THE IMPACT OF INDONESIA'S PALM OIL INDUSTRY ON ECONOMIC AND ENVIRONMENTAL PERFORMANCE

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Hopefully this research paper could give benefit and insight.

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Abstract

Indonesia is number one palm oil producer worldwide. Oil palm development is important for Indonesia's economy. However, it has some issues regarding economic and environmental performance should be considered. This paper examines the relation of economic and environmental sides of oil palm development in Indonesia. It revealed the relation of gross regional domestic product (GRDP), unemployment rate, environmental quality index and oil palm plantation and oil palm production. This study utilises panel data regression analysis using time dimension 2007 to 2017 in Indonesia. This paper uses two independent variables, oil palm plantation and oil palm production. It has three dependent variables as follows: gross regional domestic product (GRDP) per capita, unemployment rate and environmental quality index. Furthermore, it seems that oil palm plantation has insignificant correlation to gross regional domestic product (GRDP) per capita. However, oil palm production has negatively correlated to gross regional domestic product (GRDP) per capita. Additionally, both oil palm plantation and oil palm production have negative relationship with unemployment rate. It means that for every increasing of oil palm plantation and oil palm production will decrease unemployment rate. The results for the relation between oil palm plantation and oil palm production with environmental quality index is quiet similar. There is no significant relation between those variables.

Relevance to Development Studies

Oil palm is one of the most important commodities in Indonesia to support its economy. Generally, it can be said that oil palm has a positive impact on Indonesia's economy. However, there are a lot of potential problems regarding the environment effect of oil palm. Indonesia has received a lot of criticism regarding the environmental effect of oil palm exploitation. The criticism comes from within and outside the country. There are a lot of research regarding Indonesia's oil palm exploitation. Most of prior studies only concern on the one side effect only, either economic effect or environmental effect. Oil palm development supports Indonesia, however, there are several environmental issues will become globally threatened not only Indonesia but also its surrounding. To fulfil high demand of palm oil both domestic and export oriented, Indonesia change the land use, including forest. Land use change process is potentially damaging the environment, including decreasing of air and water quality. As a developing country, economic benefit of oil palm development is intriguing to consider rather than its environmental issues. Hence, this paper tries to see the relation of both economic and environment effect of oil palm exploitation in the entire regions of Indonesia.

Keywords

Oil palm plantation, oil palm production, economic development, environment, regional economic growth, unemployment, gross regional domestic product.

CHAPTER 1
INTRODUCTION

1.1 Background

Indonesia is the biggest palm oil producer in the world. Indonesia produces more or less 50% of the global demand of palm oil (Indonesia Palm Oil Association 2017). By 2018, palm oil is Indonesia's flagship exports commodity, along with coal. It contributes 11% of total exports of non-oil and gas products (Statistics Indonesia 2018a). Moreover, palm oil saved Indonesia's trade balance. Without palm oil, Indonesia trade balance would be deficit in 2017 (Indonesia Palm Oil Association 2017). In addition, among 514 municipalities, there are 200 municipalities produce palm oil all over Indonesia (Indonesia Palm Oil Association 2017). Contribution of palm oil in Indonesia's economic development are alleviating poverty, raising regional growth, lowering unemployment, supporting national income through tax and exports, and distributing infrastructures (World Growth 2011). Furthermore, palm oil is important source to substitute fossil fuels since oil palm plantations is the fastest growing monoculture in tropics.

Perhaps, oil palm industry drives economic development, however, it produces degradation of the environment as well. By 2018, palm oil exports to European Union was decreased due to environmental issue, especially deforestation (Statistics Indonesia 2018a). Palm oil industry indicates to contribute major deforestation in Indonesia's rainforest. Deforestation is crucial regarding establishment of industrial tree plantation. Deforestation is changing forest into non-forest used through clearing, cutting and removing and it is causing ecosystem less of ecosystem biodiversity (Kricher 1997). The haze resulted by land-clearing process produces greenhouse gas emission. Indonesia is fifth largest producer of greenhouse gas emission (Chrisolite H 2017). In addition, Indonesia's tropical forest is a home of distinct species such as orang utan, Sumatran tiger and rhinoceros. Industrial tree plantation like palm oil is harmful for those species' habitat. Furthermore, palm oil plantation is one of land conflict triggered in Sumatra and Kalimantan (Gerber 2011p. 4). Converting customary *(adat)* land to be palm oil plantation leads dispute between indigenous people and palm oil plantation companies.

Planting and producing palm oil and its derivatives have pros and cons. Its impact on Indonesia could be beneficial and harmful respectively. This research will find the link between economic and environment impact of palm oil in Indonesia, since palm oil not only enhances economic development for many provinces in Indonesia, but harms environment on the other side.

This research is relevant with Indonesia's condition recently, which economic interest overlaps with environmental issues. As a developing country with a huge population, Indonesia needs to boost its economy to increase the well-being of the inhabitants. Additionally, as a tropical country, Indonesia has abundant natural resources that will support its economy. On contrary, using natural resources as main source of national revenue causes ecological problems, such as greenhouse gas emission, reducing of biodiversity, land erosion, disturbing local livelihoods and tourism destination, flood, aridity and forest fired. For example, land-clearing process to open palm plan-

tation produces huge air pollutant that affect other countries like Singapore and Malaysia since it used fire to clear the forests. Furthermore, since tropical rainforests are home to more than 3,000 known species of animals, and 29,000 species of plants, and the livelihoods of 50-60 million people, the ecological issue become important to consider (World Research Institute 2017).

This issue can be said as developing country dilemma, save the forest or boosting economic growth? Since Indonesia has one of the biggest rainforest in the world , Indonesia's environmental issue can affect the rest of the world. That is why this issue need to be considered. This economic and environmental issue is a major notice of United Nations' Sustainable Development Goals (SDGs), which has purpose to keep the Earth safe and to maintain well-being of its inhabitants.

Due to pros and cons palm oil production in Indonesia, this study will examine the relation of oil palm production on regional economic growth and regional unemployment. Additionally, this research will analyse the relation between oil palm production and environmental degradation as well.

1.2 Research Objectives

As oil palm industry is valuable commodity to Indonesia, its affect Indonesia's economy. Furthermore, the expansion of oil palm in inevitable. This condition is beneficial for its economy, however, it has potential damage for the environment. Thus, this phenomenon will be intriguing to consider. Hence, this paper has aim to describe the relation of oil palm development to economic and environmental performance in Indonesia.

1.3 RESEARCH QUESTIONS

To reach this objective, the research questions will focus on:

1. How is the correlation between palm oil production in Indonesia and regional economic growth?
2. How is the correlation between palm oil production in Indonesia and regional unemployment?
3. How is the correlation between palm oil production in Indonesia and regional environmental impact?

This research will use official secondary quantitative data. In doing this upcoming research, this paper utilise panel data regression analysis on all 34 provinces in Indonesia for period 2007 until 2017. All of the variables will be in provincial level. This study will examine correlation between oil palm plantation and oil palm production to regional economic growth and unemployment. Lastly, it will also analyse correlation between oil palm plantation and oil palm production to environmental impact. This study will focus on economic and environmental performance regarding oil palm industry. However, the focus of environment performance is only on forest, water and air quality (its coverage on regional environment quality index).

