
3	Korea, Republic of	17.05	13.71
4	Australia	10.21	9.84
5	Others	40.61	28.41
Total		**100**	**100**

Source: Author's Calculation Based on Data of Bureau of Statistics of East Kalimantan Province, "East Kalimantan in Numbers", 2010

It is well known that East Kalimantan Province is the largest forest area in Indonesia. Rural population density is very low, because about 78% of the East Kalimantan area is forest. Logging is one of main economic activities for people in East Kalimantan Province. Since

2004 to 2009, there is incresing share of palm oil production in East Kalimantan province. This number is projected to increase due to Indonesian government plan on palm oil sector.

Table 5.32 Share of East Kalimantan's Palm oil Plantation (%)

No	Provinces	2004	2005	2006	2007	2008*	2009**
1	Share of East Kalimantan on total Kalimantan Region (%)	15.5	17.5	15.4	14.6	20.2	20.4
2	Share of East Kalimantan on total Indonesia (%)	3.2	3.7	3.6	5	5.3	5.3

Source: Author's Calculation Based on Data of Bureau of Statistics of East Kalimantan Province, "East Kalimantan in Numbers", 2010

The following table shows that palm oil plantations occupied the largest percentage of planted areas in East Kalimantan The share keep increased during 2005-2009 and reached 75% in 2009. Meanwhile, percentage share of other plantation decreased gradually. Rubber as second largest plantation area decreased from 16.19% in 2005 to 11.19% in 2009.

Table 5.33 Percentage Shares of Planted Area of Each Type Plantation, 2005-2009 (%)

No	Type of Plantation	Planted Area				
		2005	2006	2007	2008	2009
1	Rubber	16.19	15.45	14.17	13.41	11.19
2	Coconut	11.83	11.35	7.21	6.00	4.91
3	Coffee	4.61	4.14	3.15	2.77	2.25
4	Pepper	3.58	3.51	3.03	2.67	2.20
5	Cloves	0.06	0.06	0.04	0.04	0.03
6	Cocoa	9.67	9.82	7.21	6.21	4.92
7	Palm Oil	52.14	53.59	65.00	69.00	75.00
8	Others	1.91	2.08	0.00	0.00	0.00
Total		100	100	100	100	100

Source: Author's Calculation Based on Data of East Kalimantan in Numbers, 2010

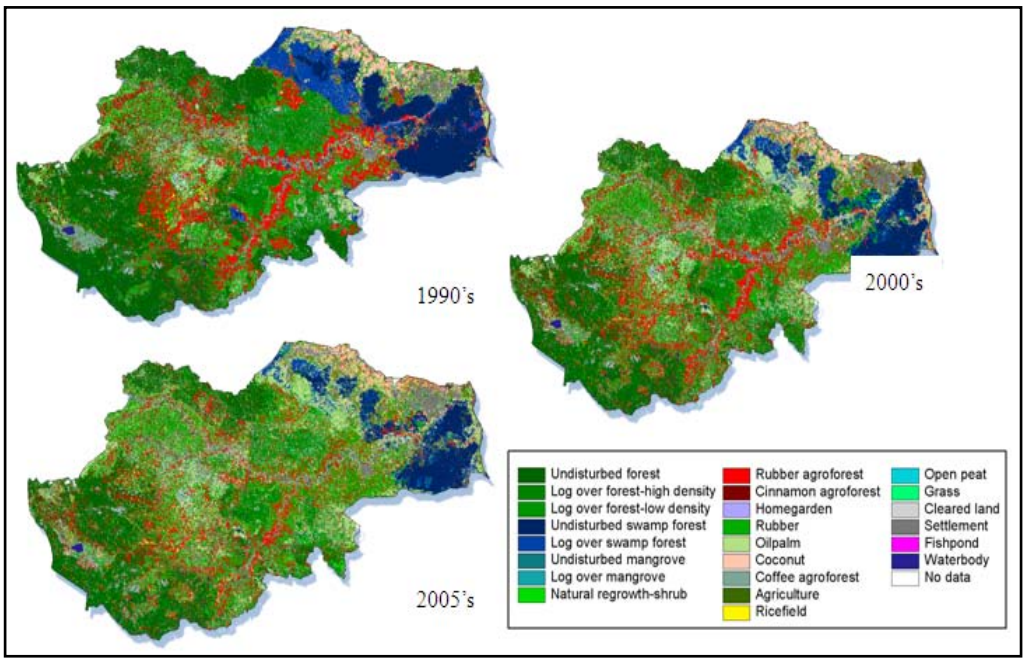
5.3 Environmental Indicators for Jambi and East Kalimantan Province

As is presented previously, this study utilizes land cover map conducted by ICRAF, Southeast Regional Office, Bogor, Indonesia (2005). Therefore, this section will present how land use in Jambi province and East Kalimantan province change since 1990 to 2005.

5.3.1 Land Use Change in Jambi Province

As shown on the following figures, the Jambi province has seen increasing deforestation or conversion of forested areas to non-forest land use from 1990 to 2005. Logging and rubber processing industry were accounted nearly 99% for export in 1993. Indonesian government encouraged the transmigration system to Jambi province since 1990. As a result, the conversion of forest area to agriculture and settlement has increased greatly. Hence, recently Jambi province has only 34% of forest area, while remains are converted to state forest land, rubber agro forest and other forms of agriculture. The detailed explanation of each category of land use can be seen on the Appendix.

Figure 5.10 Land Cover Map of Jambi, 1990, 2000, 2005

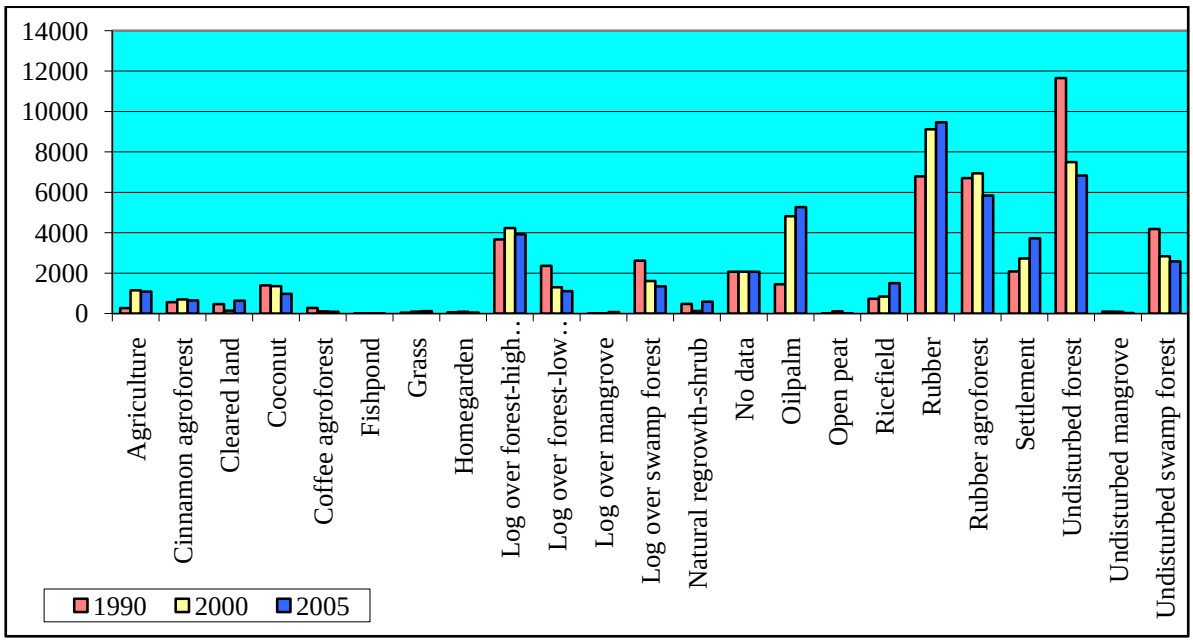


Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007.

The following figure presents the land use change in Jambi province from year 1990 to 2005. In year 1990, the undisturbed forest was large, by having area 11.65 thousand km^2 but it decreased to other forms of land use in 2000 and 2005, then it remains only 6.88 thousand km^2. The similar condition is for the undisturbed swamp forest area. In 2005, the

undisturbed swamp forest area is only 2.56 thousand km^2. Other forms of land use which showed increasing area from year 1990 to 2005 are palm oil, rubber, and settlement. Total land area used for palm oil increased large since 1990 to 2005. In 1990, palm oil area was only about 1.45 thousand km^2 and increased to be about 5.26 thousand km^2. It increased about 200% from year 1990. The Rubber also showed large increased area, as in 1990, the rubber area was 6.79 thousand km^2, and increased to be about 9.47 thousand km^2. Other land use which showed increased is settlement. It was about 2.08 thousand km^2, and increased to be about 3.72 thousand km^2. This condition caused mainly by transmigration program that was implemented by the Indonesian government starting in 1993.

Figure 5.11 Jambi Land Use 1990, 2000, 2005 (km^2)



Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007

The following table presents the percentage of forest land that had been changed between 1990 to 2005. From year 1990 to 2000, the highest deforestation rate was in forest category, which has rate been about 15.2%. But the rate decreased for the year 2000- 2005, was about only 2%. The forest swap area had deforestation rate for the year 1990 to 2000

about 6.9%, and decreased to be 3.2% for the year 2000- 2005. The mangrove area also showed decreasing deforestation rate in 2005. It had deforestation rate about 3.3% for the year 1990 to 2000, and no deforestation in 2005. In the case of degradation rate, Swap forest category and mangrove showed highest deforestation rate for the year 1990 to 2000 and for the year 2000 to 2005 respectively. The forest area has decreased degradation rate from year 1990 to 2005.

Table 5.34 Forest Change in Jambi Province, 1990-2005 (%)

Classes	Forested area (Km^2)			Undisturbed (Km^2)			Deforestation		Degradation	
	1990	2000	2005	1990	2000	2005	1990-2000	2000-2005	1990-2000	2000-2005
Forest	1,7687.99	13,031.36	11,864.12	11,653.80	7,497.75	6,831.45	2,684.03	256.31	1,472.02	409.99
Swamp forest	6797.99	4,445.81	3,936.75	4,180.77	2,834.94	2,585.20	470.51	140.18	875.32	140.18
Mangrove	102.89	102.83	102.38	98.90	91.05	29.32	3.38	0.00	6.39	61.73
Forest rate							15.2%	2.0%	12.6%	5.5%
Forest annual rate							3.3%	2.3%	4.8%	2.3%
Swamp forest rate							6.9%	3.2%	20.9%	4.9%
Swamp forest-annual rate							4.6%	3.0%	4.2%	2.3%
Mangrove rate							3.3%	0.0%	6.5%	67.8%
Mangrove annual rate							0.0%	0.1%	0.9%	24.7%

Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007

Note:
- Forested area is total of undisturbed forest classes and log over forest classes
- Deforestation is changes from forest classes (undisturbed/log over) to non forest classes
- Degradation is changes from undisturbed forest to log over forest or shrub
- Deforestation rate is total area of deforestation divided by total forested area
-Degradation rate is total area of degradation divided by total area of undisturbed forest classes
- Annual deforestation/degradation rate is calculated by taking into account the discounting factor between two time series

As shown in the following table, the highest percentage share of land use change activity in Jambi province is hold by palm oil sector. It has increasing share of land use change since 1990 to 2005. In 1990, palm oil has percentage share of total area in Jambi province was only 3%, while in 2000 and 2005 it increased to be about 10% and 11% respectively. This represents large palm oil expansion in Jambi province. The second is Rubber which its land use had percentage share of total area in Jambi province was about

14%, it increased to be 19% and about 20% for the year 2000 and 2005 respectively. The share of land use as undisturbed forest area decreased since 1990 to 2005. In 1990, the share of undisturbed forest area to total area was about 24%, and it decreased in 2000 to be only 15%, and in 2005 became only about 14% of total area in Jambi province.

Table 5.35 Percentage Shares of Land Use Change of Jambi Province, 1990-2005

No	Classname	1990		2000		2005	
		thousand km^2	%	thousand km^2	%	thousand km^2	%
1	Agriculture	0.27	0.55	1.15	2.36	1.09	2.23
2	Cinnamon agroforest	0.57	1.17	0.70	1.43	0.65	1.34
3	Cleared land	0.48	0.96	0.14	0.29	0.64	1.31
4	Coconut	1.40	2.87	1.36	2.79	0.98	2.01
5	Coffee agroforest	0.28	0.57	0.11	0.23	88.64*	0.18
6	Fishpond	1.25*	0.00	1.71*	0.00	1.59*	0.00
7	Grass	41.51*	0.09	99.33*	0.20	0.12	0.24
8	Homegarden	65.65*	0.13	84.97*	0.17	51.62*	0.11
9	Log over forest high density	3.67	7.54	4.23	8.70	3.92	8.06
10	Log over forest low density	2.37	4.86	1.30	2.67	1.11	2.28
11	Log over mangrove	3.99*	0.01	11.78*	0.02	73.06*	0.15
12	Log over swamp forest	2.62	5.38	1.61	3.31	1.35	2.78
13	Natural re-growth shrub	0.48	0.98	0.13	0.26	0.60	1.21
14	No data	2.1	4.25	2.07	4.25	2.07	4.25
15	**Palm Oil**	**1.45**	**2.98**	**4.82**	**9.90**	**5.27**	**10.82**
16	Open peat	5.15*	0.01	0.11	0.22	9.88*	0.02
17	Ricefield	0.73	1.51	0.84	1.74	1.51	3.10
18	**Rubber**	**6.79**	**13.95**	**9.12**	**18.74**	**9.47**	**19.45**
19	Rubber agroforest	6.71	13.78	6.94	14.26	5.84	11.99
20	Settlement	2.08	4.28	2.73	5.61	3.72	7.65
21	**Undisturbed forest**	**11.65**	**23.94**	**7.50**	**15.40**	**6.83**	**14.03**
22	Undisturbed mangrove	98.9*	0.20	91.05*	0.19	29.32*	0.06
23	Undisturbed swamp forest	4.18	8.59	2.84	5.82	2.60	5.31
24	Waterbody	0.68	1.41	0.69	1.41	0.68	1.41
	Grand Total	**4.87**	**100.00**	**4.87**	**100.00**	**4.87**	**100.00**

Source:ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007
Note: * indicates the value are in km^2

The following table presents the detailed land use by each categories. Land use for undisturbed mangrove in Jambi Province in 2000 was 91.3 sq km, and decreased to be 29.3 sq

km in 2005. The area from the original undisturbed mangrove remaining as undisturbed forest was only 29.3 sq km. About 61.7 sq km area used for undisturbed mangrove in 2000 were converted to other us in 2005.

Table 5.36 Detailed Land Use Change of Undisturbed Mangrove Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	0.6		-0.6
2	Coconut	0.7		-0.7
3	Log over swamp forest	0.5		-0.5
4	Natural re-growth shrub	0.2		-0.2
5	Undisturbed mangrove	89.1	29.3	-59.8
Grand Total		91.1	**29.3**	-61.7

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, undisturbed swamp forest covered area of 2,834.9 sq km, and in 2005, it covered only 2,585 sq km. The area from the original undisturbed swap forest remaining as undisturbed swap forest was only 2582 sq km, others were converted for other land use in 2005.

Table 5.37 Detailed Land Use Change of Undisturbed Swap Forest in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Undisturbed swamp forest	2,834.9	2,585.2	-249.7
Grand Total		2,834.9	**2,585.2**	-249.7

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, agriculture covered an area of 1,150 sq km, and in 2005, it covered only 1,087 sq km. The decreasing area for agriculture in 2005 is about 63.4 sq km. The area from the original agriculture remaining as agriculture was only 1,087.4 sq km. Others came from the original cinnamon agro forest converted to agriculture was 13.7 sq km, from the original cleared land used for agriculture in 2005 was 3.5 sq km, from the original grass was 1.9 sq km, from the original home garden was 3.3 sq km, Log over forest high density was 44.7 sq km,

Log over forest low density was 6.2 sq km, log over swap forest was 18.1 sq km, from natural re-growth natural forest was 3.7 sq km, from the original rice field was 1 sq km, from rubber was 198. 2 sq km, rubber agro forest was 95.9 sq km and from the original undisturbed forest was only 19.9 sq km.

Table 5.38 Detailed Land Use Change of Agriculture Sector in Jambi 2000- 2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	200.0	677.3	477.3
2	Cinnamon agro forest	16.4	13.7	-2.6
3	Cleared land	42.2	3.5	-38.7
4	Coconut	60.8		-60.8
5	Coffee agro forest	1.9		-1.9
7	Grass	2.7	1.9	-0.7
8	Home garden	0.4	3.3	2.9
9	Log over forest high density	70.6	44.7	-25.9
10	Log over forest low density	58.3	6.2	-52.1
12	Log over swamp forest	61.1	18.1	-43.0
13	Natural re-growth shrub	1.0	3.7	2.6
16	Open peat	0.4		-0.4
17	Rice field	53.6	1.0	-52.6
18	Rubber	223.3	198.2	-25.1
19	Rubber agro forest	209.8	95.9	-113.9
21	Undisturbed forest	148.3	19.9	-128.4
Grand Total		1,150.8	**1,087.4**	-63.4

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, cinnamon agro forest covered an area of 650 sq km, and in 2005, it covered only 652 sq km. There was decreasing area for cinnamon agro forest about 45.6 sq km. The area from the original cinnamon agro forest remaining as cinnamon agro forest was only 652.3 sq km. Other land use change came from homegarden converted to cinnamon agro forest was only 0.1 sq km and from natural regrowth shrub used for cinnamon agro forest in 2005 was 2.2 sq km.

Table 5.39 Detailed Land Use Change of Cinnamon Agro forest Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cinnamon agro forest	538.4	650	111.7
2	Cleared land	4.1		-4.1
3	Coconut	0.1		-0.1
4	Grass	0.8	0	-0.8
5	Home garden	0.4	0.1	-0.4
6	Log over forest high density	4.4		-4.4
7	Log over forest low density	25.8		-25.8
8	Natural re-growth shrub	7.3	2.2	-5
9	Undisturbed forest	116.6		-116.6
	Grand Total	698	**652.3**	-45.6

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

As presented on the following table, the cleared land covered area increased from year 2000 to 2005. In 2000, cleared land covered area of 143 sq km, and in 2005, it covered 639 sq km. The difference land covered area from year 2000 to 2005 is about 495.9 sq km. The area from the cleared land remaining as cleared land was only 4.6 sq km. Others land use change came from conversion of land to other sectors such as from log over swamp forest converted to cleared land was 72.5 sq km and from palm oil converted to cleared land was 85 sq km.

Table 5.40 Land Use Change of Cleared Land Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	3.9	4.6	0.7
2	Coconut		28.5	28.5
3	Coffee agro forest	0.8	10.8	10
4	Grass		3.4	3.4
5	Log over forest high density	15	57	42
6	Log over forest low density	17.1	15.7	-1.3
7	Log over swamp forest		72.5	72.5
8	Natural re-growth shrub	2.5	4.9	2.4
9	Palm Oil	3.8	85	81.2

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
10	Rubber	29.7	155	125.3
11	Rubber agro forest	38.2	102.1	63.9
12	Undisturbed forest	32.3	99.6	67.4
	Grand Total	143.1	**639**	495.9

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, coconut covered an area of 1.40 thousand sq km, and in 2005, it covered only 978 sq km. There was decreasing area for coconut sector about 381.6 sq km. The area from the coconut sector remaining as coconut sector was 886.2 sq km. Others came from the grass converted to coconut sector was only 0.9 sq km, from homegarden converted to coconut sector was 2.1 sq km, from logged - over swamp forest converted to coconut sector was 76.8 sq km, from Natural re-growth shrub converted to coconut sector was 9.1 sq km and from open peat used for coconut sector in 2005 was 2.7 sq km.

Table 5.41 Detailed Land Use Change of Coconut Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	32.1	0.2	-31.9
2	Coconut	817.4	886.2	68.8
3	Coffee agro forest	13.6		-13.6
4	Grass	1.2	0.9	-0.3
5	Home garden	0.1	2.1	1.9
6	Log over forest high density	86.2		-86.2
7	Log over forest low density	51.9		-51.9
8	Log over swamp forest	194.9	76.8	-118.1
9	Natural re-growth shrub	87.1	9.1	-78
10	Open peat	0.7	2.7	2
11	Undisturbed forest	74.3		-74.3
	Grand Total	1,359.7	**978.1**	-381.6

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

Between 2000 and 2005, the area of coffee agroforest changed about 21.9 km. In 2000, coffee agroforest area covered 110.5 sq km, and in 2005, it covered only 88.6 sq km.

The area from the coffee agroforest area remaining as coffee agroforest area was 88.6 sq km in total or there is no convertion from other land cover type.

Table 5.42 Detailed Land Use Change of Coffee Agro forest Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	0.1	0	0
2	Coffee agro forest	109.4	88.6	-20.8
3	Log over forest high density	0.2		-0.2
4	Log over forest low density	0.2		-0.2
5	Natural re-growth shrub	0.1	0	-0.1
6	Undisturbed forest	0.5		-0.5
	Grand Total	110.5	**88.6**	-21.9

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

Table 5.43 presents the land use change of fishpond in Jambi province during year 2000 to 2005. In 2000, fishpond area of 1.7 sq km, and in 2005, it covered only 1.6 sq km. There was decreasing area of fishpond about 0.1 sq km. The area from the fishpond area remaining as fishpond area was totally 1.6 sq km or there's no convertion from other land cover type.

Table 5.43 Detailed Land Use Change of Fishpond Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	0.1	0	0
2	Fishpond	1.2	1.6	0.3
3	Open peat	0.2	0	-0.2
4	Undisturbed mangrove	0.1		-0.1
5	Undisturbed swamp forest	0.1		-0.1
	Grand Total	1.7	**1.6**	-0.1

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

Land used for grass sector during year 2000- 2005 also changed. Land area used for grass sector increased about 18.9 sq km. In 2000, grass area of 99.3 sq km, and in 2005, it

covered 118.2 sq km. The change of area for grass sector came from the remaining of grass area which was only 1.4 sq km. Others came from 33.7 sq km of log over swamp forest, and about 41.5 sq km of rubber agroforest.

Table 5.44 Detailed Land Use Change of Grass Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	3.7	2.5	-1.1
2	Coconut	2.1		-2.1
3	Grass	0.2	1.4	1.1
4	Home garden		1.2	1.2
5	Log over forest high density	17.1	16.5	-0.6
6	Log over forest low density	10.3	10.6	0.3
7	Log over swamp forest		33.7	33.7
8	Natural re-growth shrub	1.7	1.5	-0.2
9	Palm Oil	1.1		-1.1
10	Open peat	0	1.5	1.5
11	Rubber	17.5		-17.5
12	Rubber agro forest	15.3	41.5	26.2
13	Undisturbed forest	30.4	7.9	-22.5
Grand Total		99.3	**118.2**	18.9

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

The following tabel present detailed change of home garden sector in Jambi province during year 2000- 2005. In 2005, the area used for home garden sector is about 51.6 sq km. The change are come from 46 sq km of remaining area of home garden. Others came from 1.7 sq km of cleared land, 3.1 sq km of coconut and 0.8 sq km of grass area.

Table 5.45 Detailed Land Use Change of Home Garden Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	0.3	0	-0.3
2	Cleared land	10.7	1.7	-8.9
3	Coconut	0.7	3.1	2.3
4	Coffee agro forest	1.6		-1.6

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
5	Grass	0.3	0.8	0.5
6	Home garden	51.2	46	-5.1
7	Log over forest high density	1.8		-1.8
8	Log over forest low density	4.6		-4.6
9	Log over swamp forest	0.1		-0.1
10	Natural re-growth shrub	9		-9
11	Open peat	0.1		-0.1
12	Undisturbed forest	4.6		-4.6
Grand Total		85	**51.6**	-33.4

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, log over-high density area of 4,233.2 sq km, and in 2005, it covered only 3,922.4 sq km. The decreased area for home garden was about 310.8 sq km. In detail, the change are from about 3,512.4 sq km of remaining area of log over- high density, and about 410 sq km of undisturbed forest used.

Table 5.46 Detailed Land Use Change of Log over forest high density Sector in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	0.1		-0.1
2	Coconut	0.1		-0.1
3	Log over forest high density	2.76*	3.51*	752.4
4	Log over forest low density	0.9		-0.9
5	Log over swamp forest	0.1		-0.1
6	Undisturbed forest	1.47*	410	-1.06*
Grand Total		4.23*	3.92*	-310.8

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia
Note: * indicates the value is in thousand km^2

The Log over forest low density are also changed during year 2000 to 2005. In 2000, log over-low density area was 1,300.4 sq km, but in 2005, it covered only 1,110.3 sq km. The Log over forest low density area decreased about 190.1 sq km. The remaining area of log over- low density was 1,110.3 sq km and there's no convertion from other land cover type.

Table 5.47 Detailed Land Use Change of Log over forest low density in Jambi Province, 2000-2005

No	Land Cover Type	Year (Km^2)		Change
		2000	2005	
1	Cleared land	6.8		-6.8
2	Coconut	12.8		-12.8
3	Coffee agro forest	0.2		-0.2
4	Grass	0.5		-0.5
5	Home garden	1.8		-1.8
6	Log over forest low density	1,249.6	1,110.3	-139.3
7	Log over swamp forest	25.7		-25.7
8	Natural re-growth shrub	2.9		-2.9
9	Open peat	0.1		-0.1
	Grand Total	1,300.4	**1,110.3**	-190.1

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

The change of log over mangrove during year 2000- 2005 was about 61.3 sq km. The changed area are from 11. 3 sq km of remaining area of log over mangrove area, and 61.7 sq km of undisturbed mangrove.

Table 5.48 Detailed Land Use Change of Log over Mangrove in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Coconut	1.2		-1.2
2	Log over mangrove	4	11.3	7.4
3	Log over swamp forest	0.1		-0.1
4	Natural re-growth shrub	0.1		-0.1
5	Undisturbed mangrove	6.4	61.7	55.3
	Grand Total	11.8	**73.1**	61.3

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, log over swampt forest area of 1,610.9 sq km, and in 2005, it covered only 1,351.6 sq km. The changed area are from about 1, 211.4 sq km of remaining area of log over swampt forest, and only 140.2 sq of undisturbed swamp forest.

Table 5.49 Detailed Land Use Change of Log Over Swap Forest Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Cleared land	1.3		-1.3
2	Coconut	3.3		-3.3
3	Home garden	0.2		-0.2
4	Log over forest low density	1.1		-1.1
5	Log over swamp forest	728.4	1,211.4	482.9
6	Natural re-growth shrub	1.1		-1.1
7	Undisturbed swamp forest	875.3	140.2	-735.1
Grand Total		1,610.9	**1,351.6**	-259.3

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, Natural re-growth shrub area of 126.2sq km, and in 2005, it covered 589.7 sq km. The increased area for Natural re-growth shrub area was about 463.5 sq km. The increased area are from about 26.5 sq km of remaining area of Natural re-growth shrub, 119.3 sq km of log over forest over high densiry and 136. 8 sq km of rubber agroforest, and others as presented on the following table.

Table 5.50 Detailed Land Use Change of Natural re-growth shrub in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	0.4	46.9	46.5
2	Cinnamon agro forest	0.5		-0.5
3	Cleared land	2	9	7.1
4	Coconut	7.1		-7.1
5	Coffee agro forest	0.8		-0.8
7	Grass	0.1	23.8	23.8
9	Log over forest high density	5	119.3	114.3
10	Log over forest low density	3.1		-3.1
12	Log over swamp forest	6.9	47.6	40.7
13	Natural re-growth shrub	93.2	26.5	-66.7
15	Palm Oil	0.8	124.3	123.5
16	Open peat	0	3.6	3.6
17	Rice field	3		-3

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
19	Rubber agro forest		136.8	136.8
21	Undisturbed forest	3.4	51.8	48.4
	Grand Total	126.2	**589.7**	463.5

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, palm oil area was 4.81 thousand sq km, and in 2005, it covered 5.27 thousnad sq km. The increased area for palm oil during year 2000- 2005 was about 447.7 sq km. The area from the palm oil area remaining as palm oil area was 4.38 thousand sq km, others came from agriculture area converted to palm oil area was 78.8 sq km, from cleared land converted to palm oil area was 9.7 sq km, from coconut converted to palm oil area was 1.40 thousand sq km, from grass converted to palm oil area was 4 sq km, from log over-high density converted to palm oil area was 86.7 sq km, from log over-low density converted to palm oil area was 15.9 sq km, from log over swamp forest converted to palm oil area was 42.3 sq km, from Natural re-growth shrub converted to palm oil was 6.3 sq km, from open peat converted to palm oil area was 13 sq km, from rubber converted to palm oil area was 40.4 sq km, from rubber agroforest converted to palm oil area was 348.8 sq km, from undisturbed forest converted to palm oil area was 77.1 sq km and from undisturbed swamp forest used for palm oil area in 2005 was 27.3 sq km.

Table 5.51 Detailed Land Use Change of Palm Oil Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	0	78.8	78.8
2	Cleared land	74.6	9.7	-65
3	Coconut	102.2	139.6	37.5
4	Coffee agro forest	28.8		-28.8
5	Grass	4.7	4	-0.7
6	Home garden	0.3		-0.3
7	Log over forest high density	**175.1**	86.7	-88.4

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
8	Log over forest low density	**252.4**	15.9	-236.5
9	Log over swamp forest	**1,480.2**	42.3	-1437.9
10	Natural re-growth shrub	**33.1**	6.3	-26.7
11	Palm Oil	1,429.4	4,376.2	2946.8
12	Open peat	1.8	13	11.2
13	Rice field	95.3		-95.3
14	Rubber	194.7	40.4	-154.3
15	Rubber agro forest	528.7	348.8	-179.9
16	Undisturbed forest	**407.4**	77.1	-330.2
17	Undisturbed swamp forest	10	27.3	17.4
	Grand Total	4,818.5	**5,266.2**	447.7

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

During year 2000- 2005, there was increasing area for open peat. In 2000, open peat area of 109.4 sq km, and in 2005, it covered only 9.9 sq km. The decreased area is about 99.5 sq km. The area from the open peat area remaining as open peat area was 9.6 sq km, others came from agriculture converted to open peat area was 0.1 sq km and undisturbed swamp forest used for open peat area in 2005 was only 0.2 sq km.

Table 5.52 Detailed Land Use Change of Open Peat Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	0	0.1	0.1
2	Log over swamp forest	32.8	0	-32.8
3	Natural re-growth shrub	27.4		-27.4
4	Open peat	0.1	9.6	9.5
5	Undisturbed swamp forest	49	0.2	-48.9
	Grand Total	109.4	**9.9**	-99.5

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

The following table presents detailed change area for rice field sector. In 2000, rice field area of 844.8 sq km, and in 2005, it covered 1,507.8 sq km. The increased area for rice field area was 663 sq km. The area from the rice field area remaining as rice field area was

793.8 sq km, others came from agriculture converted to rice field area was 65.5 sq km, from cleared land converted to rice field area was 9.9 sq km, from coconut converted to rice field area was 64.7 sq km, from coffee agroforest converted to rice field area was 6.1 sq km, from fishpond converted to rice field area was 0.1 sq km, from grass converted to rice field area was 5 sq km, from homegarden converted to rice field area was 7.9 sq km, from Log over forest low density converted to rice field area was 27.2 sq km, from Natural re-growth shrub converted to rice field area was 9.1 sq km, from rubber converted to rice field area was 310.6 sq km and rubber agroforest used for rice field area in 2005 was 207.8 sq km.

Table 5.53 Detailed Land Use Change of Rice field Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	0	65.5	65.5
2	Cleared land	31.2	9.9	-21.2
3	Coconut	39.3	64.7	25.5
4	Coffee agro forest	2.3	6.1	3.8
5	Fishpond		0.1	0.1
6	Grass	2.2	5	2.9
7	Home garden	1.6	7.9	6.3
8	Log over forest high density	10.7		-10.7
9	Log over forest low density	49.9	27.2	-22.7
10	Log over swamp forest	13.5		-13.5
11	Natural re-growth shrub	22.3	9.1	-13.1
12	Open peat	0.9		-0.9
13	Rice field	372.5	793.8	421.3
14	Rubber		310.6	310.6
15	Rubber agro forest	116.3	207.8	91.5
16	Undisturbed forest	182.3		-182.3
Grand Total		844.8	**1,507.8**	663

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

The area for rice field area during year 2000 to 2005 increasead about 347.1 sq km. The area from the rice rubber area remaining as rubber area was 6,802 sq km, others came

from agriculture converted to rubber area was 211.1 sq km, from cleared land converted to rubber area was 86.1 sq km, from coconut converted to rubber area was 204.9 sq km, from coffee agroforest converted to rubber area was 0.2 sq km, from grass converted to rubber area was 54.1 sq km, from homegarden converted to rubber area was 19.1 sq km, from Log over forest high density converted to rubber area was 348.3 sq km from Log over forest low density converted to rubber area was 97.1 sq km,from log over swamp forest converter to rubber area was 62.1 sq km, from Natural re-growth shrub converted to rubber area was 29.6 sq km, from open peat converted to rubber area was 72.3 sq km and rubber agroforest used for rubber area in 2005 was 1,481.2 sq km.