1.4 CONTRIBUTION TO THE LITERATURE

The existing of palm oil is intriguing to debate, since it contains pros and cons. In Indonesia, economic side of oil palm will be preferable to reveal than its environmental side. There are many studies regarding oil palm development. However, some previous studies only focus on it benefit for the economy. Other researches only concern on its social effect and impact on environment. Since Indonesia is a biggest producer of palm oil, a lot of studies took Indonesia as sample. Moreover, some prior studies took only some provinces or municipalities or even villages as sample. They took qualitative data and did field research in those area. It can be said that only few studies concern on both environmental and economic together. In addition, some previous study concern on specific area or region only.

This study tries to explore the relation of oil palm development with both economic and environmental performance. It is important to look for both point of view because the environmental degradation should be concerned not only economic benefit. However, since this study only uses quantitative data, it will be focused on environmental issues regarding air, water and land cover quality and economic performance. Social effect will be excluded because of limited availability of secondary data. Furthermore, the sample of the research employed all of provinces in Indonesia, because almost all of provinces in Indonesia is developing oil palm recently. Thus, this study offers more comprehensive oil palm development research because it estimates economic and environmental performance from all provinces in Indonesia using panel data analysis.

1.5 STRUCTURE OF THE RESEARCH PAPER

This research is divided into six chapter. Next chapter provides context of Indonesia. It explains the history of oil palm in Indonesia and background of analysis regarding the role of oil palm, especially for economic performance and how is it influence the surrounding environment.

Chapter 3 discusses theoretical framework, which explain prior studies related oil palm. This chapter also provides empirical evidence examined by previous research.

Chapter 4 explains about the methodology used in this research. Besides that, it elaborates the econometric model, variable description, and correlation matrix. Additionally, source of the data is found in this chapter as well.

Next, chapter 5 elaborates research's finding. Furthermore, it analyses the finding more briefly.

Lastly, chapter 6 presents conclusion. This chapter concludes the finding of the research. It also suggests policy recommendation. Then, based on the finding, it revealed limitation of this study. Finally, according to the result and limitation of this research, it will lead to future research possibility.

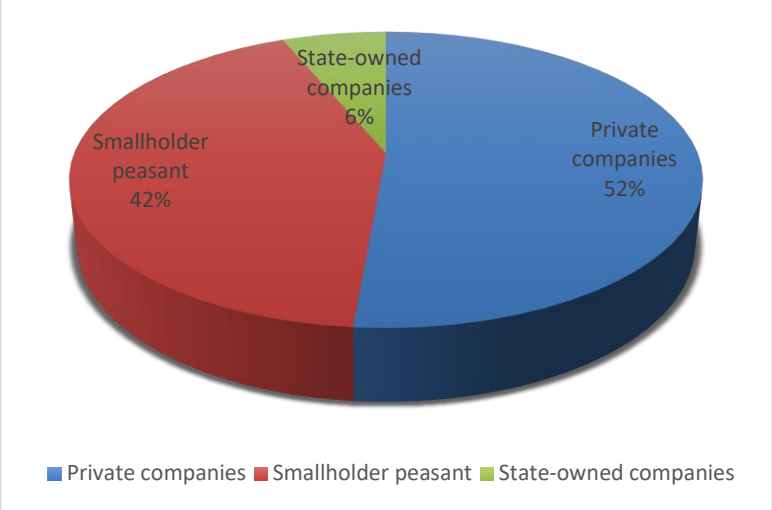
CHAPTER 2
CONTEXT OF INDONESIA

2.1 History and Recent Trends of Indonesia's Oil Palm Plantations

Oil palm cultivation spreads almost across the entire country. The history of development oil palm plantation in Indonesia started since Dutch colonisation. According to Poku (2002), palm oil or *Elaeis guineensis* is originally from West Africa. In 1848, the Dutch brought four oil palm seeds from Amsterdam and Reunion Island to Buitenzorg Botanic Garden, Java, Dutch East Indies (now Indonesia). By 1911, oil palm introduced as commercial plantation. The Dutch developed the first oil palm plantation in Deli, North Sumatra. Oil palm plantation in Sumatra grew rapidly in 1925 up to 31,500 ha. However, it decreased gradually until 1980's (Corley and Tinker 2008). By 1980's, the government focused on rural economic development through transmigration programme. In the late 1980's, for the first time, the government supported trans-migrants to cultivate oil palm in their field in Jambi, Sumatra (Gatto et al. 2015). This programme has aim to develop oil palm.

There are three type of oil palm plantation ownership. Oil palm plantation can be owned by private sector, state-owned company and smallholder peasant.

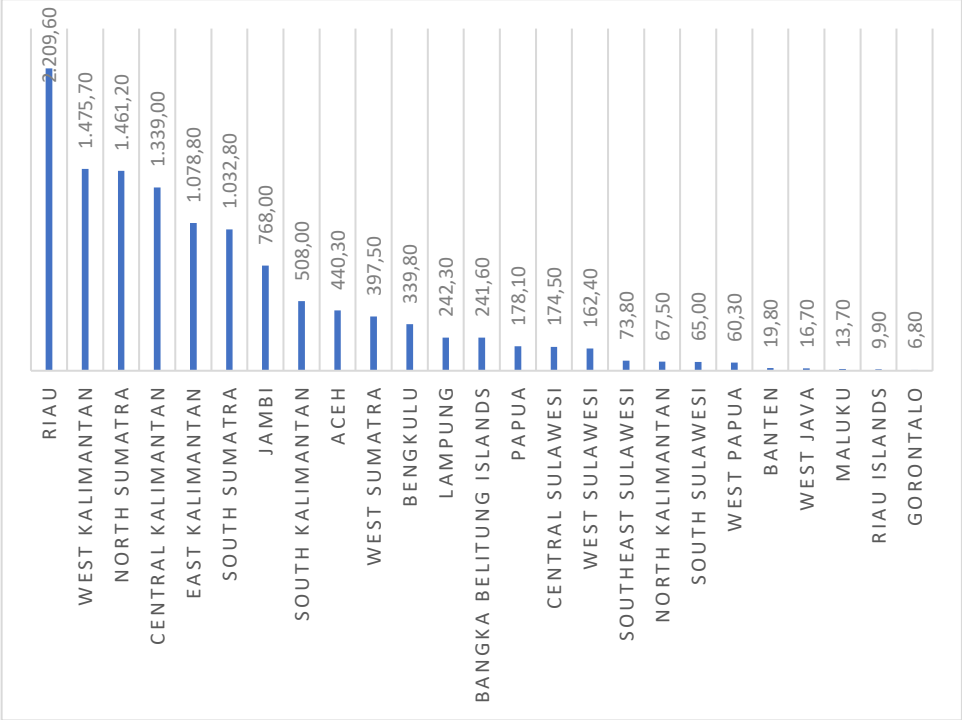
Figure 1 Types of ownership of oil palm plantations in Indonesia



Source: Statistics Indonesia (2018b)

Figure 1 illustrates types of ownership of oil palm plantations in Indonesia in 2017. By 2017, big private companies have 51.37% (5.75 million hectare), smallholder peasants have 42.31% (4.74 million hectare) and state-owned companies have 6.32% (0.71 million hectare) (Statistics Indonesia 2018b).