Table 5.54 Detailed Land Use Change of Rubber Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	31.2	211.1	179.9
2	Cleared land	195.8	86.1	-109.6
3	Coconut	234.1	204.9	-29.2
4	Coffee agro forest	72.2	0.2	-72
5	Grass	7.2	54.1	46.9
6	Home garden	5.3	19.1	13.8
7	Log over forest high density	358.9	348.3	-10.5
8	Log over forest low density	380.7	97.1	-283.6
9	Log over swamp forest	36.6	62.1	25.5
10	Natural re-growth shrub	107.2	29.6	-77.5
11	Open peat	0.7	72.3	71.6
12	Rice field	118.5		-118.5
13	Rubber	5.18*	6.80*	1621.9
14	Rubber agro forest	1.29*	1.48*	190.1
15	Undisturbed forest	707.1		-707.1
16	Undisturbed swamp forest	394.6		-394.6
Grand Total		9.12*	9.47*	347.1

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia
Note: * indicates the value is in thousand km^2

In 2000, rubber agroforest area of 6,943.2 sq km, and in 2005, it covered 5,837.1 sq km. The decreased area of rubber agroforest during year 2000 to 2005 was about 1,106 sq km. The area from the rubber agroforest area remaining as rubber agroforest area was 4,394 sq km, others came from Natural re-growth shrub converted to rubber agroforest area was 28.1 sq km, and rubber used for rubber agroforest area in 2005 was 4,394 sq km.

Table 5.55 Detailed Land Use Change of Rubber Agro forest Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	28.9	0	-28.9
3	Cleared land	40.2		-40.2
4	Coconut	95.5		-95.5
5	Coffee agro forest	25.4	0	-25.4
7	Grass	20		-20
8	Home garden	2.2		-2.2
9	Log over forest high density	127.2		-127.2
10	Log over forest low density	214.5		-214.5
12	Log over swamp forest	15.6		-15.6
13	Natural re-growth shrub	66.7	28.1	-38.6
16	Open peat	0.1		-0.1
17	Rice field	64.6		-64.6
18	Rubber	1,036.5	1,415	378.5
19	Rubber agro forest	4,397.9	4,394	-3.8
21	Undisturbed forest	808.1		-808.1
Grand Total		6,943.2	**5,837.1**	-1106

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

As presented on the following table, In 2000, settlement area of 2.73 thousand sq km, and in 2005, it covered 3.72 thousand sq km. The area from the settlement area remaining as settlement area was 2.73 thousand sq km, others came from agriculture converted to settlement area was 71.1 sq km, from cinnamon agroforest converted to settlement area was 34.2 sq km, from cleared land converted to settlement area was 15.7 sq km, from coconut converted to settlement area was 32.7 sq km, from coffee agroforest converted to settlement

area was 4.9 sq km, from fishpond converted to settlement area was only 0.1 sq km, from grass converted to settlement area was 4 sq km, from homegarden converted to settlement area was 5.4 sq km, from Log over forest high density converted to settlement area was 48.2 sq km, from Log over forest low density converted to settlement area was 17.4 sq km, from log over mangrove converted to settlement area was only 0.5 sq km, from log over swamp forest converter to settlement area was 46.5 sq km, from Natural re-growth shrub converted to settlement area was 5.1 sq km, from palm oil converted to settlement area was 233.1 sq km, from open peat converted to settlement area was 6.7 sq km, from ricefield converted to settlement area was 50 sq km, from rubber converted to settlement area was 199.8, from rubber agroforest converted to settlement area was 135 sq km and undisturbed swamp forest used for settlement area in 2005 was 82.1 sq km.

Table 5.56 Detailed Land Use Change of Settlement Type in Jambi Province, 2000-2005

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
1	Agriculture	7.6	71.1	63.5
2	Cinnamon agro forest	12.2	34.2	22
3	Cleared land	19.1	15.7	-3.4
4	Coconut	19.7	32.7	13
5	Coffee agro forest	19.2	4.9	-14.3
6	Fishpond	0	0.1	0.1
7	Grass	1.7	4	2.3
8	Home garden	2.1	5.4	3.3
9	Log over forest high density	36.2	48.2	12
10	Log over forest low density	45.4	17.4	-28
11	Log over mangrove	0	0.5	0.4
12	Log over swamp forest	20.7	46.5	25.8
13	Natural re-growth shrub	14.8	5.1	-9.7
15	Palm Oil	14.6	233.1	218.5
16	Open peat	0.1	6.7	6.6
17	Rice field	25.8	50	24.2
18	Rubber	108.7	199.8	91.1
19	Rubber agro forest	110.2	135	24.8

No	Land Cover Type	Year (km^2)		Change
		2000	2005	
20	Settlement	2,083.5	2,730.6	647
21	Undisturbed forest	168.8		-168.8
22	Undisturbed mangrove	3.3		-3.3
23	Undisturbed swamp forest	16.9	82.1	65.2
	Grand Total	2,730.6	**3,722.9**	992.3

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, undisturbed forest area of 7,497.8 sq km, and in 2005, it covered only 6,831.5 sq km. The decreased area for undisturbed forest area was about 666.3 sq km. The area from the undisturbed forest area remaining as undisturbed forest area was 6,831.5 sq km and there's no convertion from other land type.

Table 5.57 Detailed Land Use Change of Undisturbed Forest Type in Jambi Province, 2000-2005

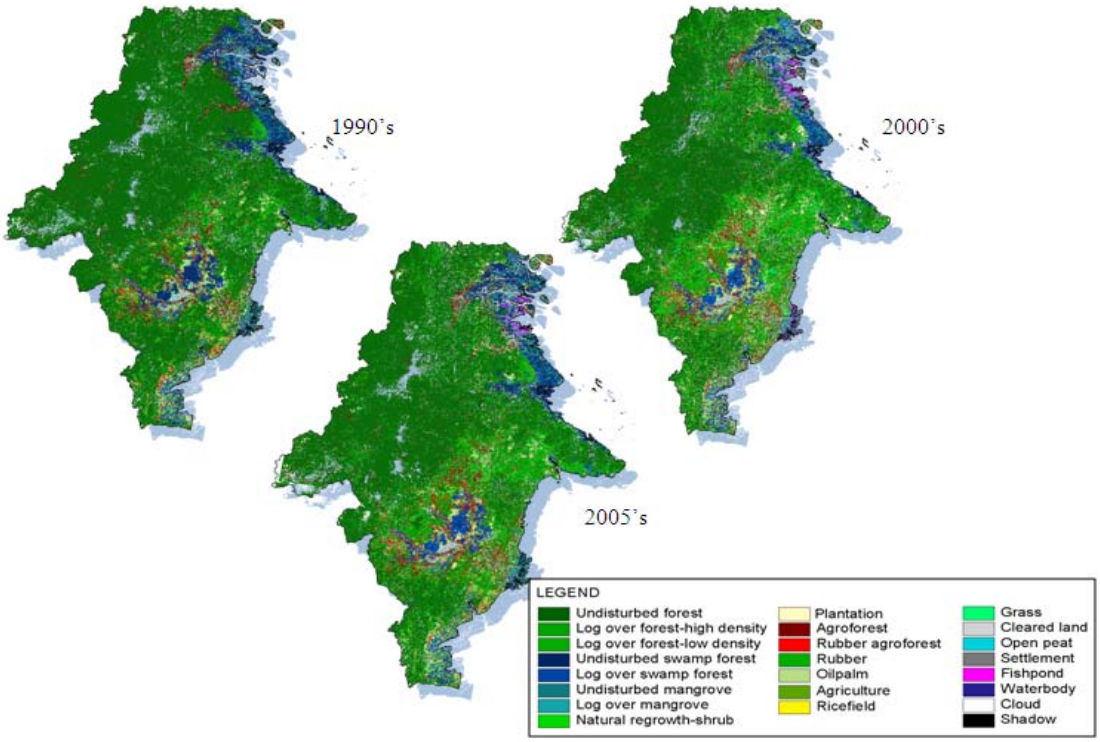
No	Land Cover Type	Year (km2)		Change
		2000	2005	
1	Undisturbed forest	7,497.8	6,831.5	-666.3
	Grand Total	7,497.8	**6,831.5**	-666.3

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

5.3.2 Land Use Change in East Kalimantan Province

Logging and harvesting from forest are two main economic sources for people live in this profice. East Kalimantan has area about 220,400 sq km. ICRAF (2007) stated that about 70% if East Kalimantan's area is forested area. East Kalimantan still has large land availability, so there is increasing area converted to palm oil plantation.

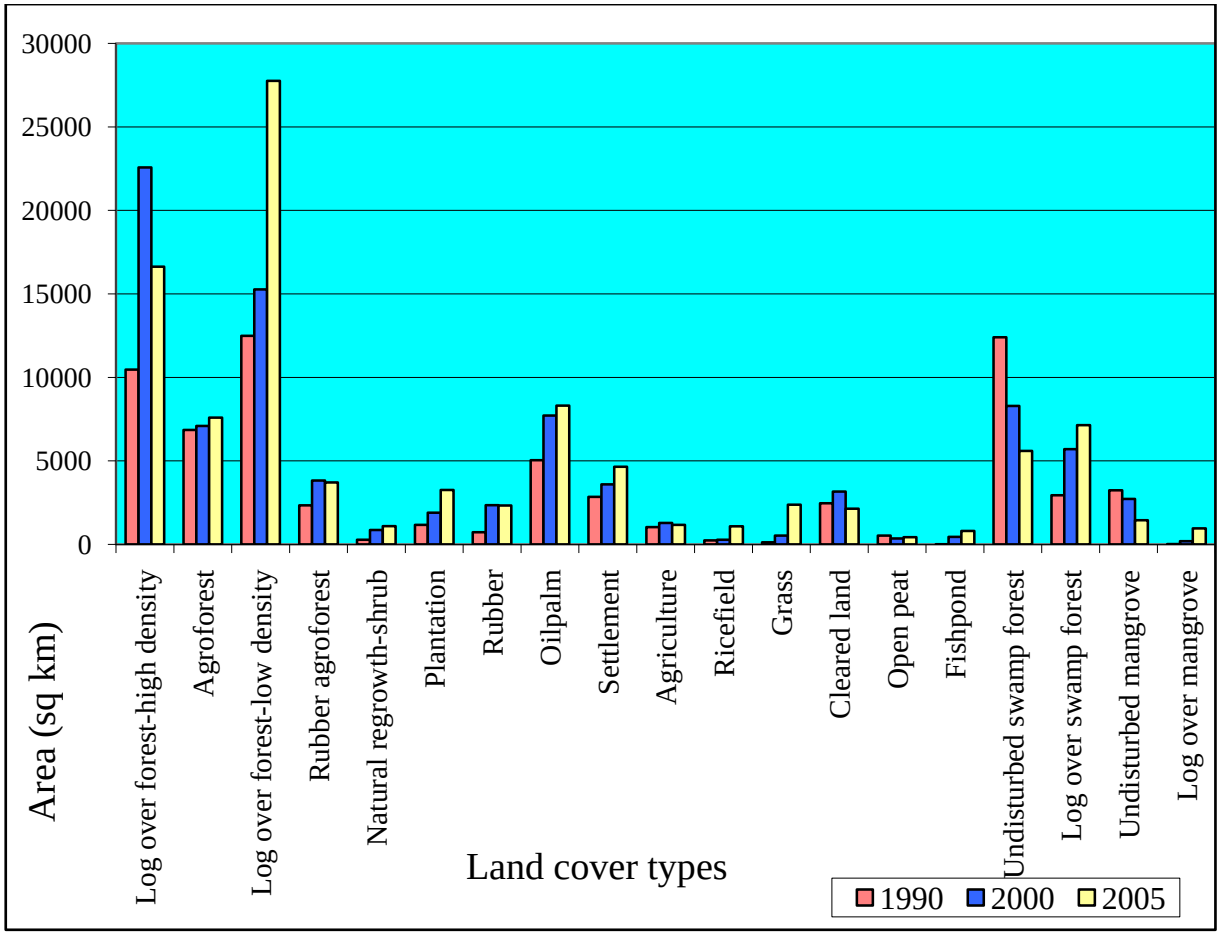
Figure 5.12 East Kalimantan Land Cover Map, 1990,2000, 2005



Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007

As presented on the following figure, there were increasing and decreasing of land area used for some sectors from year 2000 to 2005. The increased area are for sectors of agro forest, Log over forest low density, rubber, and palm oil. Land used for agro forest increased to be 7.59 thousand sq km in 2005, for Log over forest low density increased to be 27.76 thousand sq km, rubber increased to be 2.33 thousand sq km, and palm oil increased to be about 8.31 thousand sq km. The decreased areas in 2005 were for Log over forest high density, natural re-growth, cleared land and undisturbed swap forest. Land used for Log over forest high density decreased in 2005 to be about 16.63 thousand sq km, natural re-growth decreased to be 1.1 thousand sq km, cleared land decreased to be 2.14 thousand sq km, and undisturbed swap forest decreased to be about 5.6 thousand sq km.

Figure 5.13 East Kalimantan Land Use,1990, 2000, 2005



Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007

The following table presents degradation rate in East Kalimantan province during period 1990 to 2005. Deforestation rate is higher than deforestation rate as shown on the following table. The degradation rate from year 2000- 2005 is 11.2%, and deforestation rate is only 1.2%. Furthermore, the rate of degradation and deforestation for swap forest and mangrove area are higher than forest area.

Table 5.58 Forest Changes in East Kalimantan Province, 1990-2005 (%)

Classes	Forested area			Undisturbed			Deforestation		Degradation	
	1990	2000	2005	1990	2000	2005	1990-2000	2000-2005	1990-2000	2000-2005
Forest	143,652.49	135,507.70	132,097.60	120,701.14	97,665.07	87,710.19	4,370.99	1,674.55	16,727.33	10,950.31
Swamp forest	15,340.34	13,993.38	12,735.81	12,396.35	8,288.27	5,596.98	884.39	430.25	3,171.62	1,857.98
Mangrove	3,252.95	2,914.34	2,402.28	3,236.89	2,721.85	1,444.74	330.31	355.27	170.76	811.77

Classes	Forested area			Undisturbed			Deforestation		Degradation	
	1990	2000	2005	1990	2000	2005	1990-2000	2000-2005	1990-2000	2000-2005
Forest rate							3.0%	1.2%	13.9%	11.2%
Forest annual rate							0.6%	0.6%	2.3%	2.7%
Swamp forest rate							5.8%	3.1%	25.6%	22.4%
Swamp forest annual rate							1.0%	2.3%	4.4%	9.3%
Mangrove rate							10.2%	12.2%	5.3%	29.8%
Mangrove annual rate							1.2%	4.7%	1.9%	14.6%

Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007

Note: - forested area is total of undisturbed forest classes and log over forest classes
- Deforestation is changes from forest classes (undisturbed/log over) to non forest classes
- Degradation is changes from undisturbed forest to log over forest or shrub
- Deforestation rate is total area of deforestation divided by total forested area
-Degradation rate is total area of degradation divided by total area of undisturbed forest classes
- Annual deforestation/degradation rate is calculated by taking into account the discounting factor between two time series

The following table presents the percentage shares of land used change for any type of land cover in East Kalimantan province from 1990 to 2005. Undisturbed forest still is the highest share of total area. Its share is 45% of total area. It means that East Kalimantan province has potential land availability. Log over forest low density is on the second rank, by having about 14% share on total area. The share of land used by palm oil plantation share increased from about 2% in 1990 to be 4.6% in 2005.

Table 5.59 Percentage Shares of Land Use Change of East Kalimantan Province, 1990-2005

No	Landcover Type	1990		2000		2005	
		thousand 0km^2	%	thousand km^2	%	thousand km^2	%
1	Undisturbed forest	120.70	62.00%	97.67	50.20%	87.71	45.00%
2	Log over forest high density	10.47	5.40%	22.57	11.60%	16.63	8.50%
3	Agroforest	6.85	3.50%	7.09	3.60%	7.59	3.90%
4	Log over forest low density	12.49	6.40%	15.27	7.80%	27.76	14.30%
5	Rubber agroforest	2.34	1.20%	3.83	2.00%	3.71	1.90%
6	Natural re-growth shrub	0.28	0.10%	0.86	0.40%	1.10	0.60%
7	Plantation	1.17	0.60%	1.89	1.00%	3.26	1.70%
8	Rubber	0.72	0.40%	2.35	1.20%	2.33	1.20%
9	Palm Oil	5.04	2.60%	7.72	4.00%	8.31	4.30%

No	Landcover Type	1990		2000		2005	
		thousand 0km^2	%	thousand km^2	%	thousand km^2	%
10	Settlement	2.84	1.50%	3.59	1.80%	4.64	2.40%
11	Agriculture	1.03	0.50%	1.29	0.70%	1.17	0.60%
12	Ricefield	0.24	0.10%	0.28	0.10%	1.08	0.60%
17	Grass	0.12	0.10%	0.53	0.30%	2.38	1.20%
18	Cleared land	2.47	1.30%	3.16	1.60%	2.14	1.10%
19	Open peat	0.52	0.30%	0.35	0.20%	0.43	0.20%
20	Fishpond	6.3*	0.00%	0.45	0.23%	0.81	0.42%
21	Undisturbed swamp forest	12.40	6.40%	8.29	4.30%	5.60	2.90%
22	Log over swamp forest	2.94	1.50%	5.71	2.90%	7.14	3.70%
23	Undisturbed mangrove	3.24	1.70%	2.72	1.40%	1.44	0.70%
24	Log over mangrove	16.1*	0.01%	0.19	0.10%	0.95	0.49%
Sub Total		185. 86	95.40%	185.79	95.40%	186.18	95.60%
No data		8.88	4.60%	8.94	4.60%	8.55	4.40%
Grand total		**194.73**	**100%**	**194.73**	**100%**	**194.73**	**100%**

Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia, 2007
Note: * indicates the values are in km^2

In 2000, agriculture covered a total area of 1,136 sq km, and in 2005, it covered only 1,095 sq km. The area from the original agriculture remaining as agriculture increased to 789 sq km. Others came from the original agro forest converted to agriculture was 36.2 sq km, from the original cleared land was 41.4 sq km, from grass increased to be 30.66 sq km, from Log over forest high density was 45.42 sq km, Log over forest low density was 36 sq km, Natural re-growth shrub was 27.59 sq km, from rice field was 22.79 sq km, from rubber was 24 sq km, rubber agro forest was 4.74 sq km, and from undisturbed forest was only 37.86 sq km.

Table 5.60 Detailed Land Use Change of Agriculture Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	2005	
Agriculture	360.0	788.45	428.4
Agro forest	86.7	36.2	-50.5
Cleared land	72.6	41.44	-31.1
Grass	16.9	30.66	13.8
Log over forest high density	36.2	45.45	9.3
Log over forest low density	155.5	35.79	-119.7

Land Cover Type	Year (km^2)		Change
	2000	2005	
Natural re-growth shrub	35.3	27.59	-7.7
Rice field		22.79	22.8
Rubber		24.18	24.2
Rubber agro forest		4.74	4.7
Undisturbed forest	373.1	37.86	-335.3
Grand Total	**1.13***	**1.10***	-41.1

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia
Note: * indicates the values are in thousand km^2

Agroforest covered area in East Kalimantan was about 6.5 thosuand sq km in 2000, then there was increasing area to 7.23 thousand sq km in 2005. The area from the original agroforest remaining as agroforest increased to be 6.4 sq km. Others came from the original agriculture converted to agroforest decreased to be 77.03 sq km, from the original cleared land was 177.95 sq km, from grass was 51.88 sq km, from Log over forest high density was 55.66 sq km, Log over forest low density was 235.66 sq km, Natural re-growth shrub was 256.72 sq km, open peat was 14.21 sq km, and from rice field was 19.37 sq km.

Table 5.61 Detailed Land Use Change of Agro forest Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	2005	
Agriculture	530.6	77.03	-453.5
Agro forest	5.58*	6.40*	819.8
Cleared land	96.7	177.95	81.2
Grass		51.88	51.9
Log over forest high density	243.2	55.66	-187.6
Log over forest low density		235.66	235.7
Natural re-growth shrub	60.8	256.72	195.9
Open peat		14.21	14.2
Rice field		19.37	19.4
Grand Total	**6.51***	**7.28***	777.0

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia
Note: * indicates the values are in thousand km^2

Cleared covered area has decreased about 810.5 sq km in 2005. The area was 2,801 sq km five years before. The area from the original cleared land remaining as cleared land

increased to be 1,553.96 sq km. Others came from the original agriculture converted to cleared land was 26.04 sq km, from agro forest was 59.89 sq km, from grass was 10.28 sq km, from Log over forest high density was 141.68 sq km, Log over forest low density was 73.27 sq km, Natural re-growth shrub was 5.82 sq km, open peat was 5.37 sq km, from plantation was 27.07 sq km, from rice field was 3.89 sq km, from rubber was 6.46 sq km, rubber agro forest was 9.73 sq km, and from undisturbed forest was 67.05 sq km.

Table 5.62 Detailed Land Use Change of Cleared land Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	2005	
Agriculture		26.04	26.0
Agro forest		59.89	59.9
Cleared land	1.49*	1.55*	65.6
Grass		10.28	10.3
Log over forest high density	94.4	141.68	47.3
Log over forest low density	158.0	73.27	-84.8
Natural re-growth shrub	26.0	5.82	-20.2
Palm Oi^{2}l	20.1		-20.1
Open peat		5.37	5.4
Plantation	9.6	27.07	17.4
Rice field	3.2	3.89	0.7
Rubber		6.46	6.5
Rubber agro forest		9.73	9.7
Undisturbed forest	1.00*	67.05	-934.2
Grand Total	**2.80***	**1.99***	-810.5

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia
Note: * indicates the value is in thousand km^2

In 2000, fishpond covered area of 304.6 sq km, and in 2005, it covered 790.95 sq km. There was increasing area for fishpond about 486.4 sq km. The area from the original fishpond remaining as fishpond increased about 427.2 sq km. Others came from the original Log over forest high density was 10.29 sq km, log over mangrove was 7.72 sq km, log over swampt forest was 25.94 sq km, from open peat was 2.19 sq km, from undisturbed mangrove was 240.35 sq km, and from undisturbed swampt forest was only 71.07 sq km.

Table 5.63 Detailed Land Use Change of Fishpond Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	2005	
Fishpond	6.2	433.39	427.2
Log over forest high density		10.29	10.3
Log over mangrove	0.0	7.72	7.7
Log over swamp forest		25.94	25.9
Open peat		2.19	2.2
Undisturbed mangrove	258.6	240.35	-18.3
Undisturbed swamp forest	39.8	71.07	31.3
Grand Total	**304.6**	**790.95**	486.4

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

Grass covered area was 2.3 thousand sq km in 2005. There was increasing area of grass about 1.81 thousand sq km from 2005. The area from the original grass remaining as grass increased to be 120.65 sq km. Others came from the original agro forest converted to grass was 163.46 sq km, from the original cleared land was 59.04 sq km, from Log over forest high density increased to be 418.02 sq km, Log over forest low density was 387.38 sq km, log over swampt forest was 132.72 sq km, Natural re-growth shrub was 21.66 sq km, from plantation was 88.23 sq km, from rubber was 30.35 sq km, rubber agro forest was 84.54 sq km, from undisturbed forest was 683.47 sq km, and from undisturbed swampt forest was 107.15 sq km.

Table 5.64 Detailed Land Use Change of Grass Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	2005	
Agro forest		163.46	163.5
Cleared land	33.5	59.04	25.5
Grass	28.4	120.65	92.3
Log over forest high density	34.4	418.02	383.6
Log over forest low density	92.5	387.38	294.9
Log over swamp forest		132.72	132.7
Natural re-growth shrub		21.66	21.7
Plantation		88.23	88.2
Rubber		30.35	30.4

Land Cover Type	Year (km^2)		Change
	2000	2005	
Rubber agro forest		84.54	84.5
Undisturbed forest	256.5	683.47	427.0
Undisturbed swamp forest		107.15	107.2
Grand Total	**445.3**	**2,296.67**	1851.4

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, Log over forest high density covered area of 23 thousand sq km, and in 2005, it covered only 16.37 thousand sq km. It decreased about 6.20 thousand sq km. The area from the original Log over forest high density remaining as Log over forest high density increased to be 11.81 thousand sq km. Others came from the original undisturbed forest converted to Log over forest high density decreased to be 4.56 thousand sq km.

Table 5.65 Detailed Land Use Change of Log over forest high density Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (thousand km^2)		Change
	2000	2005	
Log over forest high density	6.89	11.81	4.92
Undisturbed forest	15.68	4.56	-11.13
Grand Total	**22.57**	**16.37**	-6.20

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

Log over forest low density covered area was 15.27 thousand sq km in 2000, and became 27.44 thousand sq km in 2005. It increased about 12.17 thousand sq km. The area from the original Log over forest low density remaining as Log over forest low density increased to be 12.86 thousand sq km. Others came from the original Log over forest high density converted to Log over forest low density increased to be 8.3 thousand sq km and from undisturbed forest was 6.28 thousand sq km.

Table 5.66 Detailed Land Use Change of Log over forest low density Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (thousand km^2)		Change
	2000	2005	
Log over forest high density	2.73	8.30	5.57
Log over forest low density	11.36	12.86	1.50

Land Cover Type	Year (thousand km^2)		Change
	2000	2005	
Undisturbed forest	1.18	6.28	5.09
Grand Total	**15.27**	**27.44**	12.17

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, log over mangrove covered area was 192.5 sq km, then increased to be 942.31 sq km in 2005. The area from the original log over mangrove remaining as log over mangrove increased about 115.6 sq km from five years before. Others came from the original undisturbed mangrove converted to log over mangrove increased to be 811.04 sq km.

Table 5.67 Detailed Land Use Change of Log over Mangrove Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	2005	
Log over mangrove	15.7	131.27	115.6
Undisturbed mangrove	176.8	811.04	634.3
Grand Total	**192.5**	**942.31**	749.9

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

From 2000 to 2005, logging in swamp forest areas increased by 1.41 thousand sq km. The area from the original log over swampt forest remaining as log over swampt forest increased to be 5.26 thousand sq km in 2005. Others came from the original undisturbed swampt forest converted to log over swampt forest decreased to be 1.86 thousand sq km.

Table 5.68 Detailed Land Use Change of Log Over Swamp Forest Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (thousand km^2)		Change
	2000	2005	
Log over swamp forest	2.51	5.26	2.75
Undisturbed swamp forest	3.20	1.86	-1.34
Grand Total	**5.71**	**7.12**	1.41

Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

In 2000, Natural re-growth shrub covered area of 742.4 sq km, and in 2005, it covered 999.85 sq km. There was increasing area about 257.5 sq km. The area from the original Natural re-growth shrub remaining as Natural re-growth shrub increased to be 163.48

sq km. Others came from the original agriculture converted to Natural re-growth shrub was 35.54 sq km, from agro forest was 59.64 sq km, from the original cleared land was 265.14 sq km, from grass increased to be 98.43 sq km, from Log over forest high density was 56.91 sq km, Log over forest low density was 76.19 sq km, log over swampt forest was only 0.69 sq km, palm oil 26.59 sq km, open peat 34.71 sq km, plantation 34.69 sq km, from rice field was 3.75 sq km, from rubber was 23.74 sq km, from undisturbed forest was 114.69 sq km, and from undisturbed swampt forest 5.66 sq km.

Table 5.69 Detailed Land Use Change of Natural re-growth shrub Type in East Kalimantan Province, 2000-2005

Land Cover Type	Year (km^2)		Change
	2000	**2005**	
Agriculture		35.54	35.5
Agro forest	52.0	59.64	7.7
Cleared land	38.0	265.14	227.1
Grass	6.6	98.43	91.8
Log over forest high density	45.9	56.91	11.0
Log over forest low density	101.5	76.19	-25.3
Log over swamp forest		0.69	0.7
Natural re-growth srub	113.9	163.48	49.6
Palm Oil		26.59	26.6
Open peat		34.71	34.7
Plantation	19.7	34.69	15.0
Rice field	4.3	3.75	-0.6
Rubber		23.74	23.7
Undisturbed forest	360.5	114.69	-245.8
Undisturbed swamp forest		5.66	5.7
Grand Total	**742.4**	**999.85**	257.5

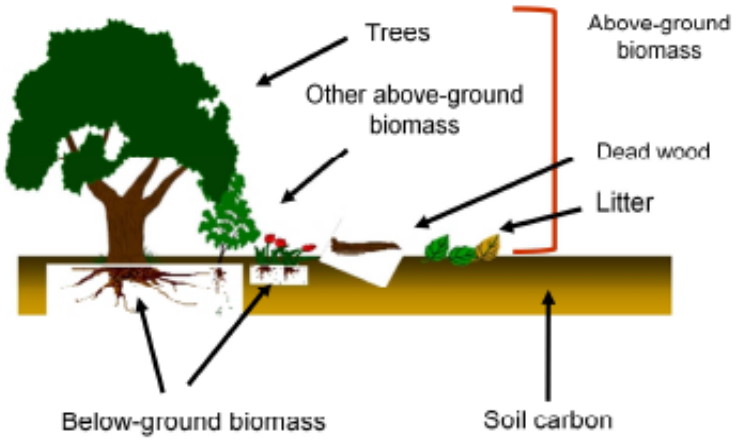
Source: Author's Calculation Based on ICRAF Database, Southeast Regional Office, Bogor, Indonesia

5.4 CO_2 Emission caused by land use change in Jambi Province and East Kalimantan Province

The second step after calculate land use change in Jambi province and East Kalimantan province during the period 1990 to 2005 is to calculate CO_2 emission caused by land use change. As stated previously, this study calculates CO_2 emission as

decreasing of carbon stock. Gibss *et al.* (2007) stated that there approaches to estimate carbon stock, are biome averages, ground-based measurements and remote sensing measurements. Furthermore, the Intergovernmental Panel on Climate Change (IPCC GPG), 2003 classified the approaches to estimate carbon stock or carbon pools into five categories are aboveground biomass, belowground biomass, litter, dead wood, and soil organic carbon. The aboveground biomass approach which includes trees, other above-ground biomass, dead wood and litter is the main interest. IPCC approaches on carbon pools are shown on the following figure:

Figure 5.14 IPCC GHG Carbon Pools Approaches

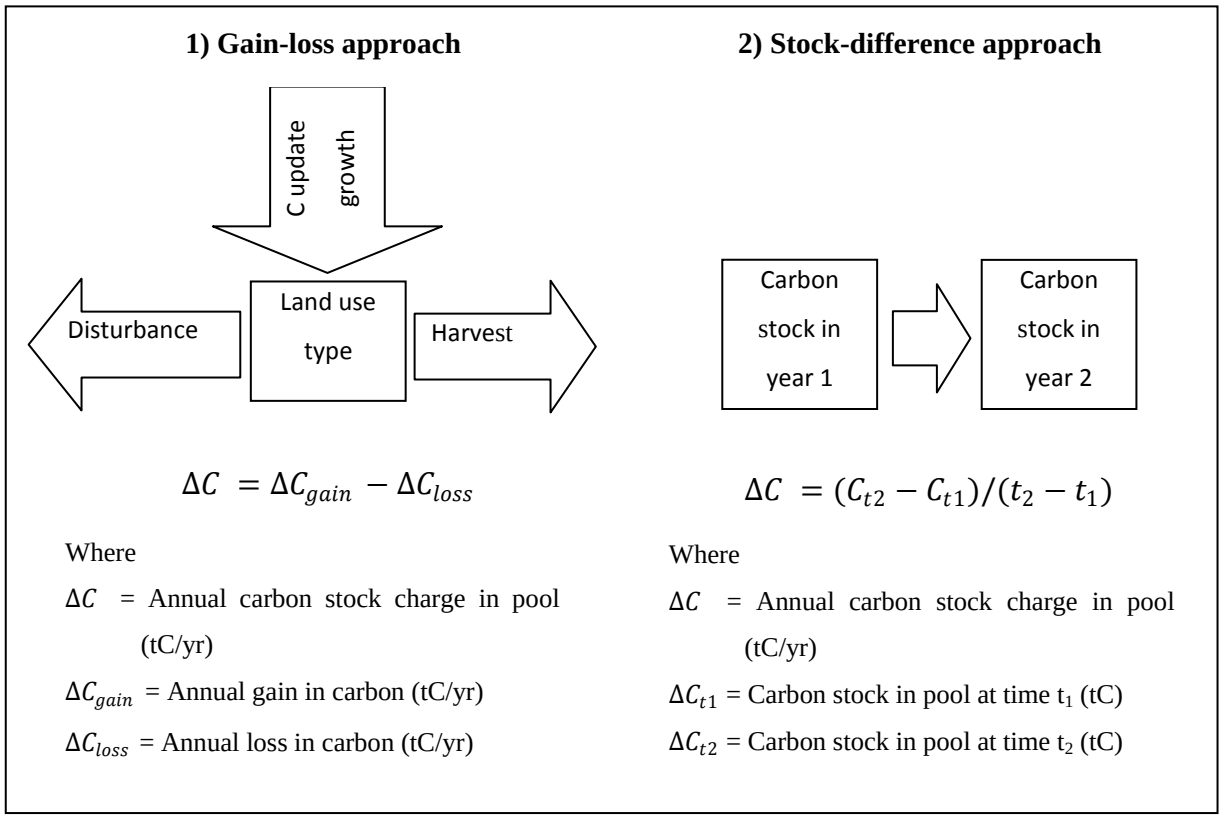


Source: CIFOR, Forest Carbon Toll box, 2008

IPCC refers to types of methods in calculating emissions: (i) gain-loss method, which accounts the detail of fluxes due to both human activities and natural processes at a relatively short time scale, (ii) stock-difference method, which accounts for changes in stock due at coarser time scale. The first method, if done appropriately, can be more accurate especially using a short time scale and using a small area. However, this method is very tedious and quite expensive. The measurement of large areas using this method can lead to estimation

error. Nevertheless, the first method can be used to obtain annual data such as growth rate and wood harvest.

Figure 5.15 IPCC GHG Carbon Emission Estimation Approach



Source: Estimating carbon stock changes, Wertz-Kanounnikof 2008, adopted from Eggleston 2008, and Brown and Braatz 2008

Since the data of carbon stock used in this study are from RaCSA, ICRAF, carbon emission will also be calculated using this method.. RaCSA adopted the second method to calculate carbon emission of land use change in Jambi Province and East Kalimantan Province. The stock-difference method estimates the difference in carbon stocks in a particular pool at two moments in time. The benefit of using the second method is suitable for estimating carbon emission caused by both deforestation and degradation can be applied to all carbon pool, and makes carbon emission accounting for large scale such national forest inventories is easier. However, the stock-difference approach also has some limitations are;

(1) the sensitivity in counting emission when there are no changes in land use system, (2) it does not capture a short temporal dynamics, and (3) some assumptions may nor appropriately address some reality on the ground, and therefore might not achieve the purpose of the accounting, e.g., removal of biomass from the site are counted as emissions.

In the RaCSA, the emission factors are defined as the stock differences between original and change of land use system. Time-averaged C stock is defined as a land use system specific measure. Land use systems capture the combination of land cover (vegetation density and composition that cover the earth surface), land use (human activities conducted on the land and on the vegetation on it) and the periodic cycle attached to those particular human activities that relate with a specific various change of land use. In detail, carbon stock for any type of land use in Indonesia is presented on the following table.

Table 5.70 Above Ground Time-Averaged Carbon Stocks of Different Land Use Systems in Indonesia

ID	Landcover	Cstock (Mg/ha)
1	Undisturbed forest	300
2	Log over forest high density	250
3	Log over forest low density	150
4	Undisturbed mangrove	200
5	Log over mangrove	100
6	Undisturbed swamp forest	200
7	Log over swamp forest	200
8	Agroforest	116.11
9	Rubber agroforest	62.06
10	Rubber	46.76
11	Plantation	23.17
12	Palm Oil	30.96
13	Natural re-growth shrub	26.83
14	Agriculture	11.85
15	Ricefield	0.97
16	Grass	2
17	Settlement	4.14
18	Open peat	4.14
19	Cleared land	3.9

ID	Landcover	Cstock (Mg/ha)
20	Fishpond	0
21	Water	0

Source: Hairiah ICRAF, 2005

This study calculated four kinds of carbon stock change, including total net carbon stock change from year 2000 to 2005 (tons), annual total net carbon stock change (ton/year), total mean carbon stock change per ha (tons/ha), annual total mean carbon stock change (ton/ha/year), then it converted to CO_2 emission by multiplying with 3.67[1]. this section will present CO_2 emission caused by land use change in Jambi province and East Kalimantan province from year 1990 to 2005 separately.

5.4.1 CO_2 Emission in Jambi Province

The following table presents the CO_2 emissions and sequestrations in Jambi Province from year 2000 to 2005. From the table 5.41, the total net CO_2 emissions caused by land use change from year 2000 to 2005 is 174 Mega tons of CO_2 and the total net CO_2 sequestration is 104 Mega tons. The largest CO_2 emission is produced by rubber which has CO_2 emission of 38 Mega tons in total with the annual total net CO_2 emission of 8 Mega tons. The net CO_2 emission per ha is 7.87 tons / ha and the annual average CO_2 emission is 1.57 ton/ ha/ year. The second sector which has large CO_2 emission is cleared land. The total net CO_2 emission for cleared land from year 2000 to 2005 is 28.5 million tons or contribute almost 16 % of total CO_2 emission in Jambi Province from year 2000 to 2005. Palm oil sector contribute nearly 15 % to total CO_2 emission by having total net CO_2 emission is 26 Mega tones, annual net CO_2 emission is 5 Mega tons, the average total net CO_2 emission is 5.35 tons and the annual average net CO_2 emission is 1.07 ton/ha/year. The Settlement is the fourth sector which contributes large CO_2 emission for Jambi Province during the period 2000-2005. Settlement land use in Jambi Province has the total net CO_2 emission 25 Mega tones (about 14% of total

[1] indicates the chemical equivalent for conversion of carbon to be carbon dioxide

CO_2 emission in Jambi Province), the annual net CO_2 emission is 5 Mega tons, the average total net CO_2 emission is 5.10 ton/ha, and the average annual net CO_2 emission is 1.02 ton/ha/year.

Table 5.71 Summary of Changes of Areas and CO_2 Emissions and Sequestrations in Jambi Province between 2000 and 2005

No	Land Use Type	Area of Changes (thousand ha)	Total Net CO_2 Emission (mega tons)	Annual Net CO_2 Emission (mega ton/ year)	Net CO_2 Emission (ton/ha)	Carbon Emission Factor (ton/ha/year)
1	**Agriculture**	-6.34	12.13	2.43	2.49	0.50
2	**Cleared land**	49.59	28.5	5.70	5.85	1.17
3	**Coconut**	-38.16	2.7	0.54	0.55	0.11
4	**Grass**	2.00	6.33	1.27	1.3	0.26
5	**Log over forest high density**	-31.08	7.52	1.50	1.55	0.31
6	**Log over mangrove**	6.13	2.27	0.45	0.47	0.09
7	**Natural re-growth shrub**	46.35	19.38	3.88	3.99	0.80
8	**Palm oil**	44.77	26.04	5.21	5.35	1.07
9	**Rice field**	66.30	14	2.80	2.87	0.57
10	**Rubber**	34.71	38.27	7.66	7.87	1.57
11	**Settlement**	99.23	24.83	5.00	5.10	1.02
Total net CO_2 Emission (tons)			173.66	34.73	35.68	7.14
Total CO_2 Sequestrations (tons)			104.05	20.81	14.30	2.86

Source: Author's Calculation

Furthermore, this study uses 10 USD as estimated price of carbon by MoF (2007). Indonesian Ministry of Finance estimate that the average cost to reduce emissions in the forestry sector is in the range of 10 USD and 23 USD/ton of carbon. It can be called as abatement cost. The estimated abatement cost for total net CO_2 emission in Jambi Province from year 2000 to 2005 is about 16.3 trillion IDR, while the abatement cost for annual total net CO_2 emission is nearly 3.4 trillion IDR with the average abatement cost of CO_2 emission per ha is 3.3 million IDR. The abatement cost for total CO_2 emission of Rubber is about 3.6 trillion IDR and about 0.72 million IDR annually. The estimated abatement cost for total net CO_2 emission for cleared land is 2.7 trillion Rupiah, and annually abatement cost is about

0.54 trillion IDR. For the total net CO_2 emission of palm oil, its estimated abatement cost is about 2.4 trillion Rupiah.

Table 5.72 Summary of Monetary Value of CO_2 Emissions and Sequestrations in Jambi Province between 2000 and 2005 in IDR

No	Land Use Type	Total Net CO_2 Emission (in trillion IDR)*	Annual Net CO_2 Emission (in trillion IDR/year)	Net CO_2 emission (million IDR/ha)	Carbon Emission Factor (IDR/ha/year)
1	Agriculture	1.14	0.20	0.23	47,000
2	Cleared land	2.68	0.54	0.55	109,980
3	Coconut	0.25	0.05	0.05	10,340
4	Grass	0.59	0.12	0.12	24,440
5	Log over high density	0.71	0.14	0.15	29,140
6	Log over mangrove	0.21	0.04	0.04	8,460
7	Natural re-growth shrub	1.82	0.36	0.38	75.200
8	Palm oil	2.45	0.49	0.50	100.580
9	Rice field	1.31	0.26	0.27	53.580
10	Rubber	3.6	0.72	0.74	147.580
11	Settlement	2.33	0.47	0.48	95.880
	Total CO_2 Emission	16.32	3.42	3.34	671,160

Source: Author's Calculation
Note: * at 2009 Exchange Rate, Rp 9400 per 1 US$

5.4.2 CO_2 Emission in East Kalimantan Province

This following table presents the total net CO_2 emissions caused by land use change in East Kalimantan from year 2000 to 2005 was 1.24 Giga tons of CO_2 and the total net CO_2 sequestration was 0.45 Giga tons. The largest CO_2 emission was occured in undisturbed forest which has CO_2 emission 619 Mega tons in total with the annual total net CO_2 emission is 123 Mega tons. The net CO_2 emission per ha was 34.13 tons/ha and the annual average CO_2 emission was 6.83 ton/ha/year. The second sector which had large CO_2 emission was Log over forest high density. The total net CO_2 emission for Log over forest high density from year 2000 to 2005 was 443.6 Mega tons or contributed about 36 % of total CO_2 emission

in East Kalimantan from year 2000 to 2005. Log over forest low density was the third sector which contributes large CO_2 emission for East Kalimantan from year 2000 to 2005. It had the total net CO_2 emission 68.26 mega tons (about 5.5% of total CO_2 emission in Jambi Province), the annual net CO_2 emission is 13 mega tons, the average total net CO_2 emission is 3.76 ton/ha, and the average annual net CO_2 emission is 0.75 ton/ha/year. Palm oil sector contributed only 0.08% to total CO_2 emission by having total net CO_2 emission was 1.02 mega tons, annual net CO_2 emission is 0.2 mega tons, the average total net CO_2 emission is 0.06 tons and the annual average net CO_2 emission is 0.01 ton/ha/year.

Table 5.73 Summary of Changes of Areas and CO_2 Emission and Sequestrations in East Kalimantan Province between 2000 and 2005

No	Land Use Type	Area of changes (Thousand ha)	Total Net Emissions (mega tons)	Annual Net Carbon Emission (m tons/year)	Carbon emission (ton/ha)	Annual carbon Emission per ha (ton/ha/year)
1	Agro forest	31.95	21	4.29	1.18	0.24
2	Log over forest high density	-536.53	443.61	88.72	24.42	4.88
3	Log over forest-low density	1.30**	68.26	13.65	3.76	0.75
4	Log over mangrove	75.65	1.54	0.31	0.08	0.02
5	Log over swamp forest	147.62	25.22	5.04	1.39	0.28
6	Palm oil	70.01	1.02	0.20	0.06	0.01
7	Open peat	11.24	0.57	0.11	0.03	0.01
8	Plantation	137.69	1.20	0.24	0.07	0.01
9	Rubber	-1.40	1.25	0.25	0.07	0.01
10	Rubber agro forest	-8.60	3.95	0.79	0.22	0.04
11	Undisturbed forest	-1.26**	620	124	34.13	6.83
12	Undisturbed mangrove	-116.54	54.61	10.92	3.01	0.60
13	Undisturbed swamp forest	-228.80	29	5.78	1.59	0.32
Total CO_2 Emission (tons)			1.24*	248	68.46	13.69
Total Carbon Sequestrations (tons)			0.45*	90.12	24.85	4.97

Source: Author's Calculation
Note: * means in giga tons, ** the value is in million ha

This study found that the estimated abatement cost for total net CO_2 emission in East Kalimantan from year 2000-2005 is approximately 117 trillion IDR, while the abatement cost for annual total net CO_2 emission is nearly 23.3 trillion IDR with the average abatement cost of CO_2 emission per ha is 6.4 million IDR. The abatement cost for total CO_2 emission of undisturbed forest is about 58 trillion IDR and about 12 trillion IDR annually. The estimated abatement cost for total net CO_2 emission for Log over forest high density is almost 42 trillion Rupiah, and annually abatement cost is about 8.3 trillion. For the total net CO_2 emission of palm oil, its estimated abatement cost is about 0.1 trillion Rupiah.

Table 5.74 Summary of Monetary Value of CO_2 Emission and Sequestration in East Kalimantan Province between 2000 and 2005 in IDR

No	Land Use Type	Total Net CO_2 Emission (in trillion IDR)	Annual Net CO_2 Emission (in trillion IDR)	Net CO_2 emission (IDR/ha)	Carbon Emission Factor (IDR/ha/year)
1	Agro forest	2.02	0.40	110,920	22,560
2	Log over forest high density	41.7	8.34	2.3*	458,720
3	Log over forest low density	6.42	1.28	353,440	70,500
4	Log over mangrove	0.15	0.03	7,520	1,880
5	Log over swamp forest	2.37	0.47	130,660	26,320
6	Palm oil	0.1	0.02	5,640	940
7	Open peat	0.05	0.01	2,820	940
8	Plantation	0.11	0.02	6,580	940
9	Rubber	0.12	0.02	6,580	940
10	Rubber agro forest	0.37	0.07	20,680	3,760
11	Undisturbed forest	58.28	11.66	3.21*	642,020
12	Undisturbed mangrove	5.13	1.03	282,940	56,400
13	Undisturbed swamp forest	2.72	0.54	149,460	30,080
	Total Cost	116.92	23.38	6.44*	1.27*

Source: Author's Calculation
Note: * means in million IDR

In conclusion, Between 2000 and 2005, the land use in Jambi province and East Kalimantan province changed. The change of land use in Jambi Province and East Kalimantan Province caused the change of carbon stock in the area. This is called as CO_2

emission. The sources of CO_2 emission in Jambi Province and East Kalimantan is different. The largest sources for CO_2 emission in Jambi province are from rubber and palm oil. On the other hand, the largest carbon emissions of East Kalimantan province are from undisturbed forest, rubber and palm oil. Jambi province was one of targeted areas chosen by the Indonesian government for the expansion of rubber and palm oil, although currently the land available for plantation in Jambi is limited. Conversely, in East Kalimantan province, the land availability is large. East Kalimantan province is one of the main areas set for palm oil expansion in Indonesia until 2020. This chapter presents how land use change activity occured in Jambi province and East Kalimantan from year 2000-2005. The land conversion to palm oil is the largest one occured in Jambi province and East Kalimantan province. The land coversion to palm oil in Jambi province and East Kalimantan province came mainly from undisturbed forest area. This land use activity caused carbon emission. And the estimated cost for CO_2 emission to be paid by the Indonesian government is huge. Therefore, the Indonesian Government through National Planning Agency announced the Master Plan for Acceleration and Expansion of Indonesian Economic Development has selected palm oil is one of important sectors to achieve economic growth of Indonesia. The Indonesian government targeted to achieve about 9 million tons palm oil production by 2020. In other hand, the Indonesian government also concerned with reducing GHG emission include CO_2 emission caused by palm oil sector. In May 2011, the Indonesian government signed the letter of intent with the Norwegian Government about REDD financial assistance to reduce emission from deforestation and degradation. Then, in September 2011, the Indonesian President, Susilo Bambang Yudhoyono also signed the Presidential Regulation of Republic Indonesia No 61 Year 2011 about the National Plan on GHG Emission Reduction that Indonesia commited to reduce GHG emission by 26% than BAU in 2020.

Therefore, the next chapter will present how are the impact of Indonesian government policies to support palm oil expansion as a part of Master Plan to accelerate and expand economic development of Indoneisa as well as policies to reduce carbon emission from palm oil expansion through looking on implication of REDD project and carbon tax. Jambi and East Kalimantan province are taken as representative for Indonesian palm oil case. It because Jambi and East Kalimantan provinces are two of main targeted area to expand palm oil production as well as for REDD project pilot in Indonesia. This study integrates the CO_2 emission data caused by land use change activity presented in this chapter to the 2005 Indonesian Inter-Regional Social Accounting Matrix to build "an environmentally extended Inter-Regional Social Accounting Matrix". Then this study utilizes accounting multiplier analysis to examine the impact of both policies on the whole economic structure in five regions using the 2005 Indonesia IRSAM model. The detailed explanation about EIRSAM model, simulation scenario, and the result will be presented on Chapter VI.

Chapter VI

Environmental Analysis of Palm Oil Expansion in Indonesia: The Case Studies of Jambi Province and East Kalimantan Province

This chapter will focus on how to analyze the environmental impacts of palm oil expansion in Indonesia. The structure of this chapter are as following: (1) literature reviews of the introduction of environmental analysis, brief description about the 2005 Indonesian Inter-Regional Social Accounting Matrix and environmentally extended social accounting matrix, (2) methodology, (3) data and source, (4) proposed model for environmentally extended inter-regional social accounting matrix for Indonesia 2005, (5) simulation scenarios, and the last (6) result and discussion.

6.1 Literature Reviews

6.1.1 Introduction of Environmental Analysis

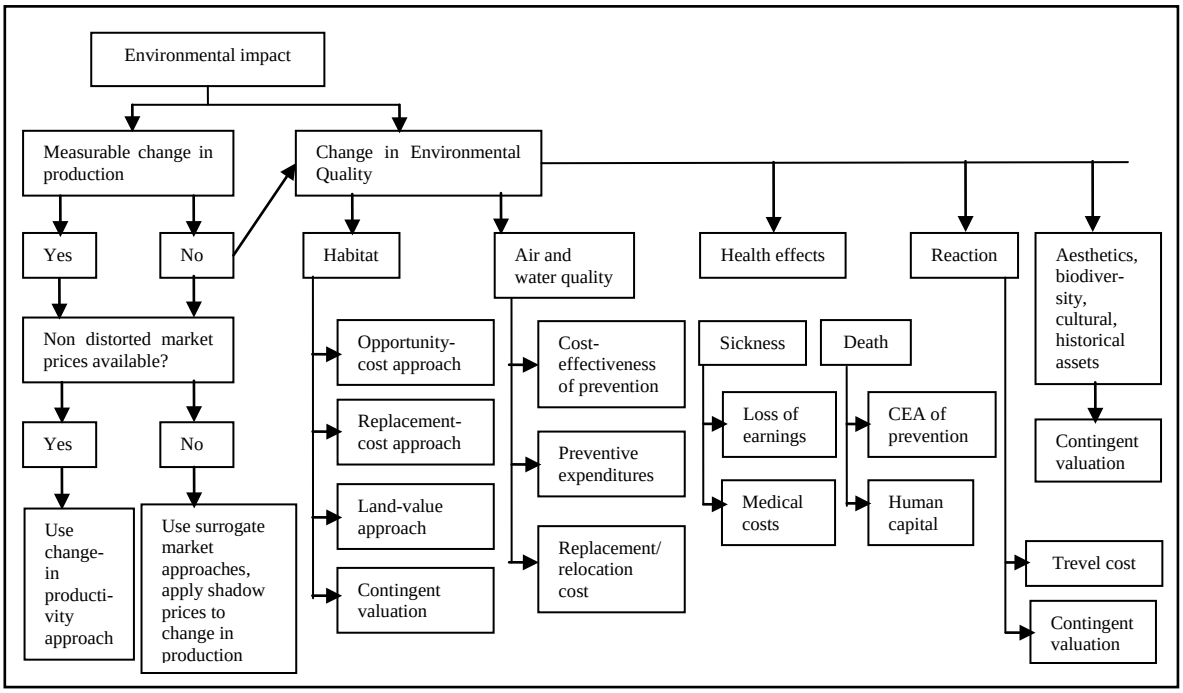
Starting from Stockholm Conference on Human Environment in 1972, the awareness of environmental as important thing to be considered for sustainable development has started. In 1992, the World Bank development report also focused on the relationship between development and environment and proposed the chance to implement “win-win solution policy” in order to balance between economic and environment. Later, many countries accepted that environmental degradation will reduce economic benefit for future or un-sustainable development. Furthermore, some researchers were conducted to link to economic and environment and to evaluate the environmental impact using economic framework.

Dixon, et al (1996) described that there are two steps to assess the economic valuation of environmental impact of projects are (1) identify what kind of environmental

impact of project or economic policy implemented by government of country and (2) quantify the impact by comparing the impact before and after the project. In details, he explained three criteria to identify environmental impacts are the length of time and geographic area which the effect will occur, the urgency, and the degree of irreversible damage to community, biodiversity, and ecosystem.

To quantify the environmental impact in economic valuation can be classified as measuring change in productivity and change in environmental quality. In detail, it is summarized in the following figure:

Figure 6.1 Flowchart of Economic Valuation of Environmental Impact



Source: Dixon and Sherman, 1990

Based on the figure above, there are two methods to measure environmental impact, which are (1) looking on measurable change in productivity and (2) looking on change in environmental quality. To measure the change in production, we can use change in productivity approach and surrogate market approaches by applying shadow prices in the changes of production. About the measurement of change in environmental quality, it can be

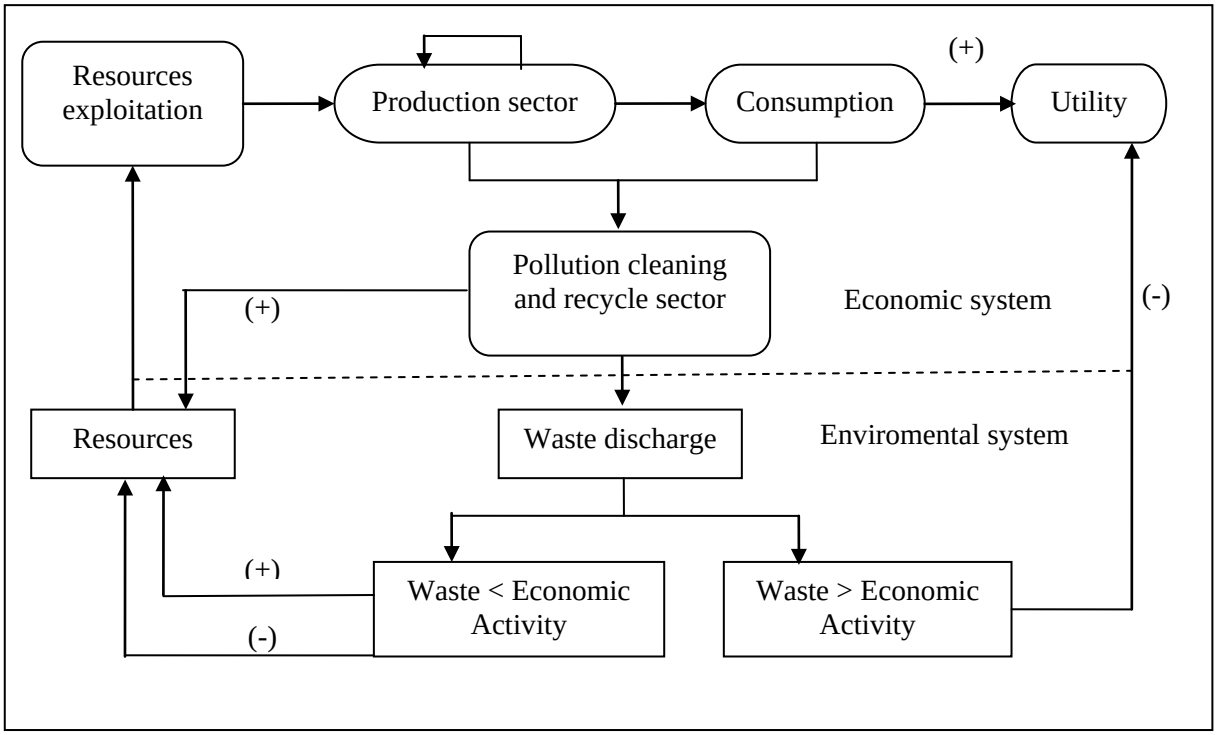
classified the impacts on (1) habitat, (2) air and water quality, (3) health effects, (4) recreation, and (5) biodiversity and cultural aspect. Each kind of impact has specific valuation method to be applied. Therefore, this study follows the second method which is measuring the change of environmental quality in focusing land use change from forested area or others to be converted to palm oil expansion. The land use changes will cause the change of carbon stock. As forested area has the largest carbon stock, there will be decrease carbon stock if forested area is converted for palm oil plantation. Therefore, in this study, it is defined as carbon emission.

All of valuation methods mentioned above are the economic valuation method to asses environmental impact of projects on the micro level. On the macro level, there are some macroeconomic methods such as linear programming method, natural resource accounting, resource and environmental account (green GDP concept, integrated accounts, and genuine savings) and the last is general equilibrium. This study uses the social accounting matrix with environmentally extended, Therefore, the literature review about the environmentally extended social accounting matrix will be presented in the following sections.

6.1.2 Towards the Integration of Environment and Economy

The interaction between environment and economy has been recognized by many researchers since many years ago. The interaction between economic and environmental factors is complex. Environment provides meterial as an input to produce goods, then goods are consumed by society. The consumption caused waste or discharge which negative impact to environment. The following figure describes the interaction between environment and economy.

Figure 6.2 Environment-Economy Interaction



Source: Xie, 2000

As shown in the figure above, the interaction between environment and economy comes in two ways. The economic activity receives material or input from the environment as resource exploitation. The material from environment is used by production sector to produce goods, then consumed by society (called consumption). Economic activity (production and consumption) also causes waste or polllutant as shown in the figure above as pollution cleaning and recycle sector and produce waste discharge. At the last, if waste discharge is less than environment's assimilative capacity, it will not cause environmentl degradation. But in the case waste discharge is larger than environmentl's assimilative capacity, the environmental degradation will occur.

Since many years ago, economists have tried to integrate the environmental indicator into economic indicator or modelling. The main reason was the lack of environmnetal account on the traditional national accounting. The results the concept of green Net Natioanl Product

as a revised version of the traditional one. Green NNP or green accounting incorporates the value of the net change in natural capital and the effect of environmental change. Furthermore, Atkinson (1997) categorized the 'green account' into three categories, are (1) natural resource account in balance sheet items which describe opening and closing of resource stocks, (2) resource and pollutant flow account which is well known as I-O, (3) Environmental expenditure accounts for the complete data on capital and expenditure of all economic agents for the protection of environmental purpose. Dixon et al (1994) as citied in Patriquin et al (2000) presented the possibility how to link environmnetal impact into the economic damage as presented on table 6.1.

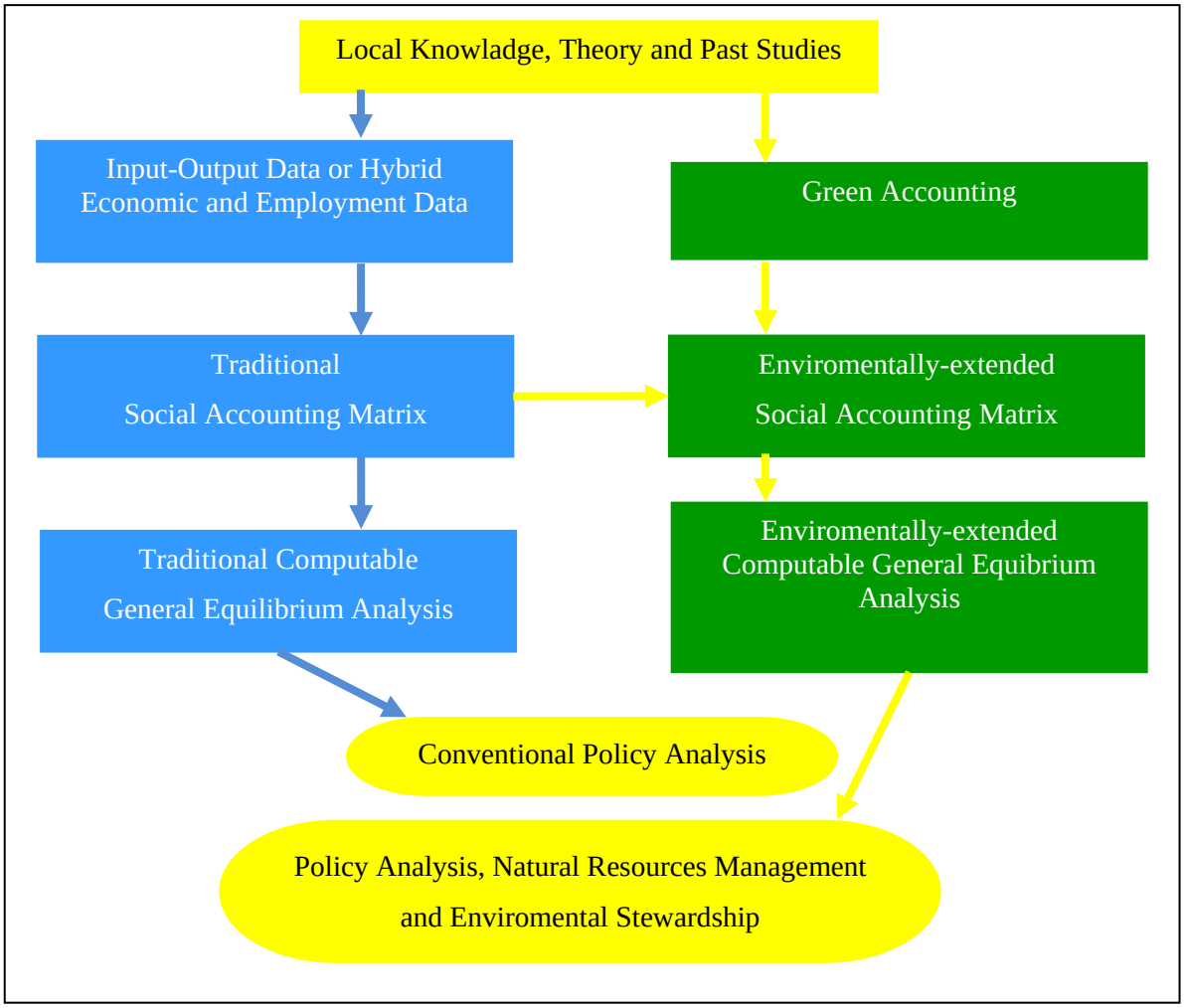
Table 6.1 Summarized of Some Economic Damages from Environmental Impacts

Environmental Impact	Economic Damage
	Air Pollution
Illness	Medical Expense
Vegetation Effects	Redused Crop Yields
Aesthetic Degradation	Property Value
	Water Pollution
Toxins in Drinking Water	Medical Expense / Water Treatment
Fisheries Effects	Lowered Catch
Water Recreation	Tourism Revenues
	Ecosystem Degradation
Forest Lands	Sedimentation
Monoculture Plantations	Loss of Biodiversity

Source: Patriquin et al, 2000

Moreover, the following figure shows the forms of general equilibrium modelling to integrate the environment account and economic account for the purpose of more complete policy analysis. There is improvement or revision of I-O, SAM, and CGE usingcluding the environment account into the model.

Figure 6.3 Process of More Complete Policy Analysis



Source: Patriquin et al, 2000

6.1.3 Brief Description of the 2005 Indonesian Inter-Regional Social Accounting Matrix

Since the 2005 Indonesian Inter-Regional Social Accounting Matrix was built with the similar general structure of Social Accounting Matrix, this sub section will briefly give an overview about social accounting matrix before description of the 2005 Indonesian IRSAM, then an overview of the structure of Social Accounting Matrix for Sumatera Region and Kalimantan Region.