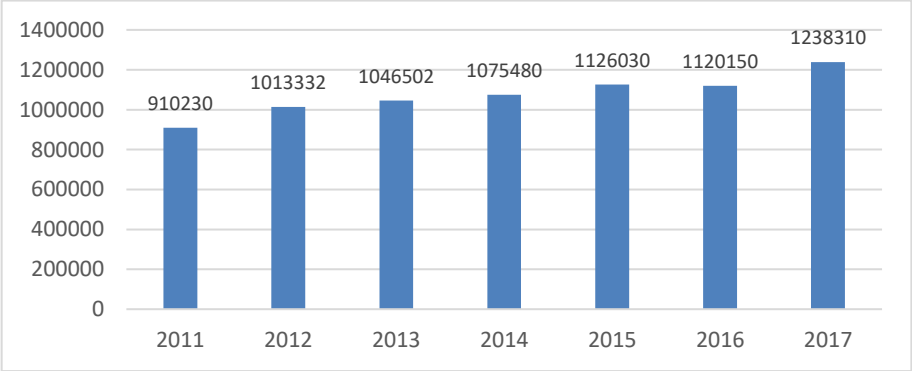
Figure 2 Oil palm plantations in Indonesia per provinces in thousand hectares (2017)



Source: Statistics Indonesia (2018b)

Figure 2 shows oil palm plantations area in 25 provinces in Indonesia. According to Statistics Indonesia (2018b), Riau, a province in Sumatra island has the largest oil palm plantations area in Indonesia. Conversely, the smallest oil palm plantation area is Gorontalo in Sulawesi island. The majority of the oil palm plantation area are in provinces lied in Sumatra island (Riau, North Sumatra, South Sumatra, Jambi, Aceh, West Sumatra, Bengkulu, Lampung, and Bangka Belitung Islands). Beside Sumatra island, Kalimantan island produces high amount of palm oil as well. Almost all of the provinces in Kalimantan island (West Kalimantan, Central Kalimantan, East Kalimantan, South Kalimantan and North Kalimantan) produce palm oil. Historically, oil palm firstly developed in Java. However, recently, there are only two provinces cultivate oil palm in Java island, which are Banten and West Java. Additionally, oil palm plantation could not be found in Bali and Nusa Tenggara because of limited area in those islands. Totally, Indonesia has 12,383.10 thousand hectares area of oil palm plantation by 2017.

Figure 3 Area of oil palm plantations area in Indonesia from 2011 to 2017 (thousand hectares)

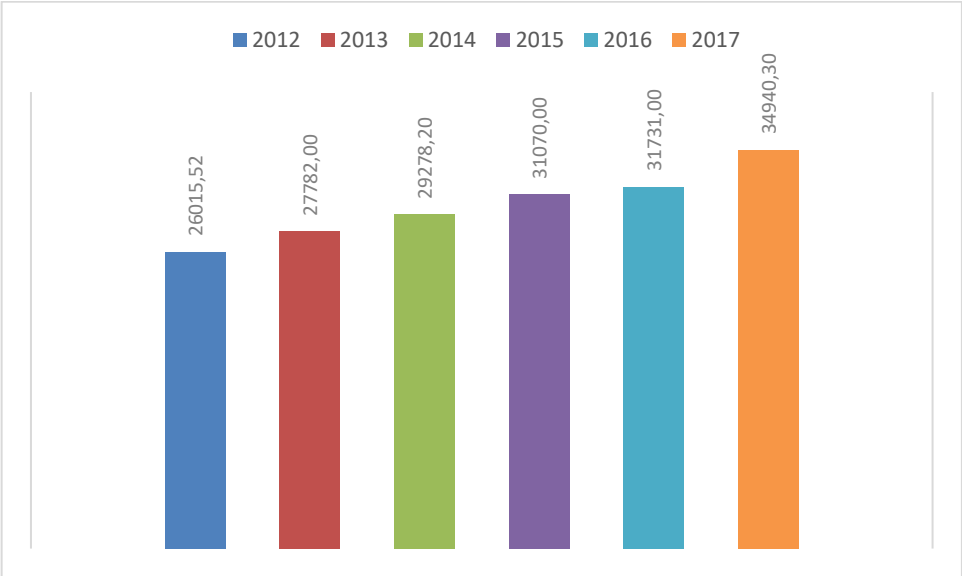


Source: Statistics Indonesia (2011-2017, compiled)

Figure 3 presents the growth of oil palm plantation in Indonesia since 2011 up to 2017. As can be seen in this graph, oil palm plantation rose gradually during the six years. The area of oil palm plantations are slightly reduced from 2015 to 2016.

2.2 Oil Palm Production

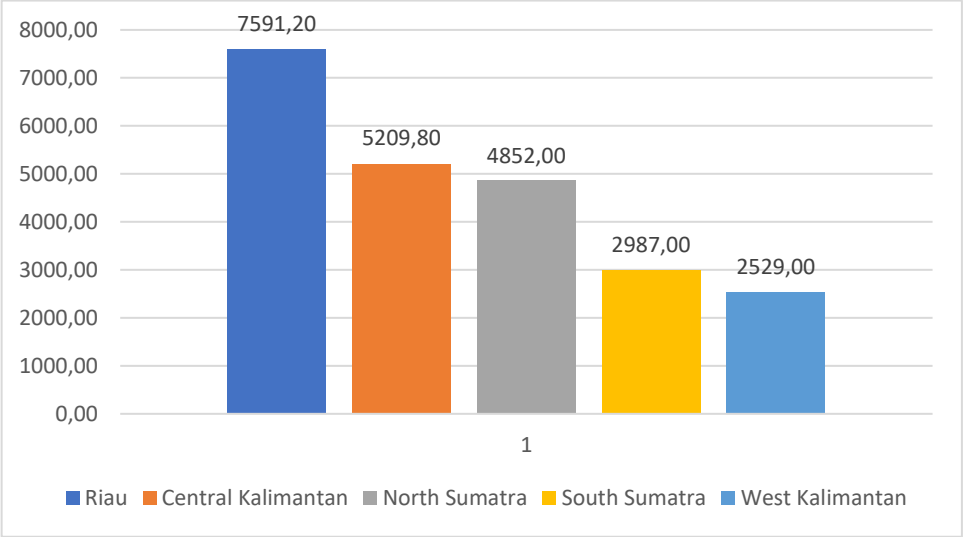
Figure 4 Indonesia's oil palm production 2012 to 2017 (thousand tons)



Source: Statistics Indonesia (2012-2017, compiled)

Figure 4 shows Indonesia's oil palm production from 2012 to 2017 has increased gradually. Since 2012, Indonesia become the largest producer palm oil in the world with production more than 25,000 thousand ton.