General definition of Social Accounting Matrix is the traditional accounting that has the same row and column which represent the economic flow among factors of production

(labor, land, capital), institutions, production sectors, commodities (domestic and imported), other accounts, and the rest of the world. Moreover, Pyatt & Round (1977) stated that SAM can be used as a tool to analyze income distribution, employment opportunities, poverties and other social indicators. The analysis using SAM is basically done by accounting multiplier analysis through setting some accounts to be exogenous accounts. The remains act as endogenous accounts. The row accounts represent the expenditure or money spent by each account to others. The column accounts represent the income by each sector from transaction with others. The following figure represents the simplified version of SAM.

Figure 6.4 Simplified Social Accounting Matrix

<table>
<tr><td></td><td colspan="6">Income</td></tr>
<tr><td></td><td colspan="3">Endogenous Accounts</td><td colspan="3">Exogenous Accounts</td></tr>
<tr><td>Expenditure</td><td>Production Activities</td><td>Factors Production</td><td>Institutions</td><td>Government</td><td>Capital Account</td><td>Rest of the World</td></tr>
<tr><td>Production Activities</td><td colspan="3" rowspan="3">Endogenous transactions</td><td colspan="3" rowspan="3">Injections</td></tr>
<tr><td>Factors of Production</td></tr>
<tr><td>Institutions (Firms & households)</td></tr>
<tr><td>Government</td><td colspan="3" rowspan="3">Leakages</td><td colspan="3" rowspan="3">Exogenous transactions</td></tr>
<tr><td>Capital Account</td></tr>
<tr><td>Rest of the World</td></tr>
</table>

Source: King, 1981

Since this study analyzes two case studies, Jambi Province and East Kalimantan Province, the next description is about the 2005 Indonesian inter-regional social accounting matrix (IRSAM) which built by Resosudarmo et al (2009). The 2005 Indonesian IRSAM was mainly based on Inter-Regional Input-Output Table, and other additional data sources such as National Socio-Economic Survey (SUSENAS), National and Regional Balance of Payment,

Current Account, Population Census, National Labor Force Survey (SAKERNAS), and others. In the IRSAM, the transaction for each region occurs into two channels which are with other regions and other countries. IRSAM for Indonesia of 2005 consists of five regions, are Sumatera, Kalimantan, Java and Bali, Sulawesi and Eastern Indonesia. The simplified the 2005 Indonesian IRSAM is presented on the appendix.

Moreover, the classification of 2005 IRSAM for each region has factors on production, institutions, production sectors, commodities, other accounts, National Government Accounts. The factors of production account has three classifications; labor, capital and land. The labor is differentiated into 16 classifications which are 8 formal and 8 informal laborers. The account of institutions has three classifications which are households, companies, and local government. Household is divided into two; rural and urban. The Production sectors are classified into 35 production sectors. The other account have three accounts are local tax, subsidy and inventory. At the national level accounts, there are three types of accounts which are capital accounts (central, local and private), central government account, and tax and subsidy accounts. The detailed of classification accounted in IRSAM 2005 can be seen on the appendix.

Since this study focuses on Jambi province and East Kalimantan province as cases of study, this study will utilize two regions only, of the 2005 Indonesia Inter-Regional Social Accounting Matrix which are Sumatera Region and Kalimantan Region. Therefore, an overview about the structure of Social Accounting Marix for Sumatera Region and Kalimantan region will be described in the following.

In general, the classification of accounts in Social Accounting Matrix for Sumatera Region and Kalimantan Region is similar with the classification in the 2005 Indonesian

IRSAM. The following table describes the simplified Social Accounting Matrix for Sumatera Region.

Table 6.2 Simplified Framework of the 2005 Social Accounting Matrix for Sumatera Region

IRSAM 2005				Sumatera Region				Other Regions				National Accounts	
Classification							Expenditure						
Receipt		1	2	3	4	5	6	7	8	9	10	11	12
Factors of Production	1			$A_{1,3}$									$A_{1,12}$
Institution	2	$A_{2,1}$	$A_{2,2}$	$A_{2,3}$		$A_{2,5}$	$A_{2,6}$				$A_{2,1}$		$A_{2,12}$
Production Sectors	3		$A_{3,2}$	$A_{3,3}$	$A_{3,4}$		$A_{3,6}$	$A_{3,7}$	$A_{3,8}$	$A_{3,9}$	$A_{3,1}$		$A_{3,12}$
Others	4			$A_{4,3}$						$A_{4,9}$			
Factors of Production	5							$A_{5,7}$					$A_{5,12}$
Institution	6	$A_{6,1}$	$A_{6,2}$			$A_{6,5}$	$A_{6,6}$		$A_{6,8}$		$A_{6,1}$		$A_{6,12}$
Production Sectors	7		$A_{7,2}$	$A_{7,3}$	$A_{7,4}$		$A_{7,6}$	$A_{7,7}$	$A_{7,8}$	$A_{7,9}$	$A_{7,1}$		$A_{7,12}$
Others	8							$A_{8,7}$		$A_{8,9}$			
Capital	9		$A_{9,2}$				$A_{9,6}$				$A_{9,1}$		$A_{9,12}$
Central Government	10	$A_{10,1}$	$A_{10,2}$	$A_{10,3}$		$A_{10,5}$	$A_{10,6}$	$A_{10,7}$			$A_{10,1}$	$A_{10,1}$	$A_{10,12}$
Imported Commodity	11		$A_{11,2}$	$A_{11,3}$			$A_{11,6}$	$A_{11,7}$		$A_{11,9}$	$A_{11,1}$		
Rest of the World	12	$A_{12,1}$	$A_{12,2}$			$A_{12,5}$	$A_{12,6}$					$A_{12,1}$	

Source: Author's Compilation

Table 6.2 presents the simplied economic flow among accounts in Social Accounting Matrix for Sumatera region and Kalimantan region. In other words, the table above contains matrices that record all transactions of receipt and expenditure from one account to others. The receipt of one accounts from others also means the expenditure done by other accounts. For the receipt account of Sumatera SAM, sub-matrix $A_{1,3}$ shows the receipt of factors of production from production sectors in Sumatera Region in terms of wage, salary and surplus and sub-matrix $A_{1,12}$ shows the receipt of factors of production in Sumatera Region from abroad (the rest of the world) mainly in form of capital inflow from abroad to Sumatera Region. Sub-matrices $A_{2,1}$, $A_{2,2}$, $A_{2,3}$ are the receipt accounts for institution (household, local government, and enterprises) from accounts in Sumatera Region. Sub-matrix $A_{2,1}$ shows the

receipt of institution from factors of production, $A_{2,2}$ shows the receipt from institution such as local government subsidy to household, the receipt of household from enterprise, receipt of local government from enterprise like tax. Sub-matrix $A_{2,3}$ shows the receipt of institution from production sectors. Sub-matrix $A_{2,10}$ is the receipt of institution from central government such as subsidy from central government to household, enterprise, and to local government. Sub-matrix $A_{2,12}$ shows the receipt of institution from the rest of the world.

Furthermore, in the receipt or income accounts in Sumatera region, Sub-matrices $A_{3,2}$, $A_{3,3}$ and $A_{3,4}$. These sub-matrices show the receipt of production sectors account from institution, production sectors, and others respectively. Sub-matrices $A_{3,6}$, $A_{3,7}$, $A_{3,8}$ show the receipt of production sectors from other regional account. Sub-matrix $A_{3,6}$ shows the receipt from production sectors from institution in other region as final demand. Sub-matrix $A_{3,7}$ shows the income of production sector from production sectors in other region due to its use as intermediate input for production sectors in other region. Sub-matrices $A_{3,9}$, $A_{3,1\,0}$, $A_{3,12}$ are the receipts from production sectors from national account. Sub-matrix $A_{3,9}$ shows the receipt of production sectors from capital in national level in form of physical investment. Sub-matrix $A_{3,10}$ shows the receipt of production sectors as final demand by central government for production sectors. Sub-matrix $A_{3,12}$ shows the receipt of production sectors from abroad or the rest of the world. As for the receipt of other accounts are shown in sub-matrices $A_{4,3}$ and $A_{4,9}$. The sub-matrix $A_{4,3}$ shows the receipt of other accounts from production sectors and sub-matrix $A_{4,9}$ shows its receipt from central government.

In the case of the income receipt by other region from Sumatera region and the same region as well as the expenditure spent by other region specifically on the factors of production accounts, which are in sub-matrices $A_{5,7}$ and $A_{5,12}$. Sub-matrix $A_{5,7}$ shows the income received by factors of production account in other region from production sectors that

use labor, land, and capital from other region. Meanwhile, sub-matrix $A_{5,12}$ shows the income received by factors of production account in other region from the rest of the world. As for the income received by institution accounts in other region, sub-matrix $A_{6,1}$ displays the receipt by institution in other region from the factors of production in Sumatera region as for the use of capital, labor and land. Sub-matrix $A_{6,2}$ shows the receipt of institution in other region from institution in Sumatera Region which is known as transfer among institution. The receipt of institution accounts in other region from other region are displayed in sub-matrices $A_{6,5}$, $A_{6,6}$ and $A_{6,8}$. The sub-matrix $A_{6,5}$ shows the receipt of institution in other region from factors of production in the same region, meanwhile sub-matrix $A_{6,6}$ displays income received by institution from institution in other region, and sub-matrix $A_{6,7}$ shows the income received by institution in other region from national accounts are shown in sub-matrices $A_{6,10}$ and $A_{6,12}$. The sub-matrix $A_{6,10}$ shows the income received by institution in other region from national government (such as subsidy) and sub-matrix $A_{6,12}$ shows the receipt of institution in other region from abroad. As for the incomes received by production sector account in other region from Sumatera Region are shown by sub-matrices $A_{7,2}$, $A_{7,3}$ and $A_{7,4}$. The sub-matrix $A_{7,2}$ shows the income received by production sectors in other region from institution in Sumatera region which is known as final demand. Sub-matrix $A_{7,3}$ shows the receipt of production sector in other region from production sectors in Sumatera Region which is known as intermediate input. Sub-matrix $A_{7,4}$ displays the income received by production sector in other region from others account in Sumatera region. As for the income received by production sectors in other region from accounts in other regions are shown by sub-matrices $A_{7,6}$, $A_{7,7}$ and $A_{7,8}$. The sub-matrix $A_{7,6}$ shows the income received by production sectors in other region from institution in other region. Sub-matrix $A_{7,7}$ shows the income received by production sectors from production sectors using region, which is known as intermediate demand. Sub-

matrix $A_{7,8}$ shows the income received by production sector from other accounts using the region. Meanwhile, incomes received by production sectors in other region from national account are shown by sub-matrices $A_{7,9}$, $A_{7,10}$ and $A_{7,11}$. The sub-matrix $A_{7,9}$ shows the income received by production sectors in other region from capital at the national level. Sub-matrix $A_{7,10}$ shows the receipt of production sectors in other region from central government (such as in form as subsidy), and $A_{7,12}$ shows the income received from the rest of the world. Moreover, for the income received by other account in other region are shown by sub-matrices $A_{8,7}$ and $A_{8,9}$. The sub-matrix $A_{8,7}$ shows the receipt of other accounts from production sectors using region such as regional tax. Sub-matrix $A_{8,9}$ shows the income received by other account in other region from capital account at the national level.

Furthermore, as for incomes received by capital account at national level are shown by sub-matrices $A_{9,2}$, $A_{9,6}$, $A_{9,10}$ and $A_{9,12}$. The sub-matrix $A_{9,2}$ shows the income received by capital account from institutions in Sumatera region which is known as saving. Sub-matrix $A_{9,6}$ shows the receipt of capital account in national level from institution in other region which is also knows as saving from other region. Sub-matrix $A_{9,10}$ shows the income received by capital account at national level from central government which is known as central government's saving. Sub-matrix $A_{9,12}$ shows the income received by capital account from abroad as the rent or capital inflow from the world. Moreover, Sub-matrices $A_{10,1}$, $A_{10,2}$, and $A_{10,3}$ show the income received by central government from accounts in Sumatera region. Meanwhile, sub-matrices $A_{10,5}$, $A_{10,6}$ and $A_{10,7}$ show the income received by central government from accounts in other region, and sub-matrices $A_{10,10}$, $A_{10,11}$ and $A_{10,12}$ show the income received by central government from central government, from imported commodities, and from abroad respectively. Moreover, Sub-matrices $A_{11,2}$ and $A_{12,3}$ show the income received by imported commodities from institution and production sectors in Sumatera region

respectively. These are also known as the final demand and intermediate demand for imported commodities in Sumatera region respectively. Meanwhile sub-matrices $A_{11,6}$ and $A_{11,7}$ show the income received by imported commodity from institution and production sectors in other region category. Lastly, sub-matrix $A_{11,10}$ shows the income received by imported commodity from central government or also known as total value of commodity imported by central government. Sub-matrices $A_{12,1}$ and $A_{12,2}$ show the income received by rest of the word from factors of production and institution in Sumatera region respectively. Sub-matrices $A_{12,5}$ and $A_{12,6}$ show the receipt of the rest of the world from the transfer of factors of production and institution in other region category. And the last sub-matrix $A_{12,11}$ shows the income received by the rest of the world from imported commodity.

6.1.4 Previous Research on ESAM

As mentioned in the introduction section, economic activities have strong impact on the environment, and vice versa. There have been many previous researches conducted through linking the economic and environment in the modeling. An environmentally-extended social accounting matrix is one of the well known models to incorporate the economic and environment effects. Previous researches done on incorporating environmental accounts into social accounting matrix (SAM) can be categorized into three ways, which are (1) introducing environmental variables into satellite table, (2) direct linking environmental accounts in physical terms into social accounting matrix in monetary terms, (3) incorporate environmental accounts into traditional social accounting matrix as endogenous account, which was introduced by Xie (2000).

The earlier ESAM framework was introduced by Weale (1991) who proposed an extended SAM by taking Indonesian case and calculated a fix multiplier to estimate the

environmental impact of a change in exogenous demand. Weale utilized Indonesian social accounting matrix from Khan and Thorbecke (1989) and environmental data taken from Repetto et al. (1989). Moreover, the simplified ESAM framework compiled by Weale (1991) is presented on the following table.

Table 6.3 Weale (1991) ESAM Framework

	Factors	**Institutions**	**Production**	**Exogenous**	**Total**
Factors			A_{13}	A_{14}	T_1
Institutions	A_{21}	A_{22}		A_{24}	T_2
Production		A_{32}	A_{33}	A_{34}	T_3
Exogenous	A_{41}	A_{42}	A_{43}	A_{44}	T_4
Total	T_1	T_2	T_3	T_4	
Environment			E_3	E_4	

Source: Weale, 1991

As is presented on the table above, ESAM framework compiled by Weale (1991) consist of a balanced row and column of traditional SAM and additional row for environmental data. The traditional SAM shows the income received by one account from the another thus also as the expenditure done by another account to that account. The example brief description from the above table are sub-matrix A_{13} shows the receipt of factors of production from production sectors, thus also as expenditure or payment done by production sectors to factors of production (labor, capital, and land) and sub-matrix A_{32} shows the payment of institution to production sectors, which is known as final demand. It also shows the income received by production sector from institution. Furthermore, Weale (1991) added three kinds of environmental accounts into production activities which are shown on sub-matrix E_3. These environmental accounts are (1) land degradation as the result of food crop's production, (2) deforestation as the result of the production of forestry, and (3) crude oil depletion as the result of production of petroleum. Weale (1991) also added sub-matrix E_4 to show the deforestation as the impact of capital account in the exogenous account.

Moreover, Atkinson et al (1995) proposed an environmentally extended social accounting matrix framework as shown in the following table. Atkinson et al (1995) corporated two additional accounts into traditional SAM, which are resources account and environment account. Atkinson introduced the concept of NNP, Net National Product as the receipt of factors of production from production sectors and as the expenditure by factors of production to institutions. He also introduced K, depreciation of human-made capital as the receipt of capital formation of production sector. Another concept is a value of environment indicator, which is defined as the expenditure by institution to environmental account. He also introduced the concepts of NRP, Net Resource Product and RE, as the value of environmental damaged using marginal social cost of emissions. The ESAM framework compiled by Atkinson et al (1995) is more related to green GDP concept.

Table 6.4 Atkinson's Simplified ESAM Framework

	Expenditure		1	2	3	4	5	6	7	8
Receipts			Production	Factors	Institutions	Capital	ROW	Resources	Environment	Total
	1	Production								
	2	Factors								
	3	Institutions								
	4	Capital								
	5	ROW								
	6	Resources								
	7	Environment								
	8	Total								

Source: Atkinson et al, 1997 as cited in Patriquin, 2000

In addition to what was compiled by Atkinson et al (1995), SESAME, Social Accounting Matrix including environmental accounts for Netherland was introduced as an environmentally extended social accounting matrix framework for Netherland by Keuning and Timmerman (1995). SESAME is basically similar with NAMEA, but put more emphasize on the income distribution. In SESAME, there are three environmental accounts added into traditional SAM, which are substances (CO_2, N2O, CH4, and others), global environmental

themes, and National environmental themes. The substances accounts received input or income from production in form of absorption substances in production, transfer of pollutant to the rest of world, allocation to global environmental themes and national environmental themes. The global environmental themes account and national environmental themes account receive income or input from capital account as environmental indicator. All environmental accounts are valued in physical unit. Other accounts can be seen in the following table:

Table 6.5 Simplified Framework of SESAME Compiled by Keuning and Timmerman (1995)

Account		Product Group	Consumption Household	Production	Generation of Income	Primary Distribution of Income	Secondary Distribution of Income	Use of Disposable Income	Capital	Tax Account		ROW	ROW	Substances	Global Environ-mental Themes	National Environ-mental Themes	Total
										Environ-mental Tax	Other Taxes	Current	Capital	CO2, N2O, CH4,and others			
Product Group																	
Consumption Household																	
Production																	
Generation of Income																	
Primary Distribution of Income																	
Secondary Distribution of Income																	
Use of Disposable Income																	
Capital																	
Tax Account	Environ-mental Tax																
	Other Taxes																
ROW	Current																
ROW	Capital																
Substances	CO_2, N_2O, CH_4,and others																
Global Environmental Themes																	
National Environmental Themes																	
Total																	

Source: Keuning and Thimmerman, 1995

Furthermore, Resosudarmo and Thorbecke (1996) compiled ESAM for the Indonesian case to examine the impact of Indonesian environmental policies on household income. The simplified framework of ESAM compiled by Resosudarmo and Thorbecke (1996) is presented as in the following table.

Table 6.6 Resosudarmo d Thorbecke (1996) ESAM Framework

										Expenditure
Income		1	2	3a	3b	3c	4		5	6
No	Classification	Factors of Production	Institutions	Dirty Production Sectors	Clean Production Sectors	Air Pollutant Health	ROW	TOTAL	Ambient Air pollutants	Health problems
1	Factors of Production									
2	Institutions									
3a	Dirty Production Sectors									
3b	Clean Production Sectors									
3c	Air Pollutant Health									
4	ROW									
	TOTAL									
5	Ambient Air pollutants									
6	Health problems									

Source: Resosudarmo and Thorbecke, 1996

The table above shows that ESAM framework separated production sectors of traditional SAM into three production sectors; dirty production sectors, clean production sectors, and air-pollutant-health. Dirty production sectors cause air pollutant, which will increase health problem. The air-pollutant health sector receives final demand from instituitions, while dirty production sectors and clean production sectors receive final demand and intermediate demand. Resosudarmo and Thorbecke (1996) added two additional accounts in the row and column, which are ambient air pollutant and health problems. Under assumption of fixed price, they estimated the effect of environmental policies to reduce air pollutant on household incomes using ESAM framework.

In addition to Resosudarmo and Thorbecke's work, Alarcon et al (1997) compiled an ESAM framework for Bolivia using the 1989 Bolivian Social Accounting Matrix. Alarcon et al incorporated the environmental accounts in physical value into traditional social accounting matrix simply by adding rows and columns. The Alarcon's ESAM Framework is similar to

the framework of SESAME and NAMEA. The simplified framework of Alarcon ESAM is as presented in the following table:

Table 6.7 Simplified Framework of Bolivian ESAM Compiled by Alarcon et al (1997)

												Expenditure
	Production Activities	**Commodities**	**Factors of Production**	**Other Institution**	**Household**	**Basic Needs**	**Rest of the World**	**Considalited Capital Account**	**Total**	**Physical Socio-Economic Indicator**	**Physical Substances Indicators**	**Total Environment**
Income												
Production Activities												
Commodities												
Factors of Production												
Other Institution												
Household												
Basic Needs												
Rest of the World												
Considalited Capital Account												
Total												
Physical Socio Economic Indicator												
Physical Substances Indicators												
Total Environment												

Source: Alarcon, 1997

Moreover, Keuning (1999) compiled the NAMEA framework for an environmentally extended national account for Netherland. The framework of NAMEA is similar with SESAME, there are two environmental accounts added to national accounts, which are substances accounts, global environmental account and national environmental account. In NAMEA, the tax account is divided into two types of tax, which are environmental tax and other taxes. All the environmental accounts are indicated in physical value.

Furthermore, Xie (2000) constructed an environmentally extended social accounting matrix for China. He integrated the environmental accounts into traditional social accounting matrix as endogenous accounts. He calculated the value of environmental accounts in monetary term. As shown in the following table, Xie distinguished activities into two groups,

which are production (intermediate input) and abatement (pollution cleanup payment). He also separated the factors of production into three categories, which are labor, capital and environmental tax/fee. Moreover, he introduced the production tax/tariff, production subsidies and abatement subsidies. The capital account in Xie ESAM is also divided into two kinds; environmental use and non-environmental use. Lastly, there are two additional accounts in the column, which are pollutants and resources. Through utilizing ESAM, Xie estimated the impact of any changes of environmental policies in China on the whole economy using ESAM model using accounting multiplier analysis and structural path analysis.

Table 6.8 Simplified Framework of ESAM Compiled by Xie (2000)

			Activities		Factors			Institutions			Govern-ment Subsides	Capital Account		Rest of the world	Total		
			1		3	4	5	6	7	8	9	10	11	12	13	14	15
			Production	Abate-ment	Labor	Capital	Environ-ment	Household	Enter-prise	Govern-ment		Non-environmental tax	Environ-ment	Exports	Total	Pollutants	Resources
Activities	1	Production															
	2	Abatement															
Factors	3	Labor															
	4	Capital															
	5	Environment															
Institutions	6	Household															
	7	Entreprise															
	8	Government															
Govern-ment Subsides	9																
Capital Account	10	Non-environmental tax															
	11	Environment															
Rest of the world	12	Imports															
Total	13	Total cost															

Source: Xie, 2000

To construct an environmentally-extended social accounting matrix for Sumatera region and Kalimantan region, this study will follow the framework of study conducted by Weale (1991), which incorporates the environmental accounts in physical value into traditional social accounting matrix by adding row and column. This study will calculate the

impact of policies of Indonesian government to support palm oil expansion and to reduce carbon emission of palm oil through accounting multiplier analysis using the 2005 environmentally extended Inter-Regional Social Accounting Matrix.

6.2 Methodology

This study employs accounting multiplier analysis using an EIRSAM framework to examine the impact of policies of Indonesian governmnet to support palm oil expansion and to reduce carbon emission of palm oil in the cases of Jambi province and East Kalimantan Province. This study follows the environmental accounting multiplier equation which is used by Weale (1991). The steps of applying the accounting multiplier approach to the ESAM can be briefly described as follows. The first step is to partition the ESAM into endogenous and exogenous accounts. In this study, exogenous accounts are local government of five regions, central government, capital account, and the rest of the world. The remaining accounts are endogenous account. The second step is to calculate the matrix of expenditure propensities of endogenous variables, which is **A**, by dividing each element of endogenous accounts by total column or *T*, in example a_{21} is A_{21} divided by T_1. It is as presented in the following table:

Table 6.9 The Simplied SAM Framework for Calculation of Accounting Multiplier Analysis

	Factors	Institutions	Production	Exogenous	Total
Factors			$A_{13}/T_3=a_{13}$	$A_{14}=x_{14}$	$T_1=y_1$
Institutions	$A_{21}/T_1=a_{21}$	$A_{22}/T_2=a_{22}$		$A_{24}=x_{24}$	$T_2=y_2$
Production		$A_{32}/T_2=a_{32}$	$A_{33}/T_3=a_{33}$	$A_{34}=x_{34}$	$T_3=y_3$
Exogenous	$A_{41}/T_1=a_{41}$	$A_{42}/T_2=a_{42}$	$A_{43}/T_3=a_{43}$	$A_{44}=x_{44}$	$T4=y_4$
Total	$T_1/T_1=1$	$T_2/T_2=1$	$T_3/T_3=1$	$T_4=x_4$	
Environment			$E_3/T_3=f_3$		

Source: Author's Calculation

The third step is to calculate inverse matrix which is writen as $(\mathbf{I}-\mathbf{A})^{-1}$. I is a diagonal matrix, the matrix which has diagonal value of 1. In this study, the environmental coeficient (**f**) is the CO_2 emission value of production sector which is divided by total of production sector. The CO_2 value of other accounts are assumed to be zero due to data availability.

Therefore, the forth step is to calculate the output change **(Δy)** which is the inverse matrix (**I-A**)$^{-1}$ multiplied by change or shock on exogenous accounts (**Δx**). And the last step is to calculate the change of environmental account due to the shocks of exogenous accounts. This is done by multiplying the environmental coefficient (**f**) usingverse matrix **(I-A)**$^{-1}$ and the shock of exogenous accounts (**Δx**). In details, the steps are presented as the following equations:

$$\mathbf{y} = \mathbf{A}\mathbf{y} + \mathbf{x} \quad \text{.....(6.1)}$$

Where: **y** = vector of total income

x = vector exogenous accounts

A = matrix of coeficient

Or it can be written as

$$\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{x} \quad \text{.....(6.2)}$$

Where:

(**I-A**) $^{-1}$ = accounting multiplier matrix

A = matrix coefficient of the matrix of 3x3 orders (for simplification). In this study, the 2005 EIRSAM model has the matrix of 300x300 orders. It can be written in the form of

$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$$

I = identity matrix which has diagonal elements are all 1. It can be written in the form of $\mathbf{A} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Therefore, the total change after shocks on exogenous accounts can be expressed as follow:

$$\Delta\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{x} \quad \text{.....(6.3)}$$

Where :

$\Delta\mathbf{y}$ = total change

$\Delta\mathbf{x}$ = shock on exogenous account

Therefore the change on environmental account is written in the form of equation:

$$\Delta\mathbf{d} = \mathbf{f}\,(\mathbf{I} - \mathbf{A})^{-1}\,\Delta\mathbf{x} \quad \text{..... (6.4)}$$

Where:

$\Delta\mathbf{d}$ = the environmental impact of the shock of exogenous accounts

$\mathbf{f}$ = the environmental coefficient of production sectors using the 2005 EIRSAM

6.3 Data and Source

This study uses two main data which are (1) data of carbon emission caused by land use change compiled by World Agroforest Research Centre, Southeast Asia Regional Office, Bogor, Indonesia, and (2) data of the 2005 Inter-Regional Social Accounting Matrix (IRSAM) for Indonesia which was built by Budy P. Resosudarmo, Arief A. Yusuf and Djoni Hartono for the Analysing Pathways to Sustainability in Indonesia project, a collaborative project between Bappenas, AusAID, CSIRO and the World Bank. The other additional data which come from Indonesia Central Bureau of Statistics (BPS) such as Jambi in Number (2010), East Kalimantan in Number (2010), Statistical Years of Indonesia (2010), and Gross Domestic Products by Expenditure and Sectoral for Provinces in Indonesia (2010).

6.4 Classifications and Sector Disaggregation

In this study, the classifications of social accounting matrix for Sumatera Region and Kalimantan Region are distinguished into factors of production, institutions, production

sectors, others and national accounts. Factor of production account is divided into three types, which are labor, capital and land. Labor classification is as presented in the following table:

Table 6.10 Labor Classifications in Social Accounting Matrix for Sumatera Region and Kalimantan Region

No	Labor Classification	No	Labor Classification
1	Formal Rural Agricultural Labor	9	Informal Rural Agricultural Labor
2	Formal Urban Agricultural Labor	10	Informal Urban Agricultural Labor
3	Formal Rural Manual Labor	11	Informal Rural Manual Labor
4	Formal Urban Manual Labor	12	Informal Urban Manual Labor
5	Formal Rural Clerical Labor	13	Informal Rural Clerical Labor
6	Formal Urban Clerical Labor	14	Informal Urban Clerical Labor
7	Formal Rural Professional Labor	15	Informal Rural Professional Labor
8	Formal Urban Professional Labor	16	Informal Urban Professional Labor

Source: Author's own classification

Institutions Account is divided into three institutions, which are household, local government and companies. The household account is divided into rural household and urban household as shown in the following table.

Table 6.11 Household Classifications in Social Accounting Matrix for Sumatera Region and Kalimantan Region

No	Classification
1	Rural Household
2	Urban Household

Source: Author's own classification

Sectors will be used in compiling an environmentally extended social accounting matrix for Sumatera region and Kalimantan region which are classified into 35 sectors shown in the appendix. For the classification of other account which is presented in the following table, it is distinguished into three types of accounts, which are regional tax, regional subsidy, and local inventory. At last, national account is classified into eight classifications as presented in the table below.

Table 6.12 Classification of Other Account of Social Accounting Matrix for Sumatera Region and Kalimantan Region

No	Classification
1	Regional Tax
2	Regional Subsidy

No	Classification
3	Local Inventory

Source: Author's Compilation

Table 6.13 Classification of National Account of Social Accounting Matrix for Sumatera Region and Kalimantan Region

No	Classification
1	Capital of Local Government
2	Capital of Central Government
3	Capital of Private
4	Indirect Taxes of Central Government
5	Subsidies of Central Government
6	Central Government
7	Imported Commodities
8	Rest of the world

Source: Author's Compilation

6.5 Proposed Model for Environmentally-extended Social Accounting Matrix 2005 for Sumatera Region and Kalimantan Region

This study follows the environmentally-extended social accounting matrix framework compiled by Weale (1991) which incorporates environmental accounts through additional rows and columns into social accounting matrix. This study utilizes ICRAF data about carbon emission caused by LUCF in physical term (tons). In integrating CO_2 emission data into the 2005 Indonesia Inter- Regional Social Accounting Matrix, this study deals with two constraints. First, the classification for production sector using the 2005 Indonesia Inter-Regional Social Accounting Matrix and CO_2 emission data caused by land use change from ICRAF are different. Therefore, the way of connecting CO_2 emission data into production sectors classification is through aggregating classification of CO_2 emission follows the classification of production sectors in the 2005 Indonesian IRSAM Model. For example, CO_2 emission data for forestry consist of CO_2 emission of undisturbed forest, undisturbed mangrove, undisturbed swamp forest, Log over forest high density, Log over forest low

density, log over mangrove, natural re-growth forest and open peat. The detailed aggregation is presented on the following table:

Table 6.14 Aggregation of CO_2 Emission into Production Sector Classification of the 2005 EIRSAM Model

No	CO_2 Emission Classification	Production Sector Classification of the 2005 IRSAM
1	Agriculture, rice field, agroforest	Paddy
2	Grass, homegarden	Other food crops
3	Plantation, coconut	Estate crops
4	Log over forest high density, Log over forest low density, log over mangrove, log over- swampt forest, undisturbed forest, undisturbed mangrove, open peat, cleared land, settlement	Forestry
5	Fishpond	Fishery
6	Palm Oil	Palm Oil
7	Rubber, rubber agroforest	Rubber Processing

Source: Author's Classification

Table 6.15 presents how this study integrate CO_2 emission of Sumatera region and Kalimantan region into production sector classification using the 2005 Indonesia IRSAM. The CO_2 emission data for other production sectors classification in Sumatera Region, Kalimantan as well as all production sectors classification in Java and Bali, Sulawesi, and the Eastern Indonesia assumed to be zero due to un-availability of CO_2 emission data. Second, the data of CO_2 emission is on the province level and the data of production sector using the 2005 Indonesian IRSAM is on the regional level. To deal with second constraint, this study calculates production ratio of Jambi province and East Kalimantan province over production of Sumatera region and Kalimantan region. Then, this study magnifies data of CO_2 emission of Jambi provinces and East Kalimantan province using production ratio to get data of CO_2 emission for Sumatera region and Kalimantan region. The last step is to calculate the environmental coefficient for the purpose of calculating environmental matrix using the 2005 Indonesia Environmentally-extended Inter- regional social accounting matrix. The detailed of production ratio, CO_2 emission, and environmental coefficient are presented on the following table:

Table 6.15 Production Ratio, CO_2 Emission and Environmental Coefficient of the 2005 Indonesia EIRSAM Model

No	Sector Classification	Production Ratio (%)		CO_2 Emission (mega tons)		CO_2 Emission (mega tons)		Production in IRSAM (million IDR)		Environmental Coefficient	
		Jambi Province	East Kalimantan Province	Jambi Province	East Kalimantan Province	Sumatera Region	Kalimantan Region	Sumatera Region	Kalimantan Region	Sumatera Region	Kalimantan Region
1	Paddy	5	10	2.79	4.29	55.82	42.95	19.20	6.18	2.91	6.95
2	Other Food Crops	4	20	3.70	0.00	92.57	0.00	22.92	4.21	4.04	0.00
3	Estate Crops	6	66	0.54	0.24	8.97	0.36	60.48	14.66	0.15	0.02
4	Forestry	11	37	16.50	248.54	150.03	671.73	17.49	8.06	8.58	83.30
5	Palm Oil	11	10	5.21	0.20	47.35	2.04	74.57	6.74	0.63	0.30
6	Rubber Processing	15	60	7.66	1.04	51.05	1.73	37.76	3.80	1.35	0.46

Source: Author's Calculation

In this study, the environmental account using EIRSAM model is symbolized by E. The simplified framework for the 2005 environmentally extended social accounting matrix utilized in this study is presented as in the following figure.