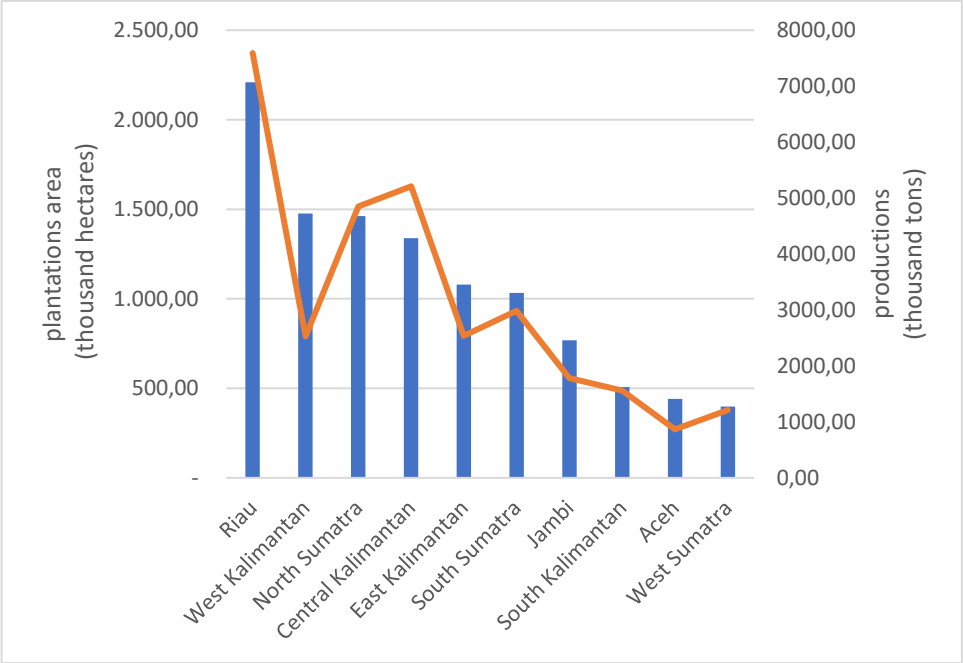
Figure 5 Top five provinces palm oil producers in Indonesia 2017 (thousand tons)



Source: Statistics Indonesia (2018)

Figure 5 illustrates five provinces biggest producers palm oil in Indonesia in 2017. According to Statistics Indonesia (2018b), Riau is the largest oil palm producer in Indonesia, that produced 7,591.20 thousand ton of palm oil. It means Riau is the biggest palm oil producer and the largest oil palm plantation in Indonesia.

Figure 6 Top ten provinces oil palm plantations and its amount of palm oil produced (2017)



Source: (Statistics Indonesia 2018b)

Figure 6 presents ten provinces that produce majority of total Indonesia's palm oil production. All of the provinces lie in Sumatra (Riau, North Sumatra, South Sumatra, Jambi, Aceh and West Sumatra) and Kalimantan (West Kalimantan, Central Kalimantan, East Kalimantan and South Kalimantan). The graph shows that Riau, a province in Sumatra island produces the highest amount of palm oil and cultivates the largest oil palm plantations in Indonesia.

2.3 Facts of Oil Palm Development in Indonesia

Oil palm plantation and production can be found in 25 provinces in Indonesia. Palm oil supports national revenue through exports and tax. Herewith the facts regarding oil palm development in Indonesia regarding economic and environmental performance, as follows:

1. By 2017, export of oil palm products and its derivatives reached 29.07 million tons, and similar with US$20.72 billion (Statistics Indonesia 2018b).
2. To support national revenue, there are some taxes obtained from oil palm plantation and oil palm production, like individual income tax, land and building tax (including estate tax), corporate income tax, value added tax and exports tax. However, based on Tax Law 28/2007 regarding general provisions and tax procedures, only individual income tax and estate tax has direct support to regional revenue. Some of the oil palm companies are intra-enterprise linkage, which integrated in their head companies. Furthermore, most of those companies registered as large and medium taxpayer in large and medium tax offices. It means, they have to do their tax obligation in large and medium tax office, not in regional tax office. Therefore, the tax paid by them cannot be accounted as regional revenue.
3. As a strategic national industry, oil palm sector contributes to alleviate unemployment. By 2016, around 15 million people were involved in this industry (Ministry of Agriculture 2016). Thus, oil palm industry increases a lot of job opportunity for Indonesian people, particularly in rural area. Most of the number of employments

has been absorbed in oil palm plantation, not in oil palm mills. However, it is not clear the percentage of local employment included in oil palm sectors.

4. Indonesia has been commited to implement REDD+ (reducing emission from deforestation and forest degradation) since 2009(CIFOR. 2012)

CHAPTER 3
LITERATURE REVIEW

This chapter provides the literature reviews used in this study. In addition, it is also completed with empirical evidences. It consists of previous studies and empirical evidences regarding oil palm development and its relation to economic and environmental performance.

3.1 Theoretical Framework and Empirical Evidence on Palm Oil and Economic Growth

This study examines the relation of oil industry and economic development. As a developing country, Indonesia is still depending on primary sector, such as farming, fishing and forestry to expand its economy. Additionally, as a tropical climate country, Indonesia is rich in natural resources such as large rainforest and fertile soil. According to Rostow (1990 pp. 8), in the second stage of development, there will be commercial exploitation of agriculture and extractive industry. In this stage pre-condition to "take off", the aim of commercialised agriculture is not only for self-sufficient consumption, but also export-oriented.

As a tropical country, Indonesia's land is suitable for some industrial tree plantations, including oil palm (Poku 2002). Hence, it encourages cultivation, not only for food crops, but also for exported-oriented tree product, such as palm oil. As exported-oriented tree product, palm oil contributes to the economy as source of foreign exchange. During the Asian financial crisis 1997 in Indonesia, palm oil helped Indonesia to collect more foreign exchange. Exporting oil palm could be solution to earn foreign exchange. Moreover, palm oil and its various derivatives produce not only food products but also oleochemical, pharmaceutical and cosmetics products with competitive price. The contribution of foreign exchange from palm oil's export increases national revenue. Similarly, export of palm oil increases export tax, which enhances national revenue as well.

In addition, the multiplier effects of oil palm plantation and production push the regional economy. For instance, oil palm expansion brought multiplier effect in Papua, Indonesia by 1.55 (Obidzinski et al. 2014 pp. 1186). Using input-output model, this research calculated US$ 9.7 billion of an investment will lead to output US$ 15.0 billion in Papua, Indonesia. It appears that oil palm expansion has positive effect in Papua. Furthermore, other study in North Sumatra by Muda, Iskandar (2018) used explanatory survey and quantitative method. They utilised trade value and economic turnover as population and sample and secondary data from Statistics Indonesia from 2000 to 2015. They found that palm oil industry from palm oil fatty oil does not affect regional economic growth in North Sumatra. However, palm oil industry from palm oil derivative product is significantly correlated to economic growth in North Sumatra. This study seems resulted different effect to regional economic growth depend on type of palm oil product. The research in Guatemala (Dürr 2017) employed primary data from agricultural producers and other stakeholders regarding sugar cane and oil palm plantations found that palm oil contributed less benefit to regional economic growth. This result found in Guatemala because palm oil sector is associated with main intra-enterprise network, which centralised their profit vertically. Thus, this profit is less possible to be benefited in regional level.

In conclusion, oil palm development has various effect to economic growth, especially in regional level.

3.2 Theoretical Framework and Empirical Evidence on Unemployment

A study by Casson (2000 pp. 8) mentioned that economic benefit of oil palm is foreign exchange source and job opportunity. It seems that palm oil has role to overcome unemployment. Furthermore, there are 6 million people involved in 6.2 million hectares oil palm plantation in Indonesia (Goenadi 2008). Oil palm plantations offer job opportunity to the local population. In addition, palm oil is a labour-intensive sector (Casson 2000). Oil palm plantation needs 91 of labours per hectare in average in one production cycle or 25 years (Budidarsono et al. 2011). Assuming for 1000 hectares of oil palm plantation, it will need 91,000 workers per year**.** This number is quiet a lot for regional level.

However, Abdullah et al (2011) examined by 2010, around 69% of the oil palm plantation workers in Malaysia were foreigners, and only 31% were locals. Foreigner workers did labour intensive fields like harvesting, collecting fruits and other general works. It is likely foreigner workers only did low skill job in the oil palm plantation. In Indonesia, the condition is different. There were only low skill labours provided by local communities. In addition, training local workers is not the choice for the oil palm investor. In the case of Papua's oil palm plantation, importing outside workers is more effective (Obidzinski et al. 2012). Thus, in aggregate, oil palm plantation is potentially reducing unemployment, however it depends on the knowledge and skill of the potential workers in each region.

A research in Guatemala showed that palm oil industry enforce fewer job opportunity for regional level compare to other small-scale agriculture (Dürr 2017). This study used primary data came from agricultural producers and their backward and forward sectors in agriculture. As large-scale agriculture, palm oil industry usually integrated to intra-enterprise network, thus their profit transferred out from the oil palm plantation region. This means that there is less advantage for local people, especially for job creation.

It is likely oil palm industry has different impact on alleviating unemployment in regional level.

3.3 Theoretical Framework and Empirical Evidence on Environmental Impact

Despite all of the multiple economic benefit, oil palm expansion creates environmental consequences. Agriculture activity, urban area enlargement, upgrading agricultural production and other human activity done by removing tropical forest massively (Foley et al. 2005). Still according to Foley et al. (2005 pp. 570), there are several impact on the environment regarding land use in the Earth. Climate changes is also resulted from land use activity, especially in regional area. Land use also affects freshwater providing for human daily activity, industry and agriculture. The changing of air and water quality was promoted by using fertilizer in land use activity. Furthermore, land use activity give impact on losing biodiversity, soil deterioration, and disturbing native species. One of land use is changing forest into plantation or agriculture activity.

Oil palm production activity is claimed as environmental changing acceleration (Koh and Ghazoul 2008). Oil palm, along with timber and logging industries are responsible for land cover changing through fire activity that causing haze exposure for the surrounding (Marlier et al. 2015a). However, oil palm claimed as eco-friendly because as perennial crops, this crop provides forest cover for 25 years (Basiron 2002). Additionally, fact of oil palm industry in Malaysia as researched by Alam et al. (2015) claimed that industry of oil palm is more eco-friendly compared other oil industries. Oil palm industry used land less than soybeans oil industry. Land usage by oil palm industry is 8.5 million hectares compared to land usage by soybeans oil industry 58 million hectares. It means, the smaller the plantation size, the fewer land use changing activity. In addition, as perennial crops, oil palm plantation provides forest cover for 25 years compared to oilseeds (Basiron et al. 2004 pp. 9). However, oil palm plantation as a result of change of land use only support less biodiversity than the natural forest, then it impact on regional biodiversity (Fitzherbert et al. 2008). In Indonesia, most of the oil palm plantation is a result of land use change activity from rainforest into commercial plantation. Land use change such as deforestation, converts forest to plantation and causes environmental degradation, that affect air, water and soil quality and other socio-economic effect. However, this study only focuses on empirical evidence of impact of oil palm industry on forest, soil, air and water quality.

The expansion of oil palm industry is claimed as major driver of deforestation, because of global demand of biofuel and palm oil products (Fitzherbert et al. 2008). During ten years, from 2000 to 2010, oil palm expansion has caused 11% of Indonesian deforestation (Lee et al. 2014). However, study by Abood et al. (2015) said there are four industries contributed to forest deterioration in five islands in Indonesia (Sumatra, Kalimantan, Sulawesi, Moluccas and Papua). According to this study, oil palm industry recorded as number three as the cause of deforestation[1], and number two of carbon dioxide emissions[2]. This study used maps of spatial resolution land cover classification to measure the losing forest for the period 2000 to 2010. Thus, oil palm industry is not the main actor of deforestation in Indonesia. Even though oil palm industry is not the major actor of deforestation, according to Wicke et al. (2011), there were more or less 40 million hectares of forest convert to oil palm plantation during

[1] Number one is fiber plantation and number two is logging concession (Abood et al. 2015)
[2] Number one is fiber plantation (Abood et al. 2015)

30 years since 1975. Oil palm plantation replaced the abundant of biodiversity and diverse of landscaping in tropical forest in Sumatra and Kalimantan. Well, this conversion causes losing of biodiversity in this region. Hence, oil palm industry has contribution to deforestation and losing of biodiversity in Indonesia.

3.4 Oil Palm and Health

Oil palm industry is not only well-known in Southeast Asia, but also in its original place, Africa. As well as in Southeast Asia, beside its economic benefit, environmental impact is still main issue. A research conducted by Ohimain et al. (2013) found that there is public health issue regarding processing of palm oil by smallholders. The boiling process of palm oil produced the emissions, which significantly higher than fossil diesel. The boiling and digestion process produce carbon monoxide (CO). In addition, digestion process produces noise as well. However, the worst air pollutant occurs only in the manually process of oil palm mill by smallholders, not in large oil palm mills. Due to the carbon monoxide produced from the palm oil process, some diseases detected, such as dizziness, headache and nausea.

Another study in Malaysia focused on water used during processing of oil palm extraction (Ahmad et al. 2003). According to this research, large quantities of water used during extraction process of palm oil. This process produced 50% of water contains in palm oil mill effluent (POME), which is a liquid contained of oil and grease, chemical oxygen demand and biochemical oxygen demand. Those waste will be a problem without properly treatment because it contains chemical. However, using technological treatment, the water can be recycled back and use to internal process of palm oil extraction. It can be said that without high treatment, large quantities of disposal water will be waste and spread water pollutant for the surrounding.

Another environmental impact on land clearance of oil palm plantation is air pollutant causing from haze or smoke. Establishing oil palm plantation, industrial wood plantation and rubber need effectivity land clearance processesing. Many Indonesian plantation used fire as cheapest and fastest method to clear land (Dauvergne 1998). However, according to this study, the fire destroyed the entire forest, including national park. Moreover, the fire generated smoke, which source of air pollutant and the fire spread across the country and it neigbourhoods. The fire forest in Sumatra and Kalimantan produced air pollutant exposed until Singapore and Malaysia. A research by Dauvergne (1998) said by 1997, around 200.000 people in Indonesia, Malaysia and Singapore need medical treatment because of this air pollutant from smoke. The air pollution index exceeded until 800 during September and October 1997. Many places hold their activities, for example school and government offices. Similarly, port and airport were temporary closed because it dangerous for health. Over one decade later, the transboundary haze case still happened. Indonesia's smoke exported to Malaysia and Singapore unintentionally. However, ironically, Malaysian and Singaporean investors are the actor behind this tremendous fire cases. Around two third of oil palm plantation controlled by investor from Malaysia and Singapore (Varkkey 2012). Varkkey (Varkkey 2012) argued that due to the fire case, regionalised oil palm industry in Southeast Asia is bad for the environment. In addition, the transboundary haze included patronage politic, who interrupted regional Southeast Asia economy as well. This study seems figure out that the haze case in Southeast Asia is transboundary problem, since it included transboundary actors. The haze disaster was getting worse because in Indonesia, land use change into oil palm cultivation not only forest, but also peatland that rich of carbon. Therefore, the land clearance process increased greenhouse gas emissions (Koh and Ghazoul 2008).