Table 6.16 Simplified of the 2005 EIRSAM Framework

					Sumatera Region				Other Regions				National Accounts	
	Classification							Expenditure						
	Receipt		1	2	3	4	5	6	7	8	9	10	11	12
Sumatera	Factors of Production	1												
	Institution	2												
	Production Sectors	3												
	Others	4												
Other Regions	Factors of Production	5												
	Institution	6												
	Production Sectors	7												
	Others	8												
National Accounts	Capital	9												
	Central Government	10												
	Imported Commodity	11												
	Rest of the World	12												
	Total													
Environmental Account	CO_2 Emission (tons)				E									

Source: Author's Compilation

6.6 Simulation Scenario

Starting in the year 2009, the Indonesian government announced the plan to expand palm oil plantation in Indonesia and projected the plantation area of palm oil will become about 9 million ha by 2020. A year later, In COP 13, the president of Indonesia announced the commitment of the Indonesian Government to reduce GHG emission in all sectors. The critics related to environmental impacts of palm oil expansion plan in Indonesia continued. The World Bank report and a study conducted by Casson et al (2007) proposed some strategies to reduce CO_2 emission from palm oil expansion in Indonesia. Therefore, the main goals of the Indonesian government policies on palm oil sector are policies to support palm oil expansion and to reduce carbon emission of palm oil expansion in Indonesia. This study will set simulation scenarios based on these main policies to analyze the impact of shocks on exogenous accounts related to the implementation of two main goals on the endogenous accounts of the Indonesian environmentally extended inter-regional social accounting matrix of the year 2005. The exogenous accounts in this EIRSAM model are local government of Sumatera, Kalimantan and the Eastern Indonesia, capital account, central or national government and the rest of the world in national account. The remainings are endogenous accounts. Furthermore, the simulation scenarios used in this study are the reflection of policies of the Indonesian government to support palm oil expansion in Indonesia and to reduce CO_2 emission about 16% by 2020. The simulation scenarios implemented in this study are related to the Indonesian government target to increase palm oil plantation by 9 million ha in 2020, to increase of investment in palm oil mainly in three regions which are in Sumatera region, Kalimantan region and the Eastern Indonesia, and to implement REDD activities, and carbon tax as economic instruments to pay the environmental impact of palm oil expansion in Indonesia. Moreover, SIM 1 is implemented to examine the impact of plan of the Indonesian

government policies to increase palm oil production, SIM 2 is related to plan of the Indonesian government policies to increase investment in palm oil sector, SIM 3 and SIM 4 are related to plan to implement REDD projects, and SIM 5 is used to examine the economic impact of plan to implement carbon tax. In details, the simulations scenarios used in this study are:

6.6.1 SIM 1

The first simulation scenario used in this study is that the Indonesian government targeted to increase palm oil export about 22 million by 2020. To achieve this target, the Indonesian government will increase palm oil production in Sumatera region, Kalimantan region and the Eastern Indonesia by 1 million Rupiah for each region. Therefore, the shock of SIM 1 will be 1 million increase in the production sector account of palm oil sector in the regions of Sumatera, Kalimantan, and the Eastern Indonesia.

6.6.2 SIM 2

The second simulation scenario is that total Investment on supporting palm oil expansion will increase for the regions of Sumatera, Kalimantan, and the Eastern Indonesia by 1 million Rupiah for each region. The increasing of investment for palm oil expansion will go to the regional tax account which is under “Others Account” in the 2005 Indonesian EIRSAM Model. [2]This is because the investment will be handled by local government in the regions of Sumatera, Kalimantan, and the Eastern Indonesia. In addition, the investor will need to pay tax for local government. This will be 1 million Rupiah of increase on the regional tax account of local government in the regions of Sumatera, Kalimantan, and the Eastern Indonesia.

[2] Please refers to the table 6.12

6.6.3 SIM 3

The third simulation scenario is that the REDD fund from the Norwegian government is assumed to be used by the Indonesian government as incentives for companies who are able to reduce carbon emission of palm oil production in Sumatera region, Kalimantan region and in the Eastern Indonesia region by 1 million Rupiah for each region. This incentive will increase companies budget in the regions of Sumatera, Kalimantan and the Eastern Indonesia. Therefore, this will be considered as an 1 million increase of increase on the companies account which is under "institution account" in the 2005 Indonesian EIRSAM model in the regions of Sumatera, Kalimantan, and the Eastern Indonesia.

6.6.4 SIM 4

The fourth simulation scenario is REDD fund from the Norwegian Government is used as subsidies for the central government. It will increase the subsidies account of the central government which is under "national account" in the 2005 Indonesian EIRSAM Model. [3] Therefore, an 1 million Rupiah increase on the subsidies account of the National government is used as shock in SIM 4.

6.6.5 SIM 5

The last simulation scenario is that the Indonesian government will implement carbon tax to encounter the environmental impact of palm oil expansion in Indonesia. The implementation of carbon tax will increase the indirect tax account of the national government which is under "national account" in the 2005 Indonesian EIRSAM model by 100 billion Rupiah.[3]

3

[3] It refers to the table 6.14

This is because the carbon tax will go directly to the national government budget. Therefore, the fifth simulation scenario will use 100 billion Rupiah increase as shock on the indirect tax account of the national government.

6.7 Result and Discussion

This section presents a summary of results from five simulation scenarios as well as discussions in the impact of some shocks in exogenous accounts on the GDP, income, output, national accounts, capital account and environmental account (CO_2 emission). As mentioned above, this study utilizes five simulation scenario, of which the first and second represent policies of the Indonesian governmnet on supporting palm oil expansion, and three last simulation scenarios represent policies of the Indonesian government on carbon emission reduction. This section will explain impacts of simulation scenarios based on categories of GDP, Income, Output, national account, and environmental accounts as presented as in the following:

6.7.1 SIM 1:

6.7.1.1 Impact on GDP

As shown in the table 6.17, SIM 1 which is an increase of palm oil production in there regions (Sumatera region, Kalimantan region, and the Eastern Indonesia region) by 1 million each will give impact in higher GDP change in Sumatera Region among other regions. The GDP of Sumatera region will increase by 1.32 million Rupiah. This GDP change consists of the change of capital, land and labor. The characteristic of change of capital, land and labor in five regions shows difference. In Sumatera Region, the impact on capital and labor is similar. Impact on capital is about 0.7 million and on labor is 0.6 million Rupiah. In Java and Bali region and the Eastern Indonesia, the impact on labor and capital is significantly different. In Java and Bali region, the impact on labor is only 0.3 million but on capital is higher which

is about 0.3 million. Moreover, the impact on agricultural rural labor is higher than on other type of labor. It shows that palm oil expansion in Indonesia creates more job opportunities for agricultural rural labor. In addition, other categories of labor also show the high impact of increasing of palm oil production such as labor in production, transport equipment operator and manual urban and clerical, sales and service urban. These types of labor are more un-skilled.

6.7.1.2 Impact on Income

The impact of SIM 1 (an increase of palm oil production) on income shows the highest impact than others. An 1 million Rupiah increase of palm oil production in Sumatera region, Kalimantan region, and the Eastern Indonesia will increase income by 4.3 million Rupiah. An increase of income is shown in Sumatera region, Java and Bali, and the Eastern Indonesia. The highest increase of income is on Sumatera region, which is about 4.1 million. In share of categories of income, In Sumatera region, local government receives more benefit on additional income due to an increase of palm oil production. The companies income in Sumatera region also receives large amount of additional income. The multiplier result on household income is smaller compared to the result of income change of local government and companies. This indicates the existing of income distribution's problem.

6.7.1.3 Impacts on Ouput (Inter-linkage among Production Sector)

The impact of an increase of palm oil production by 1 million Rupiah on the total output is the second large of other impact. An 1 million Rupiah increase of palm oil production in Sumatera region, Kalimantan region and the Eastern Indonesia will increase total output by 3.07 million. The highest increase of output is on palm oil in Sumatera region, which is about 1.05 million. An increase of palm oil production gives impact on sectors which are called backward and forward impact. The sectors included in backward linkage with palm

oil are petrochemical, electricity, gas and drinking water, construction, finance and services. The sectors included in the forward linkage with palm oil are paddy, food crops, estate crops, refinery, food and drink processing, textile, petrochemical, trade, hotel and restaurant, finance, and services. This shows that palm oil has strong backward and forward linkage with other sectors. Moreover, the backward and forward impacts are not only on Sumatera region but also give impacts on other sectors in other region, mainly in Java and Bali island. This is because majorities of processing industries are located in Java and Bali island.

6.7.1.4 Impacts on Capital Account

An 1 million Rupiah increase of palm oil production in Sumatera Region, Kalimantan region and the Eastern Indonesia shows the increase of private investment only by 0.3 million. It does not cause an increase in investment of both local and central government. This indicates that palm oil sector is more beneficial for private investor than on government.

6.7.1.5 Impacts on National Accounts and the Rest of the World

The simulation scenario 1, which is an increase of palm oil production by 1 million Rupiah also gives impacts on national accounts which are on indirect tax, subsidies and central government's revenue. The impact on indirect tax is about 1.3 million, and on subsidies is negative impacts. But the impact on central government is positive. The positive impact is also shown on the rest of the world, which can be interpreted as an increase in export in a large amount, about 2.3 million. This implies that Indonesia has strategic position in the world market of palm oil sector.

6.7.1.6 Impacts on Environmental Account (CO_2 Emission)

Unlikely the impacts on others, an 1 million Rupiah increase of palm oil production in Sumatera region, Kalimantan region and the Eastern Indonesia region create an increase of

CO_2 emission, which is about about 3 million. This is the large amount of negative environmental impact of an increase of palm oil production which should be considered as a crucial problem.

Table 6.17 Summary of Result of Simulation Scenario 1

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
GDP Change		**1.32**	**0.63**	**0.11**	**0.05**	**0.81**
1	Capital	0.65	0.34	0.09	0.02	0.59
2	Land	0.06	0.01	0.00	0.00	0.01
3	Labor	0.62	0.28	0.02	0.02	0.21
	Agricultural Rural	0.16	0.06	0.00	0.00	0.03
	Agricultural Urban	0.07	0.01	0.00	0.00	0.02
	Production, Transport Equipment Operator and Manual Urban	0.11	0.05	0.00	0.00	0.06
	Clerical, Sales and Service Urban	0.15	0.09	0.01	0.01	0.05
Income Change		**4.10**	**2.45**	**0.07**	**0.23**	**0.80**
1	Companies or Enterprise	1.25	0.75	0.03	0.17	0.43
2	Local Government	2.05	1.23	0.01	0.01	0.02
3	Household	0.80	0.47	0.03	0.04	0.35
	Household Rural	0.35	0.19	0.01	0.02	0.12
	Household Urban	0.45	0.28	0.02	0.03	0.23
Output Change		**3.07**	**1.32**	**1.20**	**0.09**	**1.80**
1	Paddy	0.02	0.04	0.00	0.00	0.01
2	Other Foodcrops	0.07	0.05	0.00	0.00	0.02
3	Estatecrops	0.35	0.02	0.01	0.01	0.04
4	Oil, Gas and Geothermal Mining	0.05	0.01	0.03	0.00	0.26
5	Refinery	0.03	0.04	0.03	0.00	0.01
6	Palm Oil	1.59	0.00	0.01	0.00	0.01
7	Food and Drink Processing	0.15	0.26	0.01	0.01	0.03
8	Textiles	0.01	0.06	0.00	0.00	0.00
9	Foot and Leather	0.00	0.01	1.00	0.00	0.00
10	Pulp and Paper	0.02	0.02	0.00	0.00	0.00
11	Petrochemical	0.02	0.10	0.05	0.01	1.04
12	Electricity, Gas and Drinking Water	0.03	0.02	0.00	0.00	0.01
13	Construction	0.01	0.01	0.00	0.00	0.01
14	Trade	0.31	0.14	0.02	0.03	0.09
15	Hotel and Restaurant	0.03	0.07	0.00	0.00	0.01
16	Land Transportation	0.04	0.02	0.00	0.00	0.02
17	Finance	0.06	0.14	0.00	0.00	0.02
18	Other Services	0.05	0.03	0.00	0.00	0.02
Capital Account	Local Government	0.00				
	Central Government	0.00				
	Private	**0.32**				
National Accounts	Indirect Tax	0.13				

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
	Subsidies	-0.04				
	Central Government	0.07				
	ROW	**2.29**				
Environmental Account	**CO_2 Emission**	**2946.07**				

Source: Author's Calculation

6.7.2 SIM2

In the second simulation scenario, it is assumed that total investment in the regions of Sumatera, Kalimantan, and the Eastern Indonesia will increase by 1 million Rupiah for each region. The Indonesian government predicted the total investment in palm oil sector will be about 2.8 billion US$ for the next three years. The increasing of total investment will focused on palm oil expansion and development of the downstream industries of palm oil. Therefore, the increasing of total investment will cause the increasing of regional tax. This is because the investors need to pay tax for local government. This study uses a 1 million Rupiah as an shock of the regional tax account of local government in the regions of Sumatera, Kalimantan, and the Eastern Indonesia. As presented on the following table, the impacts of second simulation scenario also can be devided into three part.

6.7.2.1 Impacts on GDP

An increase of total investment gives impact on capital, land and labor for all regions, which is accounted as impacts on GDP. Sulawesi, Java, and Bali region receive the highest impact on GDP because of an increase of investment. Moreover, the impact on agricultural rural labor in Sumatera region is the highest among other regions. It creates increase of agricultural rural labor in Sumatera region by 0.14 million. The highest of impact on capital and labor are found in Java and Bali island. This indicates that an increase of total investment will create more benefit on increase of capital, land and labor in the region which is the center of business in Indonesia.

6.7.2.2 Impacts on Income

In terms of the impact on income, an increase of investment in Sumatera, Kalimantan, and the Eastern Indonesia region can cause the highest increase of income in Java and Bali region. Income change in Java and Bali region is twice larger than in Sumatera region. Local government in Java and Bali region receives the largest portion of total income change. It is possible due to tax revenue of local government. The second largest portion of total income increase is on the companies' income in Java and Bali. An increase of 1 million of investment in Sumatera, Kalimantan and the Eastern Indonesia create an increase of income of companies in Java and Bali region by 1.61 million. In terms of impact on household in Java and Bali region, urban household benefits more than rural household. The positive and significant of income's increase also is found in the Sumatera region as well as in Sulawesi and the Eastern Indonesia. The characteristic is similar to incomes' increase in Java and Bali region. But, in the case of Sumatera region, the household in rural areas benefits more than the household in urban areas. This income's increase is not found the Kalimantan region. The income change in Kalimantan region caused by an increase of investment is the lowest among others. It indicates the income distribution problems of benefits of an increase of investment in Kalimantan region.

6.7.2.3 Impacts on Output (Inter-Linkage Production Sector)

The impact of an 1 million Rupiah increase of investment in Sumatera, Kalimantan, and the Eastern Indonesia on output or inter-linkage of production sectors in Java and Bali region is the largest among other regions. The change of output in Java and Bali region is about 3.08 million Rupiah. Furthermore, the food and processing, textile and trade have large share of total output's change. This is because most of processing industries are located in Java and Bali region. This is similar to the change of output in Sulawesi region. This region

benefits from increasing investment on production sectors, mostly on processing industries. Total Output in Sumatera region is the second largest by having output multiplier as 2.44 million Rupiah. Palm oil, oil, gas and geothermal mining, food and processing, and trade receive the large portion of an increase of output. Therefore, it is found that trade sector plays an important role to distribute the benefit of an increase of investment in Sumatera, Kalimantan, and the Eastern Indonesia to the other regions.

6.7.2.4 Impacts on Capital Accounts

An 1 million Rupiah increase of investment creates an increase of private investment only by 0.3 million Rupiah. Either local or central government does not have any change of capital. This is probably because investment in palm oil is more interesting and profitable for private investment than others.

6.7.2.5 Impacts on National Account and the Rest of the World

Accounting multiplier analysis's result shows that an 1 million Rupiah increase of investment in Sumatera, Kalimantan, and the Eastern Indonesia create increase in the rest of the world by about 2.3 million Rupiah. This is a large and significant increase.

6.7.2.6 Impacts on Environmental Account (CO_2 Emission)

Similar with the impact of the first simulation scenario, an 1 million Rupiah increase of investment causes environmental impact (CO_2 emission). As shown in the following table, the environmental multiplier effect (the impact on environmental account) is about 789 million Rupiah.

Table 6.18 Summary of Result of Simulation Scenario 2

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
GDP Change		**0.77**	**1.41**	**0.16**	**1.52**	**0.04**
1	Capital	0.42	0.77	0.13	0.24	0.02
2	Land	0.05	0.02	0.00	0.05	0.00
3	Labor	0.30	0.61	0.03	1.23	0.02
	Agricultural Rural	0.14	0.11	0.01	0.05	0.01

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
	Agricultural Urban	0.07	0.02	0.00	1.04	0.00
	Production, Transport Equipment Operator and Manual Urban	0.05	0.12	0.01	0.02	0.00
	Clerical, Sales and Service Urban	0.04	0.19	0.01	0.08	0.00
Income Change		**2.11**	**5.23**	**0.10**	**1.63**	**0.07**
1	Companies or Enterprise	0.63	1.61	0.04	0.10	0.04
2	Local Government	1.06	2.61	0.02	0.10	0.00
3	Household	**0.42**	**1.01**	**0.04**	**1.43**	**0.02**
	Household Rural	0.22	0.41	0.02	0.16	0.01
	Household Urban	0.21	0.60	0.03	1.26	0.01
Output Change		**2.44**	**3.08**	**0.25**	**0.97**	**0.06**
1	Paddy	0.20	0.07	0.00	0.02	0.00
2	Other Foodcrops	0.06	0.09	0.00	0.08	0.01
3	Estatecrops	0.09	0.03	0.01	0.04	0.00
4	Oil, Gas and Geothermal Mining	0.16	0.01	0.04	0.00	0.00
5	Refinery	0.06	0.12	0.07	0.00	0.00
6	Palm Oil	0.11	0.01	0.01	0.01	0.00
7	Food and Drink Processing	0.14	0.53	0.01	0.11	0.00
8	Textiles	0.01	0.11	0.00	0.00	0.00
9	Foot and Leather	0.00	0.03	0.00	0.00	0.00
10	Pulp and Paper	0.09	0.06	0.01	0.00	0.00
11	Petrochemical	0.03	0.11	0.01	0.00	0.00
12	Electricity, Gas and Drinking Water	0.08	0.04	0.00	0.03	0.00
13	Construction	0.01	0.01	0.00	0.01	0.00
14	Trade	0.11	0.31	0.02	0.18	0.01
15	Hotel and Restaurant	0.02	0.12	0.00	0.05	0.00
16	Land Transportation	0.02	0.05	0.00	0.05	0.00
17	Finance	0.04	0.26	0.00	0.04	0.00
18	Other Services	0.03	0.07	0.00	0.06	0.00
Capital Account	Local Government	0.00				
	Central Government	0.00				
	Private	0.30				
National Accounts	Indirect Tax	0.13				
	Subsidies	-0.08				
	Central Government	0.07				
	ROW	2.27				
Environmental Account	**CO_2 Emission**	788.60				

Source: Author's Calculation

6.7.3 SIM 3

The third simulation scenario is REDD fund from the Norwegian Government which is assumed to be used as incentives for companies in Sumatera, Kalimantan, and the Eastern Indonesia who are able to reduce CO_2 emission. This incentive will cause the increasing of

companies account by 1 million Rupiah for each region. Therefore, an 1 million Rupiah shock of the companies account in the regions of Sumatera, Kalimantan, and the Eastern Indonesia is used in SIM 3. This section presents the result of accounting multiplier analysis of the shock follows:

6.7.3.1 Impacts on GDP

The largest impact of the third simulation scenario on the change of GDP is found in the Eastern Indonesia and Kalimantan regions. 1 million Rupiah of REDD incentive provided to companies in Sumatera, Kalimantan, and the Eastern Indonesia region gives positive and large impact on GDP of the Eastern Indonesia and Kalimantan region. The impact on GDP of the Eastern Indonesia is about 1.0 million and that of Kalimantan region is about 0.97 million. The largest portion of GDP change is on the capital. In Kalimantan Region, it creates change of capital by about 0.56 million. Moreover, this also gives positive impacts on agricultural rural labor higher than on urban area.

6.7.3.2 Impacts on Income

In terms of impact on the income, REDD incentive creates positive change of income in all regions. The largest income change is found in Java and Bali, Sumatera, and the Eastern Indonesia. Furthermore, local governments in Java and Bali and in Sumatera region have the largest portion of income's increase. The companies in Sulawesi and the Eastern Indonesia receives the largest portion of income change. But the interesting result is found in the case of Kalimantan region. It is shown that the REDD incentive provides the largest income change for household, mainly for rural households. It creates an increase in income of rural households in Kalimantan region by about 0.22 million Rupiah. This indicates that REDD incentive can be used as one way to tackle income distribution problem among the region.

6.7.3.3 Impacts on Output (Inter-Linkage Production Sector)

The largest impact on change of output or inter-linkage production sector of REDD incentive are found in Kalimantan region, Java and Bali, and the Eastern Indonesia region. Total output change in Kalimantan region due to REDD incentive is about 2.07 million. Food and Drink processing and trade are two sectors who benefit more than other sector.

6.7.3.4 Impacts on Capital Account

The result presents that the impact of REDD incentive is large in private investment by having a change about 0.69 million. Compared to the results of two previous simulation scenario, REDD incentive creates more benefit on change of private investment.

6.7.3.5 Impacts on National Accounts and the Rest of the World

As presented in the following table, National accounts (indirect tax and central government's revenue) and the rest of the world increase due to REDD incentive. The rest of the world (ROW) gives the largest portion of the change by about 1.8 million.

6.7.3.6 Impacts on Environmental Account (CO_2 Emission)

Other impact of REDD incentive is the impact on the environmental account (CO_2 emission). 1 million Rupiah of REDD incentive provided to companies in the regions of Sumatera, Kalimantan, and the Eastern Indonesia creates lower environmental impact compared to the previous simulation scenario. It causes impact on CO_2 emission about 239 million. This indicates that REDD incentive can be a way to reduce the environmental impact of palm oil expansion as well as to tackle the income distribution problem to Kalimantan region and the Eastern Indonesia.

Table 6.19 Summary of Result of Simulation Scenario 3

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
GDP Change		**0.20**	**0.72**	**0.97**	**0.05**	**1.01**
1	Capital	0.11	0.38	0.56	0.02	0.72

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
2	Land	0.01	0.01	0.09	0.00	0.01
3	Labor	0.08	0.33	0.32	0.02	0.28
	Agricultural Rural	0.02	0.07	0.14	0.01	0.02
	Agricultural Urban	0.01	0.01	0.05	0.00	0.01
	Production, Transport Equipment Operator and Manual Urban	0.01	0.05	0.03	0.00	0.09
	Clerical, Sales and Service Urban	0.02	0.10	0.05	0.01	0.06
Income Multiplier		**1.09**	**2.80**	**0.62**	**0.27**	**1.00**
1	Companies or Enterprise	0.34	0.86	0.15	0.21	**0.53**
2	Local Government	**0.54**	**1.40**	0.08	0.01	0.02
3	Household	0.21	0.54	**0.39**	0.04	0.45
	Household Rural	0.07	0.23	**0.22**	0.02	0.16
	Household Urban	0.13	0.32	0.18	0.02	**0.29**
Output Change		**0.38**	**1.51**	**2.07**	**0.09**	**1.50**
1	Paddy	0.01	0.05	0.08	0.01	0.01
2	Other Foodcrops	0.01	0.06	0.04	0.01	0.03
3	Estatecrops	0.03	0.02	0.04	0.01	0.01
4	Oil, Gas and Geothermal Mining	0.03	0.01	0.02	0.00	0.01
5	Refinery	0.01	0.04	0.04	0.00	0.02
6	Palm Oil	0.04	0.00	0.02	0.00	0.00
7	Food and Drink Processing	**0.04**	0.36	**0.40**	0.03	0.04
8	Textiles	0.00	0.06	0.00	0.00	0.00
9	Foot and Leather	0.00	0.01	0.00	0.00	0.00
10	Pulp and Paper	0.01	0.02	0.01	0.00	0.00
11	Petrochemical	0.01	0.06	0.02	0.00	0.00
12	Electricity, Gas and Drinking Water	0.01	0.02	0.01	0.00	0.01
13	Construction	0.00	0.01	0.01	0.00	0.03
14	Trade	**0.04**	**0.16**	**0.16**	0.01	**0.07**
15	Hotel and Restaurant	0.01	**0.07**	0.02	0.00	0.02
16	Land Transportation	0.01	0.03	0.02	0.00	0.02
17	Finance	0.01	0.18	0.02	0.00	0.01
18	Other Services	0.01	0.04	0.02	0.00	0.02
Capital Account	Local Government	0.00				
	Central Government	0.00				
	Private	**0.69**				
National Accounts	Indirect Tax	0.14				
	Subsidies	-0.03				
	Central Government	0.17				
	ROW	**1.77**				

Classification		Sumatera	Java and Bali	Kalimantan	Sulawesi	The Eastern Indonesia
Environmental Account	**CO_2 Emission**	**239.13**				

Source: Author's Calculation

6.7.4 SIM 4 and SIM 5

The fourth and fifth simulation scenario are the REDD incentive assumed to be used as subsidies for the national government and the Indonesian government will implement carbon tax respectively. An 1 million Rupiah of increase on the subsidies account and an 100 billion Rupiah shock on the indirect tax of the national government are is used for SIM 4 and SIM 5. As presented in the following table, the fourth and the fifth simulation scenario give impact only on the account of rest of the world which is about 1 million Rupiah. This indicates that subsidies and carbon tax are not effective ways to pay or to reduce environmental impact of palm oil expansion in Indonesia.

Table 6.20 Summary Result of Simulation Scenario 4 and 5

Classification		
Capital Account	Local Government	0.00
	Central Government	0.00
	Private	0.00
National Accounts	Indirect Tax	0.00
	Subsidies	0.00
	Central Government	0.00
	ROW	1.00
Environmental Account	**CO_2 Emission**	0.00

Source: Author's Calculation

6.8 Conclusion

Based on the findings and discussion presented in the previos section, it can be concluded that:

1. An increase of palm oil production and investment in Sumatera, Kalimantan, and the Eastern Indonesia creates an increase of GDP, capital, labor, output, and environmental impact. The largest change of GDP, capital, labor are found in the Sumatera Region. In details, it is shown that agricultural labor in rural areas of Sumatera region and others benefit more from an increase of palm oil production and investment. In Java and Bali, Sulawesi and the Eastern Indonesia, agricultural labor in urban areas benefits more than in rural areas. Furthermore, it also creates impact on large total output's changes, which is mainly for Sumatera, Java and Bali, Sulawesi, and the Eastern Indonesia. These output change are mainly on palm oil sector (in Sumatera region), food and drinking processing, hotel and restaurant, oil, gas and geothermal mining, electricity, gas and water, finance and services. Furthermore, trade sector can play an important role on distribution of positive impact. But this is unlikely happening in the case of Kalimantan region. This is possible because of the lack of infrastructure, human resource, and technology capacities in Kalimantan region as well as in the Eastern Indonesia. It is also shown that an increase of palm oil production and investment give more benefits in Java and Bali island, as the center of business in Indonesia. Therefore, the fundamental problem behind is how to distribute the positive economic impact of palm oil expansion from Java and Bali region to less developed regions such as Kalimantan and the Eastern Indonesia. Moreover, the increase of palm oil production and investment give positive impacts on the capital account (private investment) and the rest of the world. This indicates that palm oil sector in Indonesia is profitable for private investors as well as has an important position in the world market of palm oil.
2. Simulation scenario of REDD incentive for companies who are able to reduce CO_2 emission of palm oil in the regions of Sumatera, Kalimantan, and the Eastern Indonesia

creates positive impacts on GDP, capital, labor, income and output in two less developed regions, which are Kalimantan region and the Eastern Indonesia region compared to Java and Bali, Sumatera, and Sulawesi. Specifically, REDD incentive provides postive impact on household income in rural areas. Moreover, REDD incentive provides a larger positive impact on change of private investment than two previous simulation scenarios. In addition to this positive impact, the accounting multiplier analysis's result using the 2005 Indonesia EIRSAM shows that the impact of REDD incentive on the environmental account (CO_2 emission) is lower than previous simulation scenario's results. It can be pointed out REDD incentive is one effective way to reduce CO_2 emission of palm oil expansion in Indonesia through encouraging companies to be more environmentally friendly and increase the productivity level.

3. The use of REDD fund as subsidies for central government and imposing of carbon tax do not give impacts on the change of GDP, capital, labor, income and output as well as on national accounts and environmental account. The subsidies and carbon tax create impact only on the rest of the world.

Chapter VII

Conclusion and Policy Recommendation

7.1 Conclusion

The main objective of this dissertation was to focuse on economic benefit and environmental cost of palm expansion in Indonesia in order to find an appropiate policy for the Indonesian government. In other words, this dissertation deals with the economic analysis as well as environmental analysis of palm oil expansion in Indonesia. Most of the previous studies in Indonesian palm oil sector have focused only either on the economic analysis or the environmental analysis of palm oil expansion in Indonesia. However, this dissertation introduced the 2005 Indonesian environmentally-extended inter-regional social accounting matrix. It incorporates an environmental account (CO_2 emission) into the 2005 Indonesian inter-regional social accounting matrix.

An overview of the world demand of palm oil is presented in Chapter 2. This chapter presents trends of palm oil production, consumption, export, and import in the world. It is found that these have shown significant increase in the trends palm oil production, consumption, export, and import in the world market from year 1993 to 2010. Since 2009, Indonesia became the largest palm oil producer and exporter in the world. The historical overview of the Indonesian government policies since 1960s to the current situation shows that the Indonesian government implemented various policies to support palm oil sector in Indonesia. The data of FAS Statistics showed that palm oil has the largest percentage share among other vegetable oils in the world. Palm oil has a share in production, consumption, export and import is 32.6%, 32.7%, 61%, and 63% respectively. Chapter 2 also showed that the world consumption of palm oil has increased significantly every year. Palm oil sector has

the highest growth in production, consumption, export and import among other vegetable oils in the world market. Chapter 2 also concluded that Indonesia has important position as a palm oil producer and exporter and India, China and EU are the major palm oil importers in the world market. India and China are the two emerging economies who have highest economic growth in the world. European Union countries are currently promoting renewable energy in recent situation.

Chapter 3 presents an overview of historical developments and trends of palm oil production and export of Indonesia, economic contributions of the palm oil sector on the Indonesian economy and policies of the Indonesian government to support palm oil expansion as well as to reduce CO_2 emission of palm oil in Indonesia. The historical development and trends of palm oil production and export in Indonesia showed that it is increasing siginificantly every year. The major destinations of Indonesian palm oil export also changed in recent five years. The restriction on Indonesian palm oil export from European Union market moved Indonesian palm oil export to India, China, and Pakistan. India and China are the two emergining economies who have highest economic growth recently. According to FAS 2010, Indonesian palm oil production and export has a share of 50% and 48% of the total world market respectively. This significant increase in percentage share showed that the Indonesian government put efforts and policies to support palm oil expansion in Indonesia. The major palm oil production centres in Indonesia are located in Sumatera and Kalimantan region. Palm oil production in Sumatera region has a share of about 80% of the total palm oil production in Indonesia. The large developments in palm oil sector bring huge economic contributions to Indonesia in threefold, which are on GDP, rural development and local economies. Between 2000 and 2009, the share of palm oil export in total agricultural export, non oil and gas export and total export of Indonesia increased significantly. During the same

year, average growth rate of the palm oil sector was 32.48%. It was higher than the average growth rates of agriculture and non-oil-and-gas sectors: 17.48% and 8.85% respectively. The average growth rate in the share of palm oil in agriculture and non-oil-and-gas sectors also increased to 13.87% and 21.53%, respectively. The palm oil development in Indonesia also provides job opportunities for people in rural areas such as in Sumatera region and Kalimantan region. The palm oil sector is more labor intensive, which requires mainly low skilled labor. The development of palm oil also creates positive effects through education, health care and job security for poor people in the rural areas. Other contribution of palm oil development is on the economic development of smallholders in the rural areas. The palm oil sector contributes about 37% and 75% to the economies of Jambi province and East Kalimantan province respectively. Along with its economic benefits, palm oil development in Indonesia also brings some environmental impacts, a concern raised by many NGO_s. The palm oil development is considered to have environmental impacts on land, water, air, and biodiversity or habitat conservation. Deforestation is one of the main environmental issues related to the palm oil sector. SNC Report (2010) also found that the largest source of GHG emission in Indonesia is occured in land use change and forestry (LUCF). The share of CO_2 emission of land use change and forestry in the total GHG emission of Indonesia in the year 2000 was about 74%. Concerned with the environmental issues, in May 2011, the Indonesian government signed a letter of intent with the Norwegian Government about REDD financial assistance to reduce deforestation and degradation in Indonesia. As a result, the Indonesian government announced a moratorium of using peat lands to be converted for palm oil expansion. In September 2011, Indonesian President, Susilo Bambang Yudhoyono signed the Presidential regulation number 61 year 2011 which talks about a commitment to reduce the emission of Indonesia that includes about 75 million tons of CO_2 emission from the palm oil

sector. This means that the Indonesian government faces a challenge to balance between targeted palm oil expansion and the commmitment to reduce emission of palm oil in Indonesia.

Chapter 4 examines the economic analysis of palm oil expansion in Indonesia. It focused on the determinants of Indonesian palm oil export to the world market using export demand approach. The model is based on the assumption that export supply is infinite elastic. Two main assumptions are used to support the infinite elasticity of export supply. First, as Rifin (2010) stated, in 2008 about 70% of the Indonesian palm oil production is exported to the world market. It indicates that the Indonesian palm oil production is more export oriented because there is increasing demand of palm oil in the world market. Second, Indonesia has more land availability and labor to meet this increasing world demand for palm oil. The real export price of Indonesian palm oil export, real price of world soybean oil, and real income of five key importing countries are the three explanatory variables used in export demand model. Monthly data since January 1996 to July 2010 applying ECM model was used to estimate the short-run and long-run price and income elasticity of Indonesian palm oil export to the world market. The ecomonetric results of export demand approach showed that the Indonesian palm oil export has in- elastic price and income elasticity both in the short-run and in the long-run. It also showed that the long-run price and income elasticity is smaller than in the short-run. The results are contradictory to what is theoritically suggested. However, the smaller price elasticity and income elasticity is not surprising because soybean oil price is found not significant. It means the econometric results showed that there is no substitution effect of soybean oil. In-elastic price elasticity and income elasticity of the Indonesian palm oil export both in the short-run and in the long-run indicate three important factors. First is the availability of number of substitutes to Indonesian palm oil is small. Second is the share of the

budget for palm oil on the total expenditure of consumer in importing countries is small. Third is foreign consumers considers palm oil as a non-luxury good and fourth is the there are time and transaction cost which must be borne by consumer to switch from Indonesian palm oil export to others. Population, consumer's taste and preference are another factors which possible influence Indonesian palm oil export. However, these are not captured in our econometric model. Large market share of Indonesian palm oil export to the total world palm oil export also support the econometric result. It indicates Indonesia has strong position in the world market of palm oil sector. It causes the importing countries face less opportunity to change to other products when there is price change in Indonesian palm oil export. Marketing strategies and government policies are two important strategies should be implemented by the Indonesian government to palm oil export. The differentiation of product, creating special services for loyal consumers and increasing the quality standards of palm oil products are types of marketing strategies can be implemented by the Indonesian government. The policies to support palm oil export can be taken in forms of trade policies such as export tax and domestic support policies such as production subsidies, incentives on differentiation or value added products and increasing the quality standard.

Chapter V presents socio-economic and environmental indicators for Jambi province and East Kalimantan province. Study sites in this study are Jambi province which represents for Sumatera region and East Kalimantan province which represents for Kalimantan region. Jambi province was selected because palm oil plantation is the second largest among other estate crops in Jambi province. Data from Directorate Estate Crops Agency of Jambi province showed that about 28% of total farmers in Jambi province work for palm oil plantation. ICRAF data (2005) also found that palm oil is the main sector which contributes to land use change activity in Jambi province between 1990 and 2005. The Indonesian government

supported transmigration program for people in Java island to live and engage in plantation of palm oil and rubber in Jambi province. East Kalimantan province is the largest area of Kalimantan region. It is accounted about 46% of total area in Kalimantan island. And about 75% of total estate crops in East Kalimantan province is for palm oil plantation. This province has large land availability to be converted to palm oil. The main characteristics of socio-economic indicators for Jambi province are the large of population density and mostly of people in Jambi province are working in rubber and palm oil plantations. The economic growth of Jambi province is increasing every year. The major source of GDP of Jambi province is export. The major destination of Jambi export is Singapore. Land use change activity data between 1990 and 2005 showed that the share of land use as undisturbed forest area decreased from 1990 to 2005. In 1990, the share of undisturbed forest area to total area was about 24%, and it decreased in 2000 to be only 15%, and in 2005 became about 14% of total areas in Jambi province. The forested area in Jambi province were mostly converted to rubber and palm oil plantation between 1990 and 2005. The conversion of forested area or others to be rubber and palm oil plantation caused decreasing of carbon stock which is called as carbon dioxide emission (CO_2 emission). This study uses second approach of IPCC method which is called as a stock-difference approach to calcualte CO_2 emission. It is found that the total net CO_2 emissions caused by land use change between 2000 and 2005 is 174 mega tons of CO_2 and the total net CO_2 sequestration is 104 mega tons. Palm oil sector contributes nearly 15% to total CO_2 emission in Jambi province between 2000 and 2005 by having total net CO_2 emission is 26 mega tons, annual net CO_2 emission is 5 mega tons, the average total net CO_2 emission is 5.35 tons and the annual average net CO_2 emission is 1.07 ton/ha/year. The estimated monetary value based on 10 USD/ton carbon which is standard of carbon price by the Ministry of Finance (2007) is about 2.4 trillion Rupiah. East Kalimantan

province has similar socio-economic and environmental indicators. Land availability is still large there. The population density in East Kalimantan province is not high. East Kalimantan GDP's share was about 65% of total GDP of Kalimantan region in year 2009 and it is the biggest among other provinces in the region. In 2009, the export of non oil and gas mining was the largest one, by having share about 51%. This is larger than the share of oil and gas mining sector. This indicates the large expansion of non oil and gas mining sectors such as palm oil plantations. Examining of land usage change activity data for East Kalimantan province between 1990 and 2005 found that Undisturbed forest is still the highest share of total area. Its share is 45% of total area. It means that East Kalimantan province has potential land availability. The Indonesian government set East Kalimantan and other provinces in Kalimantan region as the main targeted area for Indonesian palm oil expansion until 2020. It is found that the share of land used by palm oil plantation share increased from about 2% in 1990 to 4.6% in 2005. The total net CO_2 emissions caused by land use change in East Kalimantan from 2000- 2005 was 1.24 giga tons of CO_2 and the total net CO_2 sequestration was 0.45 giga tons. The largest CO_2 emission was occured in undisturbed forest which has CO_2 emission of 620 mega tons in total, with the annual total net CO_2 emission of 124 mega tons. The net CO_2 emission per ha was 34.13 tons and the annual average CO_2 emission was 6.83 ton/ha/year. Then, the estimated monetary value for palm oil is about 95.7 billion Rupiah. Findings on Chapter 5 prove that palm oil expansion in Jambi and East Kalimantan provinces caused large carbon emission due to land use change activity between 2000 and 2005.

Chapter 6 examined the impacts of policies of the Indonesian government on supporting palm oil expansion as well as policies to reduce carbon emission from palm oil expansion on the whole economic structure using the 2005 Indonesian environmentally-extended inter-regional social accounting matrix. Data used in this second analysis was the

carbon emission caused by land use change activity in Jambi and East Kalimantan provinces as were presented in Chapter 5, the production ratio of Jambi and East Kalimantan provinces on total Sumatera and Kalimantan regions, and the 2005 Indonesian inter-regional social accounting matrix. There are 16 types of labor and 35 production sectors using the 2005 EIRSAM model to examine the impacts of policies of the Indonesian government on supporting palm oil expansion as well as to reduce palm oil expansion's carbon emission in Indonesia on other accounts in such as rural and urban agricultural labors. Since CO_2 emission data are available at the province level, and the 2005 Indonesia IRSAM are available at the regional level, this study utilized production ratio to calculate carbon emission for Sumatera region and Kalimantan region. Jambi province and East Kalimantan region are represented for Sumatera region and East Kalimantan region respectively. Five simulation scenarios are implemented to examine the impacts of policies of the Indonesian government on supporting palm oil expansion as well as on reducing carbon emission of palm oil expansion. The Indonesian government announced that Sumatera, Kalimantan, and the Eastern Indonesia are the main targeted areas for palm oil expansion until year 2020. These five simulation scenarios are as following: first, total palm oil production in Sumatera, Kalimantan, and Papua will increase by 1 million Rupiah for each region. Second, total investment in palm oil sector in Sumatera, Kalimantan, and the Eastern Indonesia will increase by 1 million Rupiah. Third, The Indonesian government will use REDD financial assitance from the Norwegian Government as incentives for palm oil companies in Sumatera, Kalimantan, and the Eastern Indonesia as 1 million Rupiah for each region. Fourth, The Indonesian government will use REDD financial incentive as subsidy for national government. Fifth, The Indonesian government will implement carbon tax to pay carbon emission of palm oil expansion. This is assumed to be increasing indirect tax revenue for Indonesian

government about 100 billion Rupiah. The accounting multiplier analysis using 2005 EIRSAM using five simulation scenarios mentioned above found that an increase of palm oil production and investment in Sumatera, Kalimantan, and the Eastern Indonesia creates an increase of GDP, capital, labor, output, and environmental impact. The largest change of GDP, capital, labor are found in the Sumatera Region, where agricultural rural labor receives more benefit. However, agricultural labor urban in Java and Bali, Sulawesi and the Eastern regions benefits more. The positive impact is also occured on production sectors in the four regions except in Kalimantan in areas such as food and drinking processing, hotel and restaurant, oil, gas and geothermal mining, electricity, gas and water, finance and services. It was surprisingly found that trade sector can play an important role on distribution of positive impact. But this is unlikely happening in the case of Kalimantan region. This is possible due to the lack of infrastructure, human resource, and technology capacities in Kalimantan region as well as in the Eastern Indonesia. There is problem of distribution of positive impacts of palm oil expansion among the regions. Moreover, the increase of palm oil production and investment give positive impacts on the capital account (private investment) and the rest of the world. This indicates that palm oil sector in Indonesia is profitable for private investors as well as has an important position in the world market of palm oil. REDD incentive for companies who are able to reduce CO_2 emission of palm oil in the regions of Sumatera, Kalimantan, and the Eastern Indonesia creates positive impact on GDP, capital, labor, income and output in two less developed regions, which are Kalimantan and the Eastern Indonesia regions compared to Java and Bali, Sumatera, and Sulawesi. Specifically, REDD incentive provides positive impact on household income in rural areas. REDD incentive also provides a larger positive impact on change of private investment than two previous simulation scenarios. It is also found that REDD cause less environmental impact of palm oil expansion in

Indonesia. However, the use of REDD fund as subsidies for the central government and imposing of carbon tax do not give impacts on the change of GDP, capital, labor, income and output as well as on national accounts and environmental account.

All the findings presented on all the chapters mentioned above can be summed up in three major sentences: First, Indonesian palm oil export to the world market has in- elastic price and income elasticities in the short- run and in the long-run. This indicates that foreign consumers in the world market faces less opportunity to switch from palm oil to others and the needs of the Indonesian government to implement marketing strategies and domestic and trade policies to support Indonesian palm oil export. Second, Policies of the Indonesian government to support palm oil expansion in Indonesia brings economic benefits in four regions and causes more environmental impacts. However, the positive economic impact is not found in Kalimantan region. Third, REDD incentive can give larger economic postive impacts in Kalimantan region and in other regions and also to reduce environmental impact of palm oil expansion in Indonesia.

7.2 Policy Recommendation

Findings presented in all the chapters above showed the importance of palm oil expansion for Indonesian economy as well as the benefits of REDD incentives to reduce environmental impact of palm oil expansion in Indonesia. The policy recommendation of this dissertation can be drawn to balance economic benefits and environmental cost of palm expansion in Indonesia are as the following: first, the Indonesian government should put more efforts on differentiating or improving thr value added for Indonesian palm oil export and on increasing the quality standards of palm oil products and providing special services for foreign consumers to be loyal for Indonesian palm oil export. This is important to put Indonesian palm oil export in the unique position in the world market. The Indonesian

government can not only focus on exporting crude palm oil (CPO) directly to the world market for the long term. Because it will give less economic benefits than exporting more value added or processed palm oil. Creative innovation to produce more value added palm oil products will bring more economic benefits to Indonesia as well as improvement on processing industries related to palm oil, which means providing more job opportunities for the Indonesian people. Building strong cooperative between research institutes, companies, international and domestic NGO_s and other agents can support the Indonesian government to achieve this target. Proper trade policies will support the strong position of Indonesian palm oil export in the world market. Second, Domestic policies which support palm oil expansion in Indonesia need to be implemented such as providing incentives and lower interest rate for companies and farmers, good infrastructure, and incentives for processing industries related to palm oil sector. In line with this, the Indonesian government should create proper policy to distribute good economic benefits from palm oil expansion in Indonesia which occur in more developed regions to be transferred to less developed regions such as Kalimantan region and the Eastern Indonesia region such as providing subsidy to rural people and good infrastructure for companies in Kalimantan and in the Eastern Indonesia regions. Third, the Indonesian government should find an appropiate policy to strongly support the implementation of REDD projects or incentives in Indonesia. It because of the positive impacts are come from REDD incentive to distribute positive impact of palm oil expansion in Kalimantan and Eastern Indonesia regions and to reduce total environmental impact of palm oil expansion in Indonesia. The supporting policies can be taken in forms such as educate local people in less developed regions to be aware about sustainable palm oil production, improve the technology capacity for companies in Kalimantan region and in Eastern Indonesia region to be able to produce more environmentally friendly palm oil production, and encouraging private

investors to pay more attention on providing social services to local people who are living around palm oil plantation.

7.3 Future Research

Related to scope, study sites, and methodology used in this study, the future research can be done as the following. First, including the price changes into model is needed to see the impacts of price changes on the economic structure in the 2005 Indonesian EIRSAM model. The first analysis of export demand approach in Chapter 4 found that the price and income elasticities for Indonesian palm oil export to the world market are in-elastic both for the short-run and long-run. Therefore, this study focused only on the change of quantity using unconstrained multipler analysis. Two assumptions used in this study. First, prices are fixed and any changes in demand lead to the changes in physical output rather than in prices. Second, factor resources are unlimited or unconstrained, so that supply will be able to meet any changes in demand. Second, Scope of study can be developed into examining all of the environmental impacts of palm oil such as the impacts on degradation, illegal logging, water as well as the impact of all processing industries from plantation to final processing industries related to the palm oil industry. One possibility is using life cycle assessment (LCA). Third, the study sites also can be enlarged to palm oil plantation on the whole provinces in Indonesia. This depends on the availability of data on land use change map and land use change activity matrix. The collaboration with Center for International Forestry Research in headquater in Bogor and with the World Agroforestry Research Center, Southeast Regional Office, Bogor, Indonesia and the Ministry of Forestry of Indonesia is necessary. Fourth, examining of the impact of policies of the Indonesian government to support of palm oil expansion and to reduce environmental impact of palm oil expansion using qualitative approach can be implemented as a complement to the result of quantitative approach.

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Appendix 1: Land covers types and definitions

No.	Land Use/ Cover Types	Description
1	Undisturbed forest	Undisturbed forest is natural forest cover with canopy, high diverse species and basal areas. It has no logging roads, indicating that it has never been logged, at least not on a large scale, and is usually located in areas with rough topography. Canopy cover of undisturbed forest is usually > 80%. In satellite images it is indicated by high value of vegetation index and infrared spectrum channels and lower value in visible spectrum channels.
2	Undisturbed swamp forest	Similar to #1, but located in swap environment and normally with lower vegetation and canopy density compared to lowland and mountainous forest.
3	Disturbed /degraded forest	Natural forest area having been disturbed by logging or other timber extraction or fire but still has relatively dense canopy. Canopy cover is around 20-60%. Large trees with diameter >30 cm can be found.
4	Disturbed swam forest	Similar to 33, located in swamp environment.
5	Rubber agro forest	Rubber agro forest is characterized by the presence of rubber trees mixed with other tree species, which from a stand structure similar to secondary forest. Rubber trees typically account for less than 70% of the population of non-rubber trees is dominant and the plot is old enough, the area will be very hard to differentiate from natural forest.
6	Mixed garden	Mixed garden is a tree-based system with more than 30% of the area consisting of various species of trees. Mixed gardens area usually located relatively close to settlements or roads.
7	Agro forest	Agro forest is defined as a tree-based system mixed with crops and the other vegetation with a range of density and diversity lower than but similar to mixed gardens; usually also includes natural understory vegetation. The location is not limited by distance to any other land use.
8	Estate/plantation	Monoculture plantation of tree crops and/or timber. Tree canopy cover is around 30-50%.
9	Palm Oil	Monoculture plantation of Palm Oil planted by private companies and local people.

No.	Land Use/ Cover Types	Description
10	Coffee agro forest	Mixed cultivation system of coffee and shade trees, mostly managed by local people; normally located close to settlements.
11	Cleared land	Area where trees have been cleared, which include ex-logging areas or slashed-and-burned areas prepared for agriculture; vegetation cover is usually herbaceous vegetation and/or grass.
12	Cropland	Cropland is intensively cultivated land and is mostly planted with annual crops such as staple food, vegetables, and fruit.
13	Shrubs, grass	Area dominated by non-woody vegetation, which is usually an ex-forest clearing area that undergoes natural secondary re-growth. For old shrubs, there is a low cover of trees, around 5% cover; but no trees with diameter >20cm.
14	Settlement	Settlement refers to built area (city or village), which includes road; main road and/or logging road; for rural settlement this includes home gardens immediately located near the houses.
15	Water body	Water body refers to an area covers with water, for example, steam, lake, pond.
16	No data	No data refers to unclassified area, clouds, and shadow area.

Source: ICRAF Database, Southeast Regional Office, 2007

Appendix 2: Land Use Change Matrix of Jambi Province between 1990 and 2005 (km^2)

Class 1990	ID	Class 2000																							Grand Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
Agriculture	**1**	200							0.3					0.4					31.2	28.9	7.6					**268.5**
Cinnamon agro-forest	**2**	16.4	538.4											0.5							12.2					**567.3**
Cleared land	**3**	42.2	4.1	3.9	32.1	0.1	0.1	3.7	10.7	0.1	6.8	0	1.3	2		74.6	0	31.2	195.8	40.2	19.1		0.6			**468.3**
Coconut	**4**	60.8	0.1		817.4			2.1	0.7	0.1	12.8	1.2	3.3	7.1		102.2		39.3	234.1	95.5	19.7		0.7			**1397**
Coffee agro-forest	**5**	1.9		0.8	13.6	109.4			1.6		0.2			0.8		28.8		2.3	72.2	25.4	19.2					**276.2**
Fishpond	**6**						1.2														0					**1.3**
Grass	**7**	2.7	0.8		1.2	0		0.2	0.3	0	0.5		0	0.1		4.7		2.2	7.2	20	1.7		0			**41.5**
Home garden	**8**	0.4	0.4		0.1	0			51.2	0	1.8	0	0.2			0.3	0	1.6	5.3	2.2	2.1					**65.7**
Log over forest-high density	**9**	70.6	4.4	15	86.2	0.2		17.1	1.8	2760				5		175.1		10.7	358.9	127.2	36.2					**3668.4**
Log over forest-low density	**10**	58.3	25.8	17.1	51.9	0.2	0	10.3	4.6	0.9	1249.6	0	1.1	3.1		252.4	0	49.9	380.7	214.5	45.4		0			**2365.8**
Log over mangrove	**11**											4					0				0					**4**
Log over	**12**	61.1	0		194.9	0	0		0.1	0.1	25.7	0.1	728.4	6.9		1480	32.8	13.5	36.6	15.6	20.7		0.5			**2617.2**

Class 1990	ID	Class 2000																							Grand Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
swamp forest																										
Natural re-growth-shrub	**13**	1	7.3	2.5	87.1	0.1	0	1.7	9	0	2.9	0.1	1.1	93.2		33.1	27.4	22.3	107.2	66.7	14.8		0.2			**477.5**
No data	**14**														2068.4											**2068.4**
Palm Oil	**15**			3.8				1.1						0.8		1429					14.6					**1449.7**
Open peat	**16**	0.4		0	0.7		0.2	0	0.1	0	0.1		0	0		1.8	0.1	0.9	0.7	0.1	0.1		0			**5.2**
Rice field	**17**	53.6												3		95.3		372.5	118.5	64.6	25.8					**733.3**
Rubber	**18**	223.3		29.7				17.5								194.7			5180.1	1036.5	108.7					**6790.6**
Rubber agro-forest	**19**	209.8		38.2				15.3								528.7		116.3	1291.1	4397.9	110.2					**6707.5**
Settlement	**20**																				2083.5					**2083.5**
Undisturbed forest	**21**	148.3	116.6	32.3	74.3	0.5		30.4	4.6	1472				3.4		407.4		182.3	707.1	808.1	168.8	7497.8				**11653.8**
Undisturbed mangrove	**22**						0.1					6.4					0				3.3		89.1			**98.9**
Undisturbed swamp forest	**23**						0.1						875.3			10	49		394.6		16.9			2835		**4180.8**
Water body	**24**																								688	**688**
Grand Total		**1151**	**698**	**143.1**	**1359.7**	**110.5**	**1.7**	**99.3**	**85**	**4233.2**	**1300.4**	**11.8**	**1610.9**	**126.2**	**2068.4**	**4819**	**109**	**844.8**	**9121**	**6943.2**	**2730.6**	**7497.8**	**91.1**	**2835**	**688**	**48678.1**

Source: ICRAF Database, Regional Southeast Office, Bogor, Indonesia

Appendix 3: Land Use Change Matrix of East Kalimantan Province between 1990 and 2005 (km^2)

Land Cover Types	1990 ID	2000 ID																				Grand Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Agriculture	1	360.0	530.6									20.3		1.6	0.8	35.6	83.7					1032.4
Agro-forest	2	86.7	5575.1								52.0	276.7	3.4	134.0	6.1	39.8	562.3	55.1				6791.1
Cleared land	3	72.6	96.7	1488.4		33.5					38.0	44.4	0.8	20.3	3.4	25.7	6.2	35.8				1865.7
Fishpond	4				6.2											0.1		0.0				6.3
Grass	5	16.9				28.4					6.6				0.6	6.1		6.6				65.1
Log over forest-high density	6	36.2	243.2	94.4		34.4	6887.9	2726.8			45.9	165.4		32.0	1.6	114.2	32.3	27.4				10441.8
Log over forest-low density	7	155.5		158.0		92.5		11361.2			101.5	279.4		27.9	4.7	192.5		56.2				12429.3
Log over mangrove	8				0.0				15.7			0.1	0.2			0.0		0.0				16.1
Log over swamp forest	9									2505.4		364.4		34.7		22.9		16.5				2944.0
Natural re-growth shrub	10	35.3	60.8	26.0							113.9			19.4	2.2	2.7	2.2	15.5				277.9
Palm Oil	11			20.1								4587.6				426.4		6.6				5040.7
Open peat	12											345.8	125.4	2.8		41.8		4.6				520.4

Land Cover Types	1990 ID	2000 ID																				Grand Tota
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Plantation	13			9.6							19.7	29.9		939.8		135.8		30.4				1165.1
Rice field	14			3.2							4.3				227.4			2.2				237.0
Rubber	15															636.2		84.9				721.1
Rubber agro forest	16											371.6				56.5	1906.9					2335.0
Settlement	17																	2839.7				2839.7
Undisturbed forest	18	373.1		1001.3		256.5	15683.3	1183.5			360.5	881.1		420.9	19.7	486.3	1026.7	233.5	97665.1			119591.3
Undisturbed mangrove	19				258.6				176.8				56.1			3.6	17.6			2721.9		3234.5
Undisturbed swamp forest	20				39.8					3199.6		298.5	160.4	174.3		34.5	154.7	47.4			8287.3	12396.4
Grand Total		1136.2	6506.5	2801.0	304.6	445.3	22571.2	15271.4	192.5	5705.0	742.4	7665.2	346.2	1807.5	266.3	2260.6	3792.5	3462.4	97665.1	2721.9	8287.3	183950.9

Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia (2005)

Appendix 4: Carbon Stock Change of Land Use Change in Jambi province between 2000 and 2005 (ton/ha)

2000		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Sector Categories	2005	300	250	150	200	100	200	200	21.75	90.71	62.06	60	17.21	46.76	30.96	7.5	26.83	11.85	0.97	2	4.14	4.14	3.9
1	300	0	50	150	100	200	100	100	278.25	209.29	237.94	240	282.79	253.24	269.04	292.5	273.17	288.15	299.03	298	295.86	295.86	296.1
2	250	-50	0	100	50	150	50	50	228.25	159.29	187.94	190	232.79	203.24	219.04	242.5	223.17	238.15	249.03	248	245.86	245.86	246.1
3	150	-150	-100	0	-50	50	-50	-50	128.25	59.29	87.94	90	132.79	103.24	119.04	142.5	123.17	138.15	149.03	148	145.86	145.86	146.1
4	200	-100	-50	50	0	100	0	0	178.25	109.29	137.94	140	182.79	153.24	169.04	192.5	173.17	188.15	199.03	198	195.86	195.86	196.1
5	100	-200	-150	-50	-100	0	-100	-100	78.25	9.29	37.94	40	82.79	53.24	69.04	92.5	73.17	88.15	99.03	98	95.86	95.86	96.1
6	200	-100	-50	50	0	100	0	0	178.25	109.29	137.94	140	182.79	153.24	169.04	192.5	173.17	188.15	199.03	198	195.86	195.86	196.1
7	200	-100	-50	50	0	100	0	0	178.25	109.29	137.94	140	182.79	153.24	169.04	192.5	173.17	188.15	199.03	198	195.86	195.86	196.1
8	21.75	-278.25	-228.25	-128.25	-178.25	-78.25	-178.25	-178.25	0	-68.96	-40.31	-38.25	4.54	-25.01	-9.21	14.25	-5.08	9.9	20.78	19.75	17.61	17.61	17.85
9	90.71	-209.29	-159.29	-59.29	-109.29	-9.29	-109.29	-109.29	68.96	0	28.65	30.71	73.5	43.95	59.75	83.21	63.88	78.86	89.74	88.71	86.57	86.57	86.81
10	62.06	-237.94	-187.94	-87.94	-137.94	-37.94	-137.94	-137.94	40.31	-28.65	0	2.06	44.85	15.3	31.1	54.56	35.23	50.21	61.09	60.06	57.92	57.92	58.16
11	60	-240	-190	-90	-140	-40	-140	-140	38.25	-30.71	-2.06	0	42.79	13.24	29.04	52.5	33.17	48.15	59.03	58	55.86	55.86	56.1
12	17.21	-282.79	-232.79	-132.79	-182.79	-82.79	-182.79	-182.79	-4.54	-73.5	-44.85	-42.79	0	-29.55	-13.75	9.71	-9.62	5.36	16.24	15.21	13.07	13.07	13.31
13	46.76	-253.24	-203.24	-103.24	-153.24	-53.24	-153.24	-153.24	25.01	-43.95	-15.3	-13.24	29.55	0	15.8	39.26	19.93	34.91	45.79	44.76	42.62	42.62	42.86
14	30.96	-269.04	-219.04	-119.04	-169.04	-69.04	-169.04	-169.04	9.21	-59.75	-31.1	-29.04	13.75	-15.8	0	23.46	4.13	19.11	29.99	28.96	26.82	26.82	27.06
15	7.5	-292.5	-242.5	-142.5	-192.5	-92.5	-192.5	-192.5	-14.25	-83.21	-54.56	-52.5	-9.71	-39.26	-23.46	0	-19.33	-4.35	6.53	5.5	3.36	3.36	3.6
16	26.83	-273.17	-223.17	-123.17	-173.17	-73.17	-173.17	-173.17	5.08	-63.88	-35.23	-33.17	9.62	-19.93	-4.13	19.33	0	14.98	25.86	24.83	22.69	22.69	22.93
17	11.85	-288.15	-238.15	-138.15	-188.15	-88.15	-188.15	-188.15	-9.9	-78.86	-50.21	-48.15	-5.36	-34.91	-19.11	4.35	-14.98	0	10.88	9.85	7.71	7.71	7.95
18	0.97	-299.03	-249.03	-149.03	-199.03	-99.03	-199.03	-199.03	-20.78	-89.74	-61.09	-59.03	-16.24	-45.79	-29.99	-6.53	-25.86	-10.88	0	-1.03	-3.17	-3.17	-2.93
19	2	-298	-248	-148	-198	-98	-198	-198	-19.75	-88.71	-60.06	-58	-15.21	-44.76	-28.96	-5.5	-24.83	-9.85	1.03	0	-2.14	-2.14	-1.9

2000		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
20	4.14	-295.86	-245.86	-145.86	-195.86	-95.86	-195.86	-195.86	-17.61	-86.57	-57.92	-55.86	-13.07	-42.62	-26.82	-3.36	-22.69	-7.71	3.17	2.14	0	0	0.24
21	4.14	-295.86	-245.86	-145.86	-195.86	-95.86	-195.86	-195.86	-17.61	-86.57	-57.92	-55.86	-13.07	-42.62	-26.82	-3.36	-22.69	-7.71	3.17	2.14	0	0	0.24
22	3.9	-296.1	-246.1	-146.1	-196.1	-96.1	-196.1	-196.1	-17.85	-86.81	-58.16	-56.1	-13.31	-42.86	-27.06	-3.6	-22.93	-7.95	2.93	1.9	-0.24	-0.24	0

Source: ICRAF Database Regional Office, Bogor, Indonesia, 2005

Appendix 5: Carbon Stock Change of Land Use in East Kalimantan Province between 2000 and 2005 (ton/ha)