The impact of oil palm industry on health is important recently. However, this study will only focus on environmental parameter such as quality of water, air and land cover through environment performance index.

3.5 Economics Vs Environmental

There are several studies regarding interaction of human and environment. One of them comes from Malthus (1878) stated that population of human grow exponentially, however,

food production increase arithmetically. Hence, there will be shortage of food for the population. There should be interruption from human to the resources. Other finding said by Hardin (1968), pointed that resources available for all well-being, but there is overconsumption by someone that causes disadvantage for well-being in the society. One of the solutions is government regulation. In the sense of oil palm case, the global demand of oil palm products is good opportunity for Indonesia to boost economic growth. The internal demand comes from more than 200 million Indonesian people and global demand encourage the expansion of oil production. Exporting oil palm products and its derivatives, including biofuel will increase national revenue through foreign exchange and export tax. In addition, expansion in oil palm industry promotes alleviation unemployment and enhance infrastructure in regional level. However, there is a limitation of land and resources to fulfil the demand and catch its economic benefit. Moreover, massive expansion of oil palm industry resulted inevitable environment impacts, like deforestation and deterioration of water and air quality.

3.6 Theoretical Framework and Empirical Evidence on Control Variables

3.6.1 Investment

Investment and economic growth have close relation. While investment is not main point in this paper, since it is a control variable to both dependent variables: gross regional domestic product (GRDP) per capita and unemployment rate. Firstly, investment has a major impact on income growth (Blomstrom et al. 1993 pp. 14). This research applied simple regression and multiple regression, using time dimension between 1965 to 1985 for more than 100 countries. Furthermore, another research argued that investment in land in large scale will give positive impact on reducing unemployment and development in rural area (Deininger and Byerlee 2011). Large-scale investment in land needs more workers to manage, thus it will drop unemployment.

3.6.2 Education (Years of schooling)

High level education will reduce risk of unemployment is the advantage of education (Mincer 1991). It means years of school attainment is matters to reduce unemployment. Regional unemployment caused by insufficient capability of human capital in its region. Hence, it needs higher education to catch up. Perhaps, the longer years of schooling could help. However, the lower education worker will not move to high education unemployment area (Jurajda and Terrell 2009). Therefore, oil palm plantation created a small number of job (Dürr 2017). Perhaps, according this study, oil palm company is part of intra-enterprise network, which means it can employ skilled workers from outside the oil palm plantation region. Thus, local unemployment will get difficulties to gain job. Hence, year of school attainment become matter to produce skilled labours.

3.6.3 Human development index

Economic growth and human development index is correlated. Based on study by Ranis et al. (2000), the economic performance has highly correlation with human development index. This study uses cross country data and found significant finding between them. Human development index measured health, education and living standard. However, perhaps in regional level, the relationship could be different. The study using regional level as observations said that infrastructures (as resulted of economic growth) has significant correlation to human development index (Kusharjanto and Kim 2011). However, the significance result could be found in relation of road and

human development index, the other infrastructures like water and electricity showed different result. In addition, this study only used Java as sample, perhaps, the result will be different since other islands in Indonesia have different level of development.

3.6.4 Number of motor vehicle

There is an argument that most of air pollution produced by forest fires in Sumatra and Kalimantan (Rosenberg 1999). However, this study also confirmed that motor vehicle has contribution to air pollution, especially in South China Sea coastline. Another research found the similar finding in Indonesia. It said motor vehicle is one of the most air pollutant triggered (Santosa et al. 2008). Although number of motor vehicle seems have been responsible for the air pollutant, other study also mentioned not only motor vehicle but also industrial activity as triggered of air pollutant (Hopke et al. 2008). Therefore, it seems the number of motor vehicle also generated air pollutant along with forest fire and industrial activities.

3.6.5 Production of log forest concession

Since some of oil palm estates lie in land use change of forest, it accused as forest lost triggered. Generally, changing forest to be plantation mentioned as causes of deforestation (Angelsen 1995). Shifting the forest become cultivation area needs some land cover change activity, however, the affordable one is using fire. A study showed using fire to clean the forest resulted environmental problem such as air pollutant and fire emission (Marlier et al. 2015b). There are a lot of purposes of land use change, not only for oil palm estate, but also for other cultivation such as timber and logs. Based on Abood et al. (2015), oil palm cultivation is not the only triggered for deforestation. Logging concession and fiber plantation have stronger magnitude to cause forest lost. Logging concession was number one leader of deforestation. The second place was fiber plantation and the third one was oil palm cultivation. Thus, production of log concession contributes to environmental damage, in particular for land cover change.

3.7 Economics Vs Environmental

There are several studies regarding interaction of human and environment. One of them comes from Malthus (1878) stated that population of human grow exponentially, however, food production increase arithmetically. Hence, there will be run out of food for the population. There should be interruption from human to the resources. Other finding said by Hardin (1968), pointed that resources available for all well-being, but there is overconsumption by someone that causes disadvantage for well-being in the society. One of the solutions is government regulation. In the sense of oil palm case, the global demand of oil palm products is good opportunity for Indonesia to boost economic growth. The internal demand comes from more than 200 million Indonesian people and global demand encourage the expansion of oil production. Exporting oil palm products and its derivatives, including biofuel will increase national revenue through foreign exchange and export tax. In addition, expansion in oil palm industry promotes alleviation unemployment and enhance infrastructure in regional level. However, there is a limitation of land and resources to fulfil the demand and catch its economic benefit. Moreover, massive expansion of oil palm industry resulted inevitable environment impacts, like deforestation and deterioration of basic needs quality.

To sum up, environmental impact on oil palm industry is major problem. This industry affects almost all of the environment like air, water and soil quality. Cultivating

oil palm is step forward into the environmental degradation. However, it contribution to economic performance could not be avoided.

CHAPTER 4
METHODOLOGY

This chapter has four sections. First part is econometric model used in this study to measure the relation of economic and environment performance regarding Indonesia's oil palm industry. Secondly, data sources to support the empirical evidence in this study. Thirdly, descriptive statistic that summarises all of the variables used in this study. Lastly, variables employed in the panel data regression and its measurement.

4.1 ECONOMETRIC MODEL

To investigate the relationship between oil palm production in Indonesia and regional economic growth, correlation between oil palm production in Indonesia and regional unemployment and relation between oil palm production in Indonesia and regional environmental impact, this study combines cross section data and time series data, called panel data analysis. According to Gujarati (2003 pp 637), using panel data analysis will be more efficient, because of less degree of freedom and less collinearity. Combining cross section data and time series data means more information and variation of the data. In this case, cross section data comes from regional data of economic growth, unemployment and environmental impact.