	Sector Classification																			
2000		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	2005																				
	1	0	50	150	100	200	100	100	183.89	237.94	253.24	276.83	269.04	269.04	273.17	288.15	299.03	298	295.86	295.86	296.1
	2	-50	0	100	50	150	50	50	133.89	187.94	203.24	226.83	219.04	219.04	223.17	238.15	249.03	248	245.86	245.86	246.1
	3	-150	-100	0	-50	50	-50	-50	33.89	87.94	103.24	126.83	119.04	119.04	123.17	138.15	149.03	148	145.86	145.86	146.1
	4	-100	-50	50	0	100	0	0	83.89	137.94	153.24	176.83	169.04	169.04	173.17	188.15	199.03	198	195.86	195.86	196.1
	5	-200	-150	-50	-100	0	-100	-100	-16.11	37.94	53.24	76.83	69.04	69.04	73.17	88.15	99.03	98	95.86	95.86	96.1
	6	-100	-50	50	0	100	0	0	83.89	137.94	153.24	176.83	169.04	169.04	173.17	188.15	199.03	198	195.86	195.86	196.1
	7	-100	-50	50	0	100	0	0	83.89	137.94	153.24	176.83	169.04	169.04	173.17	188.15	199.03	198	195.86	195.86	196.1
	8	-183.89	-133.89	-33.89	-83.89	16.11	-83.89	-83.89	0	54.05	69.35	92.94	85.15	85.15	89.28	104.26	115.14	114.11	111.97	111.97	112.21
	9	-237.94	-187.94	-87.94	-137.94	-37.94	-137.94	-137.94	-54.05	0	15.3	38.89	31.1	31.1	35.23	50.21	61.09	60.06	57.92	57.92	58.16
	10	-253.24	-203.24	-103.24	-153.24	-53.24	-153.24	-153.24	-69.35	-15.3	0	23.59	15.8	15.8	19.93	34.91	45.79	44.76	42.62	42.62	42.86
	11	-276.83	-226.83	-126.83	-176.83	-76.83	-176.83	-176.83	-92.94	-38.89	-23.59	0	-7.79	-7.79	-3.66	11.32	22.2	21.17	19.03	19.03	19.27
	12	-269.04	-219.04	-119.04	-169.04	-69.04	-169.04	-169.04	-85.15	-31.1	-15.8	7.79	0	0	4.13	19.11	29.99	28.96	26.82	26.82	27.06
	13	-269.04	-219.04	-119.04	-169.04	-69.04	-169.04	-169.04	-85.15	-31.1	-15.8	7.79	0	0	4.13	19.11	29.99	28.96	26.82	26.82	27.06
	14	-273.17	-223.17	-123.17	-173.17	-73.17	-173.17	-173.17	-89.28	-35.23	-19.93	3.66	-4.13	-4.13	0	14.98	25.86	24.83	22.69	22.69	22.93
	15	-288.15	-238.15	-138.15	-188.15	-88.15	-188.15	-188.15	-104.26	-50.21	-34.91	-11.32	-19.11	-19.11	-14.98	0	10.88	9.85	7.71	7.71	7.95
	16	-299.03	-249.03	-149.03	-199.03	-99.03	-199.03	-199.03	-115.14	-61.09	-45.79	-22.2	-29.99	-29.99	-25.86	-10.88	0	-1.03	-3.17	-3.17	-2.93
	17	-298	-248	-148	-198	-98	-198	-198	-114.11	-60.06	-44.76	-21.17	-28.96	-28.96	-24.83	-9.85	1.03	0	-2.14	-2.14	-1.9
	18	-295.86	-245.86	-145.86	-195.86	-95.86	-195.86	-195.86	-111.97	-57.92	-42.62	-19.03	-26.82	-26.82	-22.69	-7.71	3.17	2.14	0	0	0.24

	Sector Classification																			
2000		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	2005																				
	19	-295.86	-245.86	-145.86	-195.86	-95.86	-195.86	-195.86	-111.97	-57.92	-42.62	-19.03	-26.82	-26.82	-22.69	-7.71	3.17	2.14	0	0	0.24
	20	-296.1	-246.1	-146.1	-196.1	-96.1	-196.1	-196.1	-112.21	-58.16	-42.86	-19.27	-27.06	-27.06	-22.93	-7.95	2.93	1.9	-0.24	-0.24	0

Source: ICRAF Database, Southeast Regional Office, Bogor, Indonesia (2005)

Appendix 6: Sectoral Classification and Definition of the 2005 Indonesian EIRSAM

No	*Sectoral Name*	*Description*
1	Paddy	Paddy
2	Other Food crops	maize, cassava, sweet potatoes, other root crops, groundnut, soybean, other bean, vegetables, fruits, cereals and other food crops
3	Estate crops	rubber, sugarcane, coconut, fibre crops, tobacco, coffee, tea, clove, cacao, cashew fruit, other estate crops and other agriculture
4	Livestock	livestock and livestock product except fresh milk, fresh milk, poultry and its product, and other livestock raising
5	Forestry	wood and other forest product
6	Fishery	sea fish and other sea product, inland water fish and its product, and shrimp
7	Oil, Gas and Geothermal Mining	crude oil and natural gas mining, and exertion on geothermal energy
8	Coal and Other Mining	coal, tin ore, nickel ore, bauxite ore, copper ore, gold ore, silver ore, ore and sand iron, other mining, mining of chemical non metal, crude salt, and quarrying all kinds
9	Refinery	petroleum refineries product and liquefied of natural gas
10	Palm Oil	crude Palm Oil and refined Palm Oil
11	Fish Processing	salty fish and dry fish; processed and preserved fish
12	Food and Drink Processing	meat, entrails of slaughtered animal, processed and preserved meat, dairy products, canning and preserving of fruits and vegetables, rice, wheat flour, other flour, bakery products and the like, noodle, macaroni and the like, sugar, peeled grain, chocolate and sugar confectionery, milled and peeled coffee, processed tea, soya bean product, other foods, animal feed, alcoholic beverages, non alcoholic beverages, tobacco products, and cigarettes
13	Textiles	cleaning kapok, yarn, textile, made up textile goods except wearing apparel, knitting mills, manufacture of wearing apparel, manufacture of carpet, rope and textile
14	Foot and Leather	leather tanneries and leather finishing, leather products and footwear

No	*Sectoral Name*	*Description*
15	Wood Processing	sawmill and preserved wood, manufacture of plywood and the like, wooden building components, manufacture of furniture and fixtures mainly made of wood, bamboo and rattan, manufacture of other products mainly made of wood bamboo, rattan and cork, manufacture of non-plastic plait
16	Pulp and Paper	pulp, paper and cardboard, paper and cardboard products, and printing and publishing
17	Rubber Processing	smoked and crumb rubber, tire, other rubber products, and plastics product
18	Petrochemical	basic chemical except fertilizer, fertilizer, pesticides, synthetics resin, plastic and fibber, paints, varnishes and lacquers, drug and medicine, native medicine, soap and cleaning preparation, cosmetics and other chemicals product
19	Cement	manufacture of cement
20	Basic Metal	basic iron and steel, basic iron and steel products, non-ferrous basic metal, and non-ferrous basic metal products
21	Metal Processing	kitchen wares, hand tools and agricultural tools, furniture and fixed primarily made of metal, structural metal products, and other metal products
22	Electricity Machinery	prime movers engine, machinery and apparatus, electric generator and electrical motor, electrical machinery and apparatus, communication equipment and apparatus, household electronics appliances, other electrical appliances and battery
23	Transport Equipment	ship and its repair, train and its repair, motor vehicle except motor cycle, motor cycle, other transport equipment, and aircraft and its repair
24	Other Industries	ceramic and earthenware, glass product, clay and ceramic structural products, measuring, photographic and optical equipment, jewelry, musicals instruments, sporting and athletics goods, other manufacturing industries
25	Electricity, Gas and Drinking Water	electricity, gas, and water supply
26	Construction	residential and non residential building, construction on agriculture, public work on road, bridge and harbor, construction and installation on electricity, gas, water supply and communication, and other construction
27	Trade	trade, maintenance, and repair

No	*Sectoral Name*	*Description*
28	Hotel and Restaurant	restaurant and hotel
29	Land Transportation	railway transport and road transport
30	Water Transportation	sea transport and river and lake transport
31	Air Transportation	air transport
32	Communications	services allied to transport and communication services
33	Finance	banking, other financial intermediaries, insurance and pension funds, real estate and dormitory, business services and agriculture services
34	Public Services	general government
35	Other Services	government education services, government health services, other government services, private education services, private health services, other private community services, private motion picture and its distribution, amusement, recreational and cultural services, personal and household services and other goods and services etc.

Source: EIRSAM Model by Resosudarmo *et al*

Appendix 7: Detailed of Total Net CO_2 Emission of All Production Sectors within 2005 Indonesian IRSAM Model (mega tons)

No	Sector Classification	Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
1	agricultural rural labor paid	0.00	0.00	0.00	0.00	0.00
2	agricultural urban labor paid	0.00	0.00	0.00	0.00	0.00
3	agricultural rural labor unpaid	0.00	0.00	0.00	0.00	0.00
4	agricultural urban labor unpaid	0.00	0.00	0.00	0.00	0.00
5	Production, Transport Equipment Operator, and Manual rural labor paid	0.00	0.00	0.00	0.00	0.00
6	Production, Transport Equipment Operator, and Manual urban labor paid	0.00	0.00	0.00	0.00	0.00
7	Production, Transport Equipment Operator, and Manual rural labor unpaid	0.00	0.00	0.00	0.00	0.00
8	Production, Transport Equipment Operator, and Manual urban labor unpaid	0.00	0.00	0.00	0.00	0.00
9	Clerical, Sales and Services rural labor paid	0.00	0.00	0.00	0.00	0.00
10	Clerical, Sales and Services urban labor paid	0.00	0.00	0.00	0.00	0.00
11	Clerical, Sales and Services rural labor unpaid	0.00	0.00	0.00	0.00	0.00
12	Clerical, Sales and Services urban labor unpaid	0.00	0.00	0.00	0.00	0.00
13	Professional, Managerial and Non Civilians rural labor paid	0.00	0.00	0.00	0.00	0.00
14	Professional, Managerial and Non Civilians urban labor paid	0.00	0.00	0.00	0.00	0.00
15	Professional, Managerial and Non Civilians rural labor unpaid	0.00	0.00	0.00	0.00	0.00
16	Professional, Managerial and Non Civilians urban labor unpaid	0.00	0.00	0.00	0.00	0.00
17	Non labor capital	0.00	0.00	0.00	0.00	0.00
18	Non labor land	0.00	0.00	0.00	0.00	0.00
19	Household rural	0.00	0.00	0.00	0.00	0.00
20	Household urban	0.00	0.00	0.00	0.00	0.00

No	Sector Classification	Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
21	Local government	0.00	0.00	0.00	0.00	0.00
22	Companies	0.00	0.00	0.00	0.00	0.00
23	Paddy	6.17	0.00	0.00	0.00	0.00
24	Other Food crops	344.94	0.00	6.04	0.00	0.00
25	Estate crops	8328.52	0.00	0.02	0.00	0.00
26	Livestock	0.00	0.00	0.00	0.00	0.00
27	Forestry	7.15	0.00	83.30	0.00	0.00
28	Fishery	0.00	0.00	0.00	0.00	0.00
29	Oil, Gas and Geothermal Mining	0.00	0.00	0.00	0.00	0.00
30	Coal and Other Mining	0.00	0.00	0.00	0.00	0.00
31	Refinery	0.00	0.00	0.00	0.00	0.00
32	Palm Oil	4.83	0.00	0.30	0.00	0.00
33	Fish Processing	0.00	0.00	0.00	0.00	0.00
34	Food and Drink Processing	0.00	0.00	0.00	0.00	0.00
35	Textiles	0.00	0.00	0.00	0.00	0.00
36	Foot and Leather	0.00	0.00	0.00	0.00	0.00
37	Wood Processing	0.00	0.00	0.00	0.00	0.00
38	Pulp and Paper	0.00	0.00	0.00	0.00	0.00
39	Rubber Processing	12.76	0.00	0.11	0.00	0.00
40	Petrochemical	0.00	0.00	0.00	0.00	0.00
41	Cement	0.00	0.00	0.00	0.00	0.00
42	Basic Metal	0.00	0.00	0.00	0.00	0.00
43	Metal Processing	0.00	0.00	0.00	0.00	0.00
44	Electricity Machinery	0.00	0.00	0.00	0.00	0.00
45	Transport Equipment	0.00	0.00	0.00	0.00	0.00
46	Other Industries	0.00	0.00	0.00	0.00	0.00
47	Electricity, Gas and Drinking Water	0.00	0.00	0.00	0.00	0.00
48	Construction	0.00	0.00	0.00	0.00	0.00
49	Trade	0.00	0.00	0.00	0.00	0.00
50	Hotel and Restaurant	0.00	0.00	0.00	0.00	0.00
51	Land Transportation	0.00	0.00	0.00	0.00	0.00
52	Water Transportation	0.00	0.00	0.00	0.00	0.00
53	Air Transportation	0.00	0.00	0.00	0.00	0.00
54	Communications	0.00	0.00	0.00	0.00	0.00

No	Sector Classification	Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
55	Finance	0.00	0.00	0.00	0.00	0.00
56	Public Services	0.00	0.00	0.00	0.00	0.00
57	Other Services	0.00	0.00	0.00	0.00	0.00
58	Regional Tax	0.00	0.00	0.00	0.00	0.00
59	Regional Subsidy	0.00	0.00	0.00	0.00	0.00
60	Local Inventory	0.00	0.00	0.00	0.00	0.00

Source: Author’s Calculation

Appendix 8: Detailed Result of Simulation Scenario 1

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.06	0.02	0.00	0.00	0.01
			Urban	0.03	0.00	0.00	0.00	0.01
		Unpaid	Rural	0.10	0.05	0.00	0.00	0.02
			Urban	0.04	0.01	0.00	0.00	0.01
	Agricultural	Rural		0.16	0.06	0.00	0.00	0.03
	Agricultural	Urban		0.07	0.01	0.00	0.00	0.02
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.04	0.02	0.00	0.00	0.02
			Urban	0.08	0.04	0.00	0.00	0.05
		Unpaid	Rural	0.02	0.01	0.00	0.00	0.01
			Urban	0.03	0.01	0.00	0.00	0.01
	Production, Transport Equipment Operator, and Manual	Rural		0.06	0.03	0.00	0.00	0.02
	Production, Transport Equipment Operator, and Manual	Urban		0.11	0.05	0.00	0.00	0.06
	Clerical, Sales and Services	Paid	Rural	0.01	0.01	0.00	0.00	0.00
			Urban	0.08	0.06	0.00	0.00	0.04
		Unpaid	Rural	0.03	0.02	0.00	0.00	0.01
			Urban	0.06	0.03	0.00	0.01	0.02
	Clerical, Sales and Services	Rural		0.04	0.03	0.00	0.00	0.01
	Clerical, Sales and Services	Urban		0.15	0.09	0.01	0.01	0.05
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.02	0.01	0.00	0.00	0.01
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.02	0.01	0.00	0.00	0.02
	Labor Multiplier			0.62	0.28	0.02	0.02	0.21
Non Labor		Capital		0.65	0.34	0.09	0.02	0.59
		Land		0.06	0.01	0.00	0.00	0.01
	GDP Multiplier			1.32	0.63	0.11	0.05	0.81

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Households		Rural		0.35	0.19	0.01	0.02	0.12
		Urban		0.45	0.28	0.02	0.03	0.23
	Household Income			0.80	0.47	0.03	0.04	0.35
Companies				1.25	0.75	0.03	0.17	0.43
Local Government				2.05	1.23	0.01	0.01	0.02
	Income Multipler			4.10	2.45	0.07	0.23	0.80
Paddy				0.02	0.04	0.00	0.00	0.01
Other Food crops				0.07	0.05	0.00	0.00	0.02
Estate crops				0.35	0.02	0.01	0.01	0.04
Livestock				0.04	0.03	0.00	0.00	0.02
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.03	0.01	0.00	0.00	0.01
Oil, Gas and Geothermal Mining				0.05	0.01	0.03	0.00	0.26
Coal and Other Mining				0.01	0.00	0.01	0.00	0.08
Refinery				0.03	0.04	0.03	0.00	0.01
Palm Oil				1.59	0.00	0.01	0.00	0.01
Fish Processing				0.02	0.01	0.00	0.00	0.00
Food and Drink Processing				0.15	0.26	0.01	0.01	0.03
Textiles				0.01	0.06	0.00	0.00	0.00
Foot and Leather				0.00	0.01	1.00	0.00	0.00
Wood Processing				0.01	0.00	0.00	0.00	0.00
Pulp and Paper				0.02	0.02	0.00	0.00	0.00
Rubber Processing				0.04	0.02	0.00	0.00	0.00
Petrochemical				0.02	0.10	0.05	0.01	1.04
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.01	0.00	0.00	0.00
Electricity Machinery				0.00	0.03	0.00	0.00	0.00
Transport Equipment				0.00	0.09	0.00	0.00	0.00
Other Industries				0.00	0.01	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.03	0.02	0.00	0.00	0.01
Construction				0.01	0.01	0.00	0.00	0.01

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Trade				0.31	0.14	0.02	0.03	0.09
Hotel and Restaurant				0.03	0.07	0.00	0.00	0.01
Land Transportation				0.04	0.02	0.00	0.00	0.02
Water Transportation				0.02	0.01	0.01	0.00	0.02
Air Transportation				0.01	0.01	0.00	0.00	0.01
Communications				0.02	0.03	0.00	0.00	0.01
Finance				0.06	0.14	0.00	0.00	0.02
Public Services				0.01	0.01	0.00	0.00	0.01
Other Services				0.05	0.03	0.00	0.00	0.02
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			3.07	1.32	1.20	0.09	1.80
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.32				
National Accounts	Indirect Tax			0.13				
	Subsidies			-0.04				
	Central Government			0.07				
	ROW			2.29				
Environmental Account	CO_2 Emission			2946.07				

Source: Author's Calculation

Appendix 9: Detailed Result of Simulation Scenario 1 for 1 Million increase of Palm Oil Production in Sumatera Region

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.05	0.01	0.00	0.00	0.00
			Urban	0.03	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.10	0.03	0.00	0.00	0.00
			Urban	0.04	0.00	0.00	0.00	0.00
	Agricultural	Rural		0.15	0.04	0.00	0.00	0.00
	Agricultural	Urban		0.07	0.01	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.04	0.01	0.00	0.00	0.00
			Urban	0.08	0.02	0.00	0.00	0.00
		Unpaid	Rural	0.02	0.01	0.00	0.00	0.00
			Urban	0.03	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.06	0.01	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.10	0.03	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.01	0.01	0.00	0.00	0.00
			Urban	0.08	0.03	0.00	0.00	0.00
		Unpaid	Rural	0.03	0.01	0.00	0.00	0.00
			Urban	0.06	0.02	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.04	0.02	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.14	0.05	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.02	0.01	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.02	0.01	0.00	0.00	0.00
	Labor Multiplier			0.59	0.16	0.01	0.00	0.00
Non Labor		Capital		0.61	0.19	0.03	0.00	0.00
		Land		0.06	0.01	0.00	0.00	0.00
	GDP Multiplier			1.27	0.36	0.04	0.01	0.01

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Households		Rural		0.34	0.11	0.00	0.00	0.00
		Urban		0.43	0.17	0.01	0.00	0.00
	Household Income			0.77	0.28	0.01	0.01	0.00
Companies				0.11	0.08	0.01	0.00	0.00
Local Government				0.12	0.03	0.00	0.00	0.00
	Income Multipler			1.00	0.39	0.03	0.01	0.01
Paddy				0.02	0.02	0.00	0.00	0.00
Other Food crops				0.07	0.03	0.00	0.00	0.00
Estate crops				0.34	0.01	0.00	0.00	0.00
Livestock				0.04	0.02	0.00	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.03	0.01	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.03	0.00	0.01	0.00	0.00
Coal and Other Mining				0.01	0.00	0.00	0.00	0.00
Refinery				0.03	0.03	0.01	0.00	0.00
Palm Oil				1.58	0.00	0.00	0.00	0.00
Fish Processing				0.02	0.01	0.00	0.00	0.00
Food and Drink Processing				0.14	0.13	0.01	0.00	0.00
Textiles				0.01	0.04	0.00	0.00	0.00
Foot and Leather				0.00	0.01	0.00	0.00	0.00
Wood Processing				0.01	0.00	0.00	0.00	0.00
Pulp and Paper				0.01	0.01	0.00	0.00	0.00
Rubber Processing				0.03	0.01	0.00	0.00	0.00
Petrochemical				0.02	0.04	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.02	0.00	0.00	0.00
Transport Equipment				0.00	0.05	0.00	0.00	0.00
Other Industries				0.00	0.01	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.02	0.01	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Construction				0.01	0.00	0.00	0.00	0.00
Trade				0.30	0.08	0.01	0.00	0.00
Hotel and Restaurant				0.03	0.05	0.00	0.00	0.00
Land Transportation				0.04	0.01	0.00	0.00	0.00
Water Transportation				0.02	0.01	0.01	0.00	0.00
Air Transportation				0.01	0.01	0.00	0.00	0.00
Communications				0.02	0.02	0.00	0.00	0.00
Finance				0.06	0.08	0.00	0.00	0.00
Public Services				0.01	0.00	0.00	0.00	0.00
Other Services				0.04	0.02	0.00	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			2.96	0.73	0.07	0.01	0.01
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.11				
National Accounts	Indirect Tax			0.07				
	Subsidies			-0.02				
	Central Government			0.03				
	ROW			0.64				
Environmental Account	CO_2 Emission			2863.81				

Source: Author's Calculation

Appendix 10: Detailed Result of Simulation Scenario 1 for 1 Million increase of Palm Oil Production in Kalimantan Region

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Agricultural	Rural		0.00	0.00	0.00	0.00	0.00
	Agricultural	Urban		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.00	0.00	0.00	0.00
	Labor Multiplier			0.00	0.00	0.00	0.00	0.00
Non Labor		Capital		0.00	0.00	0.00	0.00	0.00
		Land		0.00	0.00	0.00	0.00	0.00
	GDP Multiplier			0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Households		Rural		0.00	0.00	0.00	0.00	0.00
		Urban		0.00	0.00	0.00	0.00	0.00
	Household Income			0.00	0.00	0.00	0.00	0.00
Companies				0.00	0.00	0.00	0.00	0.00
Local Government				0.00	0.00	0.00	0.00	0.00
	Income Multipler			0.00	0.00	0.00	0.00	0.00
Paddy				0.00	0.00	0.00	0.00	0.00
Other Food crops				0.00	0.00	0.00	0.00	0.00
Estate crops				0.00	0.00	0.00	0.00	0.00
Livestock				0.00	0.00	0.00	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.00	0.00	0.00	0.00	0.00
Coal and Other Mining				0.00	0.00	0.00	0.00	0.00
Refinery				0.00	0.00	0.00	0.00	0.00
Palm Oil				0.00	0.00	0.00	0.00	0.00
Fish Processing				0.00	0.00	0.00	0.00	0.00
Food and Drink Processing				0.00	0.00	0.00	0.00	0.00
Textiles				0.00	0.00	0.00	0.00	0.00
Foot and Leather				0.00	0.00	1.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.00	0.00	0.00	0.00
Rubber Processing				0.00	0.00	0.00	0.00	0.00
Petrochemical				0.00	0.00	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.00	0.00	0.00	0.00
Transport Equipment				0.00	0.00	0.00	0.00	0.00
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.00	0.00	0.00	0.00
Construction				0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Trade				0.00	0.00	0.00	0.00	0.00
Hotel and Restaurant				0.00	0.00	0.00	0.00	0.00
Land Transportation				0.00	0.00	0.00	0.00	0.00
Water Transportation				0.00	0.00	0.00	0.00	0.00
Air Transportation				0.00	0.00	0.00	0.00	0.00
Communications				0.00	0.00	0.00	0.00	0.00
Finance				0.00	0.00	0.00	0.00	0.00
Public Services				0.00	0.00	0.00	0.00	0.00
Other Services				0.00	0.00	0.00	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.00	0.00	1.00	0.00	0.00
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.00				
National Accounts	Indirect Tax			0.00				
	Subsidies			0.00				
	Central Government			0.00				
	ROW			1.00				
Environmental Account	CO_2 Emission			0.30				

Source: Author's Calculation

Appendix 11: Detailed Result of Simulation Scenario 1 for 1 Million increase of Palm Oil Production in the Eastern Indonesia

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.01	0.00	0.00	0.01
			Urban	0.00	0.00	0.00	0.00	0.01
		Unpaid	Rural	0.00	0.02	0.00	0.00	0.02
			Urban	0.00	0.00	0.00	0.00	0.01
	Agricultural	Rural		0.01	0.03	0.00	0.00	0.03
	Agricultural	Urban		0.00	0.01	0.00	0.00	0.01
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.01	0.00	0.00	0.02
			Urban	0.00	0.02	0.00	0.00	0.05
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.01
			Urban	0.00	0.00	0.00	0.00	0.01
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.01	0.00	0.00	0.02
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.02	0.00	0.00	0.06
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.02	0.00	0.00	0.03
		Unpaid	Rural	0.00	0.01	0.00	0.00	0.01
			Urban	0.00	0.01	0.00	0.01	0.02
	Clerical, Sales and Services	Rural		0.00	0.01	0.00	0.00	0.01
	Clerical, Sales and Services	Urban		0.01	0.04	0.00	0.01	0.05
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.01	0.00	0.00	0.01
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.01	0.00	0.00	0.02

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
	Labor Multiplier			0.02	0.12	0.01	0.02	0.21
Non Labor		Capital		0.03	0.15	0.06	0.02	0.58
		Land		0.00	0.01	0.00	0.00	0.01
	GDP Multiplier			0.06	0.28	0.07	0.04	0.80
Households		Rural		0.01	0.08	0.01	0.01	0.12
		Urban		0.02	0.11	0.01	0.02	0.23
	Household Income			0.03	0.20	0.02	0.03	0.35
Companies				0.01	0.05	0.02	0.17	0.43
Local Government				0.01	0.02	0.01	0.01	0.02
	Income Multipler			0.05	0.27	0.04	0.22	0.79
Paddy				0.00	0.02	0.00	0.00	0.01
Other Food crops				0.00	0.02	0.00	0.00	0.02
Estate crops				0.01	0.01	0.01	0.00	0.04
Livestock				0.00	0.01	0.00	0.00	0.02
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.00	0.00	0.01
Oil, Gas and Geothermal Mining				0.02	0.01	0.02	0.00	0.26
Coal and Other Mining				0.00	0.00	0.01	0.00	0.08
Refinery				0.00	0.01	0.01	0.00	0.01
Palm Oil				0.02	0.00	0.00	0.00	0.01
Fish Processing				0.00	0.00	0.00	0.00	0.00
Food and Drink Processing				0.01	0.13	0.00	0.01	0.03
Textiles				0.00	0.02	0.00	0.00	0.00
Foot and Leather				0.00	0.01	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.01	0.00	0.00	0.00
Rubber Processing				0.01	0.01	0.00	0.00	0.00
Petrochemical				0.00	0.06	0.05	0.01	1.04
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.01	0.00	0.00	0.00
Transport Equipment				0.00	0.04	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.01	0.00	0.00	0.01
Construction				0.00	0.00	0.00	0.00	0.01
Trade				0.01	0.06	0.01	0.03	0.09
Hotel and Restaurant				0.00	0.03	0.00	0.00	0.01
Land Transportation				0.00	0.01	0.00	0.00	0.02
Water Transportation				0.00	0.00	0.00	0.00	0.01
Air Transportation				0.00	0.00	0.00	0.00	0.01
Communications				0.00	0.01	0.00	0.00	0.01
Finance				0.00	0.06	0.00	0.00	0.02
Public Services				0.00	0.00	0.00	0.00	0.01
Other Services				0.00	0.01	0.00	0.00	0.02
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.11	0.59	0.13	0.08	1.78
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.20				
National Accounts	Indirect Tax			0.06				
	Subsidies			-0.02				
	Central Government			0.04				
	ROW			0.65				
Environmental Account	CO_2 Emission			81.96				

Source: Author's Calculation

Appendix 12: Detailed Result of Simulation Scenario 2

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.02	0.03	0.00	0.02	0.00
			Urban	0.02	0.01	0.00	0.01	0.00
		Unpaid	Rural	0.12	0.09	0.00	0.04	0.00
			Urban	0.05	0.01	0.00	1.02	0.00
	Agricultural	Rural		0.14	0.11	0.01	0.05	0.01
	Agricultural	Urban		0.07	0.02	0.00	1.04	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.01	0.04	0.00	0.01	0.00
			Urban	0.04	0.10	0.01	0.02	0.00
		Unpaid	Rural	0.01	0.02	0.00	0.00	0.00
			Urban	0.01	0.02	0.00	0.01	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.02	0.06	0.00	0.01	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.05	0.12	0.01	0.02	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.02	0.00	0.01	0.00
			Urban	0.02	0.12	0.00	0.04	0.00
		Unpaid	Rural	0.01	0.04	0.00	0.01	0.00
			Urban	0.02	0.07	0.00	0.04	0.00
	Clerical, Sales and Services	Rural		0.01	0.06	0.00	0.02	0.00
	Clerical, Sales and Services	Urban		0.04	0.19	0.01	0.08	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	-0.01	0.01	0.00	0.00	0.00
			Urban	-0.02	0.03	0.00	0.01	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		-0.01	0.01	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		-0.02	0.03	0.00	0.01	0.00
	Labor Multiplier			0.30	0.61	0.03	1.23	0.02
Non Labor		Capital		0.42	0.77	0.13	0.24	0.02

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
		Land		0.05	0.02	0.00	0.05	0.00
	GDP Multiplier			0.77	1.41	0.16	1.52	0.04
		Rural		0.22	0.41	0.02	0.16	0.01
	Households	Urban		0.21	0.60	0.03	1.26	0.01
	Household Income			0.42	1.01	0.04	1.43	0.02
Companies				0.63	1.61	0.04	0.10	0.04
Local Government				1.06	2.61	0.02	0.10	0.00
	Income Multipler			2.11	5.23	0.10	1.63	0.07
Paddy				0.20	0.07	0.00	0.02	0.00
Other Food crops				0.06	0.09	0.00	0.08	0.01
Estate crops				0.09	0.03	0.01	0.04	0.00
Livestock				0.04	0.05	0.01	0.04	0.00
Forestry				0.02	0.00	0.00	0.00	0.00
Fishery				0.04	0.01	0.00	0.08	0.00
Oil, Gas and Geothermal Mining				0.16	0.01	0.04	0.00	0.00
Coal and Other Mining				0.03	0.01	0.01	0.01	0.01
Refinery				0.06	0.12	0.07	0.00	0.00
Palm Oil				0.11	0.01	0.01	0.01	0.00
Fish Processing				0.03	0.02	0.00	0.02	0.00
Food and Drink Processing				0.14	0.53	0.01	0.11	0.00
Textiles				0.01	0.11	0.00	0.00	0.00
Foot and Leather				0.00	0.03	0.00	0.00	0.00
Wood Processing				0.02	0.03	0.00	0.01	0.00
Pulp and Paper				0.09	0.06	0.01	0.00	0.00
Rubber Processing				0.04	0.07	0.00	0.00	0.00
Petrochemical				0.03	0.11	0.01	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.02	0.02	0.00	0.00	0.00
Metal Processing				0.00	0.02	0.00	0.00	0.00
Electricity Machinery				0.01	0.21	0.00	0.00	0.00
Transport Equipment				0.00	0.48	0.00	0.00	0.00
Other Industries				0.01	0.02	0.00	0.01	0.00
Electricity, Gas and Drinking				0.08	0.04	0.00	0.03	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Water								
Construction				0.01	0.01	0.00	0.01	0.00
Trade				0.11	0.31	0.02	0.18	0.01
Hotel and Restaurant				0.02	0.12	0.00	0.05	0.00
Land Transportation				0.02	0.05	0.00	0.05	0.00
Water Transportation				0.02	0.03	0.01	0.03	0.00
Air Transportation				0.01	0.02	0.00	0.04	0.00
Communications				0.02	0.05	0.00	0.02	0.01
Finance				0.04	0.26	0.00	0.04	0.00
Public Services				-0.12	0.02	0.00	0.03	0.00
Other Services				0.03	0.07	0.00	0.06	0.00
Local Inventory				1.00	0.00	0.00	0.00	0.00
	Output Multiplier			2.44	3.08	0.25	0.97	0.06

Capital Account	Local Government	0.00
	Central Government	0.00
	Private	0.30
National Accounts	Indirect Tax	0.13
	Subsidies	-0.08
	Central Government	0.07
	ROW	2.27
Environmental Account	CO_2 Emission	788.60

Source: Author's Calculation

Appendix 13: Detailed Result of Simulation Scenario 2 for 1 million increase of Investmen of Palm Oil in Sumatera Region