Specification model in this study
Model 1

$$Unmply = \alpha + \beta_1 palm\_oil\_plant + \beta_2 palm\_oil\_prod + \varepsilon_1$$

Model 2

$$Econ\_grwth = \alpha + \beta_1 palm\_oil\_plant + \beta_2 palm\_oil\_prod + \varepsilon_1$$

Model 3

$$Env\_impct = \alpha + \beta_1 palm\_oil\_plant + \beta_2 palm\_oil\_prod + \varepsilon_1$$

Where

$Unmply$	= regional unemployment rate
$Econ\_grwth$	= gross regional domestic product (GRDP) per capita
Env_impct	= regional environment quality index
Palm_oil_plant	= land area oil palm plantation in regional level
Palm_oil_prod	= total oil palm production in regional level
a	= intercept
β_1 *and* β_2	= coefficient of independent variables
ε_1	= error term

This study examines correlation between oil palm plantation and oil palm production to gross regional domestic product (GRDP) per capita and unemployment rate. In addition, it analyses correlation between oil palm plantation and oil palm production to environmental quality index as well.

4.2 DATA SOURCES

This research uses secondary quantitative data from official institutions and organisations such as Statistics Indonesia, World Bank, Ministry of Agriculture, Ministry of Environment and Forestry, Ministry of Finance, Ministry of Trade, and Ministry of Industry. All data used in this study are in provincial level. This research uses data from 2007 until 2017 in provincial level. This table below presents more details of the data sources for respective variable.

Table 1 Data Source

Data	Description	Source
Gross Regional Domestic Product (GRDP) per capita, constant price	a statistic that measure the region's size of economy using price based on certain year (2010)	Statistics Indonesia (published year 2007 to 2018)
Unemployment rate	percentage of unemployment to the labour force	Statistics Indonesia (published year 2007 to 2018)
Environmental quality index	an index of environmental performance management using parameter like water quality, air quality and soil quality	Ministry of Environment and Forestry (published year 2007 to 2018)
Oil palm plantation	Oil palm plantation area per province	Statistics Indonesia (published year 2007 to 2018)
Oil palm production	Production of palm oil per province	Statistics Indonesia (published year 2007 to 2018)
Human development index (HDI)	An indicator to measure improvement in human life, such as long and healthy life,	Statistics Indonesia (published year 2007 to 2018)

	knowledge and standard of living	
Total Investment	Amount of money invested by both foreign and domestic investors	Statistics Indonesia (published year 2007 to 2018)
Years of schooling	Length of school year attainment	Statistics Indonesia (published year 2007 to 2018)
Number of motor vehicle	A number of motor vehicle	Statistics Indonesia (published year 2007 to 2018)
Production of logs forest concession	Production of logs in forest concession	Ministry of Environment and Forestry (published year 2007 to 2018)

4.3 VARIABLES

There are three categories variables used in this research, as follows: 1). independent variables; 2). dependent variables and 3). control variable. In addition, to run panel data analysis regression, some adjustment needed for some variables.

4.3.1 Dependent Variable

This research will analyse three dependent variables as follows:

1. Gross regional domestic product (GRDP) per capita

Gross regional domestic product (GRDP) per capita is one of the significant indicators of economic growth. According to Statistics Indonesia, gross regional domestic product (GRDP) per capita is amount of value added produced both goods and services by all of business unit in certain region. This study uses gross regional domestic product (GRDP) per capita based on constant prices. Since the data starts from 2007 to 2017, there is an adjustment for constant prices base. Previously, for year 2007, 2008, 2009, and 2010 used constant price base of year 2000, then it should be adjusted to be constant price base of year 2010. This research uses growth of gross regional domestic product (GRDP) per capita (expenditures) in provincial level. The data comes from Statistics Indonesia for 34 provinces from 2007 to 2017 in percentage form. This study expects positive relation of gross regional domestic product (GRDP) per capita and oil palm plantation and oil palm production.

2. Unemployment Rate

Statistics Indonesia adopted definition of unemployment from ILO (International Labour Organisation). It means unemployed workers are those who are willing to work or able to work, including people who are currently looking for job. According to Statistics Indonesia, unemployment rate is percentage of the number of unemployment and the number of working forces. This study uses data from Statistics Indonesia for 34 provinces from 2007 to 2017 in percentage form. The result expected from this variable is negative. Negative correlation between oil palm plantation and oil palm production means when oil palm plantation and oil palm production increase will reduce unemployment rate.

3. Environment Quality Index

This study only limits environment impact of oil palm plantation and oil palm production on water quality, air quality and land cover quality. Thus, to measure water quality, air quality and land cover quality, environmental quality index is needed. According to Ministry of Environment and Forestry, Indonesia uses environmental quality index adopted from Virginia Environmental Quality Index. This study utilises regional environmental quality index. The indicator to measure is water, air, land cover quality and land cover. Its composed by Ministry of Environment and Forestry annually. The range of the index starts from 0 to 100, means less than 30 is alert and more than 80 is very good. The finding expected from this variable is negative correlation between oil palm plantation and oil palm production and environment performance index. It means that the increasing of oil palm plantation and oil palm production is lowering environment quality index.

4.3.2 Independent Variable

This study uses two independent variables: oil palm plantation and oil palm production. The details of these variables as follows:

1. Oil palm plantation

Oil palm plantation is the area of oil palm cultivated in regional level. According to the Ministry of Agriculture and Statistics Indonesia, oil palm plantation measured in hectare. Source of this data gain from Ministry of Agriculture as published by Statistics Indonesia for period 2007 to 2017. There are only 24 provinces in Indonesia have oil palm plantation. The expected result for this variable are: 1). Increasing of gross regional domestic product (GRDP) per capita, 2). lowering unemployment rate, and 3). reducing environment quality index.

2. Oil palm production

Oil palm production is the result of oil palm processing to be new product such as palm oil, oleochemical products, cosmetics, biofuel, etc. Usually oil palm production located near oil palm plantation. The data related this variable comes from Ministry of Agriculture as published by Statistics Indonesia annually. As well as oil palm plantation, the number of oil palm production only found in 24 provinces in Indonesia. The expected finding from this variable are: 1). Increasing gross regional domestic product (GRDP) per capita, 2). alleviating unemployment rate, and 3). reducing environment quality index.

4.3.3 Control Variable

4.3.3.1 Control Variable for Gross Domestic Product Regional

Control variable used in the model are total investment and human development index (HDI). Firstly, total investment consists of domestic direct investment and foreign direct investment. All of this item are in percentage of number of projects. Data regarding investment both foreign and domestic are from Statistic Indonesia. Investment is expected to encourage economic growth as indicated in number of gross domestic product. It means it should be positive relation between investment and gross domestic product in provincial level.

Secondly, human development index (HDI) is chosen as determinant of economic growth since it represents life expectancy, health and education. Data regarding

this variable comes from Statistics Indonesia. Human development index (HDI) is expected to push economic growth and it will be reflected in gross domestic products. Thus, expected sign for this variable is positive.

4.3.3.2 Control Variable for Unemployment Rate

As well as gross regional domestic product (GRDP) per capita, there are two control variables in this model. First is investment. Investment could be come from domestic and foreign. This study uses foreign direct investment and domestic direct investment. Both of them valued in United States dollar. The measurement for this variable is growth rate of total investment per year (in percentage). The investment data is from Statistics Indonesia. Investment should have effect to alleviate unemployment, thus the expected sign is negative.