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.02	0.01	0.00	0.00	0.00
			Urban	0.02	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.11	0.04	0.00	0.00	0.00
			Urban	0.05	0.01	0.00	0.00	0.00
	Agricultural	Rural		0.13	0.05	0.00	0.00	0.00
	Agricultural	Urban		0.07	0.01	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.01	0.02	0.00	0.00	0.00
			Urban	0.03	0.05	0.00	0.00	0.00
		Unpaid	Rural	0.01	0.01	0.00	0.00	0.00
			Urban	0.01	0.01	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.02	0.03	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.04	0.06	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.01	0.00	0.00	0.00
			Urban	0.01	0.06	0.00	0.00	0.00
		Unpaid	Rural	0.01	0.02	0.00	0.00	0.00
			Urban	0.02	0.03	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.01	0.03	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.03	0.09	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	-0.01	0.00	0.00	0.00	0.00
			Urban	-0.02	0.02	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		-0.01	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		-0.02	0.02	0.00	0.00	0.00
	Labor Multiplier			0.25	0.30	0.02	0.00	0.01

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Non Labor		Capital		0.34	0.39	0.06	0.00	0.00
		Land		0.04	0.01	0.00	0.00	0.00
	GDP Multiplier			0.64	0.70	0.08	0.00	0.01
Households		Rural		0.19	0.20	0.01	0.00	0.00
		Urban		0.16	0.31	0.01	0.00	0.00
	Household Income			0.35	0.50	0.02	0.00	0.00
Companies				0.07	0.05	0.01	0.00	0.00
Local Government				0.07	0.13	0.02	0.00	0.00
	Income Multipler			0.49	0.69	0.04	0.00	0.00
Paddy				0.20	0.02	0.00	0.00	0.00
Other Food crops				0.05	0.05	0.00	0.00	0.00
Estate crops				0.07	0.01	0.00	0.00	0.00
Livestock				0.03	0.02	0.00	0.00	0.00
Forestry				0.01	0.00	0.00	0.00	0.00
Fishery				0.03	0.01	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.13	0.01	0.02	0.00	0.00
Coal and Other Mining				0.03	0.00	0.00	0.00	0.00
Refinery				0.04	0.06	0.04	0.00	0.00
Palm Oil				0.07	0.00	0.00	0.00	0.00
Fish Processing				0.03	0.01	0.00	0.00	0.00
Food and Drink Processing				0.12	0.15	0.00	0.00	0.00
Textiles				0.00	0.03	0.00	0.00	0.00
Foot and Leather				0.00	0.01	0.00	0.00	0.00
Wood Processing				0.01	0.02	0.00	0.00	0.00
Pulp and Paper				0.09	0.04	0.00	0.00	0.00
Rubber Processing				0.03	0.02	0.00	0.00	0.00
Petrochemical				0.03	0.05	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.02	0.01	0.00	0.00	0.00
Metal Processing				0.00	0.01	0.00	0.00	0.00
Electricity Machinery				0.01	0.17	0.00	0.00	0.00
Transport Equipment				0.00	0.38	0.00	0.00	0.00
Other Industries				0.01	0.01	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Electricity, Gas and Drinking Water				0.07	0.02	0.00	0.00	0.00
Construction				0.01	0.01	0.00	0.00	0.00
Trade				0.09	0.15	0.01	0.00	0.00
Hotel and Restaurant				0.02	0.05	0.00	0.00	0.00
Land Transportation				0.02	0.03	0.00	0.00	0.00
Water Transportation				0.01	0.01	0.01	0.00	0.00
Air Transportation				0.01	0.01	0.00	0.00	0.00
Communications				0.02	0.03	0.00	0.00	0.00
Finance				0.03	0.10	0.00	0.00	0.00
Public Services				-0.12	0.01	0.00	0.00	0.00
Other Services				0.02	0.03	0.00	0.00	0.00
Local Inventory				1.00	0.00	0.00	0.00	0.00
	Output Multiplier			2.19	1.56	0.11	0.02	0.02
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.11				
National Accounts	Indirect Tax			0.06				
	Subsidies			-0.04				
	Central Government			0.03				
	ROW			0.71				
Environmental Account	CO_2 Emission			589.25				

Source: Author's Calculation

Appendix 14: Detailed Result of Simulation Scenario 2 for 1 million increase of Investment of Palm Oil in Kalimantan Region

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.02	0.00	0.02	0.00
			Urban	0.00	0.00	0.00	0.01	0.00
		Unpaid	Rural	0.01	0.05	0.00	0.04	0.00
			Urban	0.00	0.01	0.00	1.02	0.00
	Agricultural	Rural		0.01	0.06	0.00	0.05	0.00
	Agricultural	Urban		0.01	0.01	0.00	1.04	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.02	0.00	0.01	0.00
			Urban	0.01	0.04	0.00	0.02	0.00
		Unpaid	Rural	0.00	0.01	0.00	0.00	0.00
			Urban	0.00	0.01	0.00	0.01	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.03	0.00	0.01	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.01	0.05	0.00	0.02	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.01	0.00	0.01	0.00
			Urban	0.01	0.06	0.00	0.04	0.00
		Unpaid	Rural	0.00	0.02	0.00	0.01	0.00
			Urban	0.00	0.03	0.00	0.04	0.00
	Clerical, Sales and Services	Rural		0.00	0.03	0.00	0.02	0.00
	Clerical, Sales and Services	Urban		0.01	0.10	0.00	0.07	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.01	0.00	0.01	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.02	0.00	0.01	0.00
	Labor Multiplier			0.05	0.31	0.02	1.23	0.01

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Non Labor		Capital		0.08	0.38	0.07	0.24	0.02
		Land		0.01	0.01	0.00	0.04	0.00
	GDP Multiplier			0.14	0.70	0.09	1.51	0.03
Households		Rural		0.03	0.21	0.01	0.16	0.01
		Urban		0.04	0.29	0.01	1.26	0.01
	Household Income			0.07	0.50	0.02	1.42	0.02
Companies				0.02	0.05	0.01	0.10	0.00
Local Government				0.02	0.12	0.02	0.10	0.04
	Income Multipler			0.11	0.68	0.06	1.62	0.06
Paddy				0.00	0.05	0.00	0.02	0.00
Other Food crops				0.01	0.04	0.00	0.07	0.01
Estate crops				0.02	0.02	0.01	0.04	0.00
Livestock				0.01	0.03	0.00	0.04	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.01	0.01	0.00	0.08	0.00
Oil, Gas and Geothermal Mining				0.03	0.01	0.02	0.00	0.00
Coal and Other Mining				0.00	0.00	0.00	0.01	0.00
Refinery				0.01	0.06	0.04	0.00	0.00
Palm Oil				0.04	0.00	0.01	0.01	0.00
Fish Processing				0.01	0.01	0.00	0.02	0.00
Food and Drink Processing				0.02	0.38	0.01	0.11	0.00
Textiles				0.00	0.08	0.00	0.00	0.00
Foot and Leather				0.00	0.02	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.01	0.00
Pulp and Paper				0.01	0.02	0.01	0.00	0.00
Rubber Processing				0.02	0.05	0.00	0.00	0.00
Petrochemical				0.00	0.06	0.01	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.01	0.00	0.00	0.00
Electricity Machinery				0.00	0.04	0.00	0.00	0.00
Transport Equipment				0.00	0.10	0.00	0.00	0.00
Other Industries				0.00	0.01	0.00	0.01	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Electricity, Gas and Drinking Water				0.00	0.02	0.00	0.03	0.00
Construction				0.00	0.01	0.00	0.01	0.00
Trade				0.02	0.16	0.01	0.18	0.00
Hotel and Restaurant				0.00	0.07	0.00	0.05	0.00
Land Transportation				0.00	0.03	0.00	0.05	0.00
Water Transportation				0.00	0.01	0.01	0.03	0.00
Air Transportation				0.00	0.01	0.00	0.04	0.00
Communications				0.00	0.03	0.00	0.02	0.01
Finance				0.01	0.16	0.00	0.04	0.00
Public Services				0.00	0.01	0.00	0.03	0.00
Other Services				0.00	0.04	0.00	0.06	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.25	1.52	0.14	0.95	0.05
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.19				
National Accounts	Indirect Tax			0.07				
	Subsidies			-0.03				
	Central Government			0.04				
	ROW			0.56				
Environmental Account	CO_2 Emission			199.35				

Source: Author's Calculation

Appendix 15: Detailed Result of Simulation Scenario 2 for 1 million increase of Investment of Palm Oil in the Eastern Indonesia

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Agricultural	Rural		0.00	0.00	0.00	0.00	0.00
	Agricultural	Urban		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial	Urban		0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
	and Non Civilians							
	Labor Multiplier			0.00	0.00	0.00	0.00	0.00
Non Labor		Capital		0.00	0.00	0.00	0.00	0.00
		Land		0.00	0.00	0.00	0.00	0.00
	GDP Multiplier			0.00	0.00	0.00	0.00	0.00
Households		Rural		0.00	0.00	0.00	0.00	0.00
		Urban		0.00	0.00	0.00	0.00	0.00
	Household Income			0.00	0.00	0.00	0.00	0.00
Companies				0.00	0.00	0.00	0.00	0.00
Local Government				0.00	0.00	0.00	0.00	0.00
	Income Multipler			0.00	0.00	0.00	0.00	0.00
Paddy				0.00	0.00	0.00	0.00	0.00
Other Food crops				0.00	0.00	0.00	0.00	0.00
Estate crops				0.00	0.00	0.00	0.00	0.00
Livestock				0.00	0.00	0.00	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.00	0.00	0.00	0.00	0.00
Coal and Other Mining				0.00	0.00	0.00	0.00	0.00
Refinery				0.00	0.00	0.00	0.00	0.00
Palm Oil				0.00	0.00	0.00	0.00	0.00
Fish Processing				0.00	0.00	0.00	0.00	0.00
Food and Drink Processing				0.00	0.00	0.00	0.00	0.00
Textiles				0.00	0.00	0.00	0.00	0.00
Foot and Leather				0.00	0.00	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.00	0.00	0.00	0.00
Rubber Processing				0.00	0.00	0.00	0.00	0.00
Petrochemical				0.00	0.00	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.00	0.00	0.00	0.00
Transport Equipment				0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.00	0.00	0.00	0.00
Construction				0.00	0.00	0.00	0.00	0.00
Trade				0.00	0.00	0.00	0.00	0.00
Hotel and Restaurant				0.00	0.00	0.00	0.00	0.00
Land Transportation				0.00	0.00	0.00	0.00	0.00
Water Transportation				0.00	0.00	0.00	0.00	0.00
Air Transportation				0.00	0.00	0.00	0.00	0.00
Communications				0.00	0.00	0.00	0.00	0.00
Finance				0.00	0.00	0.00	0.00	0.00
Public Services				0.00	0.00	0.00	0.00	0.00
Other Services				0.00	0.00	0.00	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.00	0.00	0.00	0.00	0.00
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.00				
National Accounts	Indirect Tax			0.00				
	Subsidies			0.00				
	Central Government			0.00				
	ROW			1.00				
Environmental Account	CO_2 Emission			0.00				

Source: Author's Calculation

Appendix 16: Detailed Result of SIM 3

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.01	0.02	0.08	0.00	0.01
			Urban	0.00	0.01	0.03	0.00	0.00
		Unpaid	Rural	0.01	0.05	0.07	0.00	0.02
			Urban	0.01	0.01	0.02	0.00	0.01
	Agricultural	Rural		0.02	0.07	0.14	0.01	0.02
	Agricultural	Urban		0.01	0.01	0.05	0.00	0.01
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.02	0.01	0.00	0.03
			Urban	0.01	0.04	0.02	0.00	0.06
		Unpaid	Rural	0.00	0.01	0.00	0.00	0.02
			Urban	0.00	0.01	0.00	0.00	0.02
	Production, Transport Equipment Operator, and Manual	Rural		0.01	0.03	0.02	0.00	0.05
	Production, Transport Equipment Operator, and Manual	Urban		0.01	0.05	0.03	0.00	0.09
	Clerical, Sales and Services	Paid	Rural	0.00	0.01	0.01	0.00	0.01
			Urban	0.01	0.07	0.03	0.00	0.04
		Unpaid	Rural	0.00	0.02	0.01	0.00	0.01
			Urban	0.01	0.04	0.02	0.00	0.02
	Clerical, Sales and Services	Rural		0.01	0.03	0.02	0.00	0.01
	Clerical, Sales and Services	Urban		0.02	0.10	0.05	0.01	0.06
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.02	0.01	0.00	0.02
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.01
	Professional, Managerial and Non Civilians	Urban		0.00	0.02	0.01	0.00	0.02
	Labor Multiplier			0.08	0.33	0.32	0.02	0.28
Non Labor		Capital		0.11	0.38	0.56	0.02	0.72
		Land		0.01	0.01	0.09	0.00	0.01

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
	GDP Multiplier			0.20	0.72	0.97	0.05	1.01
Households		Rural		0.07	0.23	0.22	0.02	0.16
		Urban		0.13	0.32	0.18	0.02	0.29
	Household Income			0.21	0.54	0.39	0.04	0.45
Companies				0.34	0.86	0.15	0.21	0.53
Local Government				0.54	1.40	0.08	0.01	0.02
	Income Multipler			1.09	2.80	0.62	0.27	1.00
Paddy				0.01	0.05	0.08	0.01	0.01
Other Food crops				0.01	0.06	0.04	0.01	0.03
Estate crops				0.03	0.02	0.04	0.01	0.01
Livestock				0.01	0.03	1.05	0.00	0.02
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.01	0.01	0.02	0.00	0.01
Oil, Gas and Geothermal Mining				0.03	0.01	0.02	0.00	0.01
Coal and Other Mining				0.00	0.00	0.01	0.00	1.10
Refinery				0.01	0.04	0.04	0.00	0.02
Palm Oil				0.04	0.00	0.02	0.00	0.00
Fish Processing				0.01	0.01	0.00	0.00	0.01
Food and Drink Processing				0.04	0.36	0.40	0.03	0.04
Textiles				0.00	0.06	0.00	0.00	0.00
Foot and Leather				0.00	0.01	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.01	0.02	0.01	0.00	0.00
Rubber Processing				0.03	0.02	0.01	0.00	0.00
Petrochemical				0.01	0.06	0.02	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.01	0.00	0.00	0.00
Metal Processing				0.00	0.01	0.00	0.00	0.00
Electricity Machinery				0.00	0.06	0.00	0.00	0.00
Transport Equipment				0.00	0.09	0.00	0.00	0.00
Other Industries				0.00	0.01	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.01	0.02	0.01	0.00	0.01
Construction				0.00	0.01	0.01	0.00	0.03
Trade				0.04	0.16	0.16	0.01	0.07

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Hotel and Restaurant				0.01	0.07	0.02	0.00	0.02
Land Transportation				0.01	0.03	0.02	0.00	0.02
Water Transportation				0.01	0.01	0.02	0.00	0.01
Air Transportation				0.01	0.01	0.01	0.00	0.01
Communications				0.00	0.03	0.02	0.00	0.01
Finance				0.01	0.18	0.02	0.00	0.01
Public Services				0.00	0.01	0.00	0.00	0.01
Other Services				0.01	0.04	0.02	0.00	0.02
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.38	1.51	2.07	0.09	1.50
Capital Account	Local Government				0.00			
	Central Government				0.00			
	Private				0.69			
National Accounts	Indirect Tax				0.14			
	Subsidies				-0.03			
	Central Government				0.17			
	ROW				1.77			
Environmental Account	CO_2 Emission				239.13			

Source: Author's Calculation

Appendix 17: Detailed Result of Simulation Scenario 3 for REDD Incentive for Companies in Sumatera Region

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.01	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Agricultural	Rural		0.01	0.01	0.00	0.00	0.00
	Agricultural	Urban		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.01	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.01	0.01	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.00	0.00	0.00	0.00
	Labor Multiplier			0.03	0.03	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Non Labor		Capital		0.03	0.03	0.01	0.00	0.00
		Land		0.00	0.00	0.00	0.00	0.00
	GDP Multiplier			0.07	0.07	0.01	0.00	0.00
Households		Rural		0.04	0.03	0.00	0.00	0.00
		Urban		0.09	0.04	0.00	0.00	0.00
	Household Income			0.13	0.07	0.00	0.00	0.00
Companies				1.15	0.06	0.00	0.00	0.00
Local Government				0.03	0.06	0.00	0.00	0.00
	Income Multipler			1.31	0.18	0.01	0.00	0.00
Paddy				0.00	0.00	0.00	0.00	0.00
Other Food crops				0.01	0.01	0.00	0.00	0.00
Estate crops				0.01	0.00	0.00	0.00	0.00
Livestock				0.01	0.00	0.00	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.01	0.00	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.00	0.00	0.00	0.00	0.00
Coal and Other Mining				0.00	0.00	0.00	0.00	0.00
Refinery				0.00	0.00	0.00	0.00	0.00
Palm Oil				0.01	0.00	0.00	0.00	0.00
Fish Processing				0.00	0.00	0.00	0.00	0.00
Food and Drink Processing				0.02	0.03	0.00	0.00	0.00
Textiles				0.00	0.01	0.00	0.00	0.00
Foot and Leather				0.00	0.00	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.00	0.00	0.00	0.00
Rubber Processing				0.00	0.00	0.00	0.00	0.00
Petrochemical				0.00	0.00	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.00	0.00	0.00	0.00
Transport Equipment				0.00	0.01	0.00	0.00	0.00
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Construction				0.00	0.00	0.00	0.00	0.00
Trade				0.02	0.02	0.00	0.00	0.00
Hotel and Restaurant				0.00	0.01	0.00	0.00	0.00
Land Transportation				0.00	0.00	0.00	0.00	0.00
Water Transportation				0.00	0.00	0.00	0.00	0.00
Air Transportation				0.00	0.00	0.00	0.00	0.00
Communications				0.00	0.00	0.00	0.00	0.00
Finance				0.01	0.01	0.00	0.00	0.00
Public Services				0.00	0.00	0.00	0.00	0.00
Other Services				0.01	0.00	0.00	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.13	0.14	0.01	0.00	0.00
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.35				
National Accounts	Indirect Tax			0.01				
	Subsidies			0.00				
	Central Government			0.09				
	ROW			0.48				
Environmental Account	CO_2 Emission			54.36				

Source: Author's Calculation

Appendix 18: Detailed Result of Simulation Scenario 3 for REDD Incentive for Companies in Kalimantan Region

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.01	0.08	0.00	0.00
			Urban	0.00	0.00	0.03	0.00	0.00
		Unpaid	Rural	0.00	0.03	0.07	0.00	0.00
			Urban	0.00	0.00	0.02	0.00	0.00
	Agricultural	Rural		0.01	0.03	0.14	0.00	0.00
	Agricultural	Urban		0.00	0.01	0.05	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.01	0.01	0.00	0.00
			Urban	0.00	0.02	0.02	0.00	0.00
		Unpaid	Rural	0.00	0.01	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.01	0.01	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.02	0.02	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.01	0.00	0.00
			Urban	0.00	0.03	0.03	0.00	0.00
		Unpaid	Rural	0.00	0.01	0.01	0.00	0.00
			Urban	0.00	0.02	0.02	0.00	0.00
	Clerical, Sales and Services	Rural		0.00	0.01	0.02	0.00	0.00
	Clerical, Sales and Services	Urban		0.01	0.04	0.05	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.01	0.01	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.01	0.01	0.00	0.00
	Labor Multiplier			0.03	0.15	0.31	0.01	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Non Labor		Capital		0.04	0.16	0.53	0.01	0.00
		Land		0.00	0.01	0.09	0.00	0.00
	GDP Multiplier			0.07	0.31	0.93	0.02	0.01
Households		Rural		0.02	0.10	0.21	0.01	0.00
		Urban		0.02	0.13	0.17	0.01	0.00
	Household Income			0.04	0.23	0.38	0.02	0.01
Companies				0.01	0.07	0.13	0.01	0.00
Local Government				0.01	0.02	0.07	0.00	0.00
	Income Multipler			0.06	0.33	0.58	0.03	0.01
Paddy				0.00	0.02	0.08	0.00	0.00
Other Food crops				0.01	0.02	0.04	0.00	0.00
Estate crops				0.01	0.01	0.03	0.00	0.00
Livestock				0.00	0.02	1.05	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.02	0.00	0.00
Oil, Gas and Geothermal Mining				0.01	0.00	0.01	0.00	0.00
Coal and Other Mining				0.00	0.00	0.01	0.00	0.00
Refinery				0.01	0.02	0.02	0.00	0.00
Palm Oil				0.01	0.00	0.01	0.00	0.00
Fish Processing				0.01	0.01	0.00	0.00	0.00
Food and Drink Processing				0.01	0.18	0.39	0.02	0.00
Textiles				0.00	0.02	0.00	0.00	0.00
Foot and Leather				0.00	0.01	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.01	0.01	0.00	0.00
Rubber Processing				0.01	0.01	0.00	0.00	0.00
Petrochemical				0.00	0.02	0.01	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.01	0.00	0.00	0.00
Transport Equipment				0.00	0.04	0.00	0.00	0.00
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.01	0.01	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Construction				0.00	0.00	0.00	0.00	0.00
Trade				0.01	0.07	0.15	0.01	0.00
Hotel and Restaurant				0.00	0.03	0.02	0.00	0.00
Land Transportation				0.00	0.01	0.02	0.00	0.00
Water Transportation				0.00	0.01	0.02	0.00	0.00
Air Transportation				0.00	0.01	0.01	0.00	0.00
Communications				0.00	0.01	0.02	0.00	0.00
Finance				0.00	0.07	0.02	0.00	0.00
Public Services				0.00	0.00	0.00	0.00	0.00
Other Services				0.00	0.02	0.01	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.13	0.66	1.99	0.05	0.01

Capital Account	Local Government	0.00
	Central Government	0.00
	Private	0.10
National Accounts	Indirect Tax	0.06
	Subsidies	-0.01
	Central Government	0.03
	ROW	0.72
Environmental Account	CO_2 Emission	86.40

Source: Author's Calculation

Appendix 19: Detailed Result of Simulation Scenario 3 for REDD Incentive for Companies in the Eastern Indonesia

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.01	0.00	0.00	0.01
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.02	0.00	0.00	0.02
			Urban	0.00	0.00	0.00	0.00	0.01
	Agricultural	Rural		0.01	0.03	0.00	0.00	0.02
	Agricultural	Urban		0.00	0.01	0.00	0.00	0.01
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.01	0.00	0.00	0.03
			Urban	0.00	0.02	0.00	0.00	0.06
		Unpaid	Rural	0.00	0.01	0.00	0.00	0.02
			Urban	0.00	0.00	0.00	0.00	0.02
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.01	0.00	0.00	0.05
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.02	0.00	0.00	0.09
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.01
			Urban	0.00	0.03	0.00	0.00	0.04
		Unpaid	Rural	0.00	0.01	0.00	0.00	0.01
			Urban	0.00	0.02	0.00	0.00	0.02
	Clerical, Sales and Services	Rural		0.00	0.02	0.00	0.00	0.01
	Clerical, Sales and Services	Urban		0.01	0.05	0.00	0.00	0.06
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.01	0.00	0.00	0.02
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.01
	Professional, Managerial and Non Civilians	Urban		0.00	0.01	0.00	0.00	0.02
	Labor Multiplier			0.02	0.15	0.01	0.01	0.27
Non Labor		Capital		0.04	0.18	0.03	0.01	0.72
		Land		0.00	0.01	0.00	0.00	0.01

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
	GDP Multiplier			0.06	0.34	0.04	0.02	1.00
Households		Rural		0.01	0.10	0.00	0.01	0.16
		Urban		0.02	0.14	0.01	0.01	0.28
	Household Income			0.03	0.24	0.01	0.02	0.44
Companies				0.01	0.06	0.02	0.20	0.52
Local Government				0.01	0.03	0.00	0.01	0.02
	Income Multipler			0.05	0.33	0.03	0.24	0.98
Paddy				0.00	0.02	0.00	0.00	0.01
Other Food crops				0.00	0.03	0.00	0.00	0.03
Estate crops				0.01	0.01	0.00	0.00	0.01
Livestock				0.00	0.01	0.00	0.00	0.02
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.00	0.00	0.01
Oil, Gas and Geothermal Mining				0.01	0.01	0.01	0.00	0.01
Coal and Other Mining				0.00	0.00	0.00	0.00	1.10
Refinery				0.00	0.02	0.02	0.00	0.02
Palm Oil				0.02	0.00	0.00	0.00	0.00
Fish Processing				0.00	0.00	0.00	0.00	0.01
Food and Drink Processing				0.01	0.16	0.00	0.01	0.04
Textiles				0.00	0.03	0.00	0.00	0.00
Foot and Leather				0.00	0.01	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.01	0.00	0.00	0.00
Rubber Processing				0.01	0.01	0.00	0.00	0.00
Petrochemical				0.00	0.03	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.04	0.00	0.00	0.00
Transport Equipment				0.00	0.04	0.00	0.00	0.00
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.01	0.00	0.00	0.01
Construction				0.00	0.00	0.00	0.00	0.03
Trade				0.01	0.07	0.01	0.01	0.07

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Hotel and Restaurant				0.00	0.03	0.00	0.00	0.02
Land Transportation				0.00	0.01	0.00	0.00	0.02
Water Transportation				0.00	0.01	0.00	0.00	0.01
Air Transportation				0.00	0.01	0.00	0.00	0.01
Communications				0.00	0.01	0.00	0.00	0.01
Finance				0.00	0.09	0.00	0.00	0.01
Public Services				0.00	0.00	0.00	0.00	0.01
Other Services				0.00	0.02	0.00	0.00	0.02
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.12	0.71	0.06	0.04	1.48
Capital Account	Local Government			0.00				
	Central Government			0.00				
	Private			0.24				
National Accounts	Indirect Tax			0.08				
	Subsidies			-0.02				
	Central Government			0.05				
	ROW			0.58				
Environmental Account	CO_2 Emission			98.38				

Source: Author's Calculation

Appendix 20: Detailed Result of Simulation Scenario 4

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Agricultural	Rural		0.00	0.00	0.00	0.00	0.00
	Agricultural	Urban		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.00	0.00	0.00	0.00
	Labor Multiplier			0.00	0.00	0.00	0.00	0.00
Non Labor		Capital		0.00	0.00	0.00	0.00	0.00
		Land		0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
	GDP Multiplier			0.00	0.00	0.00	0.00	0.00
Households		Rural		0.00	0.00	0.00	0.00	0.00
		Urban		0.00	0.00	0.00	0.00	0.00
	Household Income			0.00	0.00	0.00	0.00	0.00
Companies				0.00	0.00	0.00	0.00	0.00
Local Government				0.00	0.00	0.00	0.00	0.00
	Income Multipler			0.00	0.00	0.00	0.00	0.00
Paddy				0.00	0.00	0.00	0.00	0.00
Other Food crops				0.00	0.00	0.00	0.00	0.00
Estate crops				0.00	0.00	0.00	0.00	0.00
Livestock				0.00	0.00	0.00	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.00	0.00	0.00	0.00	0.00
Coal and Other Mining				0.00	0.00	0.00	0.00	0.00
Refinery				0.00	0.00	0.00	0.00	0.00
Palm Oil				0.00	0.00	0.00	0.00	0.00
Fish Processing				0.00	0.00	0.00	0.00	0.00
Food and Drink Processing				0.00	0.00	0.00	0.00	0.00
Textiles				0.00	0.00	0.00	0.00	0.00
Foot and Leather				0.00	0.00	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.00	0.00	0.00	0.00
Rubber Processing				0.00	0.00	0.00	0.00	0.00
Petrochemical				0.00	0.00	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.00	0.00	0.00	0.00
Transport Equipment				0.00	0.00	0.00	0.00	0.00
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Construction				0.00	0.00	0.00	0.00	0.00
Trade				0.00	0.00	0.00	0.00	0.00
Hotel and Restaurant				0.00	0.00	0.00	0.00	0.00
Land Transportation				0.00	0.00	0.00	0.00	0.00
Water Transportation				0.00	0.00	0.00	0.00	0.00
Air Transportation				0.00	0.00	0.00	0.00	0.00
Communications				0.00	0.00	0.00	0.00	0.00
Finance				0.00	0.00	0.00	0.00	0.00
Public Services				0.00	0.00	0.00	0.00	0.00
Other Services				0.00	0.00	0.00	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.00	0.00	0.00	0.00	0.00
Capital Account	Local Government				0.00			
	Central Government				0.00			
	Private				0.00			
National Accounts	Indirect Tax				0.00			
	Subsidies				0.00			
	Central Government				0.00			
	ROW				1.00			
Environmental Account	CO_2 Emission				0.00			

Source: Author's Calculation

Appendix 21: Detailed Result of Simulation Scenario 5

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Labor	Agricultural	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Agricultural	Rural		0.00	0.00	0.00	0.00	0.00
	Agricultural	Urban		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Rural		0.00	0.00	0.00	0.00	0.00
	Production, Transport Equipment Operator, and Manual	Urban		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Rural		0.00	0.00	0.00	0.00	0.00
	Clerical, Sales and Services	Urban		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Paid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
		Unpaid	Rural	0.00	0.00	0.00	0.00	0.00
			Urban	0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Rural		0.00	0.00	0.00	0.00	0.00
	Professional, Managerial and Non Civilians	Urban		0.00	0.00	0.00	0.00	0.00
	Labor Multiplier			0.00	0.00	0.00	0.00	0.00
Non Labo		Capital		0.00	0.00	0.00	0.00	0.00
		Land		0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
	GDP Multiplier			0.00	0.00	0.00	0.00	0.00
Households		Rural		0.00	0.00	0.00	0.00	0.00
		Urban		0.00	0.00	0.00	0.00	0.00
	Household Income			0.00	0.00	0.00	0.00	0.00
Companies				0.00	0.00	0.00	0.00	0.00
Local Governmen				0.00	0.00	0.00	0.00	0.00
	Income Multipler			0.00	0.00	0.00	0.00	0.00
Paddy				0.00	0.00	0.00	0.00	0.00
Other Food crops				0.00	0.00	0.00	0.00	0.00
Estate crops				0.00	0.00	0.00	0.00	0.00
Livestock				0.00	0.00	0.00	0.00	0.00
Forestry				0.00	0.00	0.00	0.00	0.00
Fishery				0.00	0.00	0.00	0.00	0.00
Oil, Gas and Geothermal Mining				0.00	0.00	0.00	0.00	0.00
Coal and Other Mining				0.00	0.00	0.00	0.00	0.00
Refinery				0.00	0.00	0.00	0.00	0.00
Palm Oil				0.00	0.00	0.00	0.00	0.00
Fish Processing				0.00	0.00	0.00	0.00	0.00
Food and Drink Processing				0.00	0.00	0.00	0.00	0.00
Textiles				0.00	0.00	0.00	0.00	0.00
Foot and Leather				0.00	0.00	0.00	0.00	0.00
Wood Processing				0.00	0.00	0.00	0.00	0.00
Pulp and Paper				0.00	0.00	0.00	0.00	0.00
Rubber Processing				0.00	0.00	0.00	0.00	0.00
Petrochemical				0.00	0.00	0.00	0.00	0.00
Cement				0.00	0.00	0.00	0.00	0.00
Basic Metal				0.00	0.00	0.00	0.00	0.00
Metal Processing				0.00	0.00	0.00	0.00	0.00
Electricity Machinery				0.00	0.00	0.00	0.00	0.00
Transport Equipment				0.00	0.00	0.00	0.00	0.00
Other Industries				0.00	0.00	0.00	0.00	0.00
Electricity, Gas and Drinking Water				0.00	0.00	0.00	0.00	0.00
Construction				0.00	0.00	0.00	0.00	0.00
Trade				0.00	0.00	0.00	0.00	0.00

Classification				Sumatera	Java and Bali	Kalimantan	Sulawesi	Eastern Indonesia
Hotel and Restaurant				0.00	0.00	0.00	0.00	0.00
Land Transportation				0.00	0.00	0.00	0.00	0.00
Water Transportation				0.00	0.00	0.00	0.00	0.00
Air Transportation				0.00	0.00	0.00	0.00	0.00
Communications				0.00	0.00	0.00	0.00	0.00
Finance				0.00	0.00	0.00	0.00	0.00
Public Services				0.00	0.00	0.00	0.00	0.00
Other Services				0.00	0.00	0.00	0.00	0.00
Local Inventory				0.00	0.00	0.00	0.00	0.00
	Output Multiplier			0.00	0.00	0.00	0.00	0.00
Capital Account	Local Government				0.00			
	Central Government				0.00			
	Private				0.00			
National Accounts	Indirect Tax				0.00			
	Subsidies				0.00			
	Central Government				0.00			
	ROW				1.00			
Environmental Account	CO_2 Emission				0.00			

Source: Author's Calculation