The second control variable for unemployment is years of schooling. Years of schooling has been proven to determine unemployment. To run the regression, this study converts years of schooling in logarithm form. Data of years of schooling provided by Statistic Indonesia. The expected sign from this variable is negative, because, the longer years of schooling will contribute to reduce unemployment rate.

4.3.3.3 Control Variable for Environmental Quality Index

There are two control variables for environment quality index, number of motor vehicle and production of log forest concession. Both control variables' data sources from Statistics Indonesia. From both variables, the expected sign is negative. It means that increasing of oil palm plantation and oil palm production will reduce environment quality index. The number of motor vehicle will be in logarithm form. This proxy is important because the number of motor vehicle can be determinant that cause air pollution. The second variable is production of log forest concession in percentage. This study chose this variable because production of log forest concession is quite a lot to destroy the forest, meaning production of log concession could be accused as trigger of forest lost.

4.4 Description Statistics

The descriptive statistics shows of all variables used in this research. This descriptive statistics required to show the range and variation of the data set.

Table 2 Description Statistics

Variable	Observations (1)	Mean (2)	Std Deviation (3)	Min (4)	Max (5)
Gross Regional Domestic Product (GRDP) per capita	367	4.061961	2.485008	-8.039315	20.20307
Unemployment rate	366	6.199572	2.57479	1.484647	15.75437

Environmental quality index	364	66.32242	14.8762	0	99.65
Ln Plantation/Total surface	254	-3.382237	1.58526	-9.186453	-.3670668
Ln Plantation/Population	241	-3.12026	1.835768	-8.857831	-.4872257
Ln palm oil production/population	236	-2.362352	2.103944	-11.0823	.8570929
Ln palm oil price/population	236	4.297704	2.105932	-4.578882	7.380955
Ln years of schooling	368	2.057694	.1209186	1.720979	2.399712
Human development index	368	68.55223	4.300854	54.45	80.06
Production of logs forest concession	198	.1633279	1.349502	-1	10.62557
Total Investment	349	2.336687	13.57816	-1	185.2809

Column (1) presents the variation of observations in the data set. This column shows every variable have different number of observations. Column (2) illustrates the mean of every variable. There are three variables have negative sign. For the oil palm plantation the negative sign means fluctuation large area of oil palm plantation. From column (3), it seems that environmental quality index has the widest spread standard deviation compare to gross regional domestic product and unemployment rate and others variable. However, years of schooling (in logarithm form) has the least spread standard deviation compare to all variables.

4.5 Correlation Matrix

Table 3 Correlation Matrix

	Gross regional domestic products (GRDP) per capita	Unemployment rate	Environment quality index	Ln Palm oil plantation/total surface	Ln Palm oil plantation/population	Ln Palm oil production/population	Ln Palm oil price/population	HDI	Total Investment	Ln years of schooling	Ln number of motor vehicle	Production of log forest concession
Gross regional domestic products (GRDP) per capita	1.0000											
Unemployment rate	-0.0710	1.0000										
Environment quality index	0.0064	-0.1147	1.0000									
Ln Palm oil plantation/total surface	-0.0126	-0.2158	0.0907	1.0000								
Ln Palm oil plantation/population	-0.1195	-0.4455	0.3337	0.6690	1.0000							
Ln Palm oil production/population	-0.1448	-0.3918	0.2856	0.7019	0.9575	1.0000						
Ln Palm oil price/population	-0.1361	-0.3866	0.2841	0.6965	0.9526	0.9966	1.0000					
HDI	0.0095	0.3444	-0.2717	0.2740	0.0601	0.0722	0.0539	1.0000				
Total Investment	0.0582	0.0395	0.0729	-0.1425	-0.0184	-0.0412	-0.0359	-0.1568	1.0000			
Ln years of schooling	-0.0281	0.4153	-0.1390	0.2320	0.0634	0.0778	0.0632	0.7650	-0.1357	1.0000		
Ln number of motor vehicle	0.0244	-0.2214	-0.1108	0.2977	0.4897	0.4455	0.4357	0.4292	-0.0965	0.3713	1.0000	
Production of log forest concession	-0.0275	0.0911	-0.0871	-0.0751	-0.0639	-0.0428	-0.0510	0.0375	0.0868	-0.0186	-0.0819	1.0000

Source: STATA output

Table 3 displays the correlation matrix. If the two variables have more than 0.8, means that both variables are highly correlated and have almost linier relationship between them (Gujarati and Porter 2003).

It can be seen from this table some variables have highly correlation. First, oil palm plantation divided by total population and oil palm production divided by total population. Both variables are indicators of oil palm plantation and oil palm production. The other one is oil palm plantation divided by total population and oil palm price divided by oil palm population. Table 3 shows that most of the variable do not have high correlation each others.

4.6 Hausman Test

Hausman test used to examine the inconsistencies in the random effect model by comparing the slope parameter of fixed effect and random effect. The table below shows the result of Hausman test regarding all of dependent variables used in this study.

Table 4 Hausman test result

Dependent Variable	Hausman test result	Model
GRDP per capita	Prob>chi2 = 0.2455	Random effect model
Unemployment rate	Prob>chi2 = 0.0000	Fixed effect model
Environment quality index	Prob>chi2 = 0.0000	Fixed effect model

Table 4 presents the Hausman test examines best estimation for this panel data analysis regression. From table 4, it can be seen that the best estimation for gross regional domestic products (GRDP) per capita as dependent variable is random effect model (REM) because Prob>chi2 > 0.05. Furthermore, since for unemployment rate as dependent variable has Prob>chi2 < 0.05, best estimation is fixed effect model (FEM). As well as unemployment rate, best estimation for environment quality index is fixed effect model (FEM). Hence, in the next chapter, this study will employ random effect model (REM) for gross regional domestic product (GRDP) per capita. In addition, for both unemployment rate and environmental quality index will utilise fixed effect model (FEM).

CHAPTER 5
RESULTS

This chapter provides the finding and analysis of panel data regression regarding palm oil and economic and environmental performance. These results are the answers of the research questions in chapter 1. Firstly, it answers first research question regarding the correlation between gross regional domestic product (GRDP) per capita and oil palm plantation and oil palm production. Secondly, it finds the second question related relation of oil palm plantation and oil palm production with unemployment rate. Lastly, this study figures out the relation between environmental quality index and oil palm plantation and oil palm production.

In the first subsection, this study uses random effect model to run regression for gross regional domestic product (GRDP) per capita as dependent variable. Furthermore, this paper applies fixed effect model for unemployment rate and environment quality index. However, the second subsection shows alternative regressor result to complete this study.

5.1 Gross Regional Domestic Product (GRDP) Per Capita Empirical Result

This part focuses on regression result of gross regional domestic product (GRDP) per capita as dependent variable. This study employs gross regional domestic product (GRDP) per capita using random effect model (REM). The expected result for this regression is positive relation between gross regional domestic product and oil palm plantation Furthermore, there are two independent variables: oil palm plantation and

oil palm production. In addition, it supported with two control variables: human development index (HDI) and total investment. The regression result of gross regional domestic products (GRDP) per capita using random effect model is as follows:

Table 5 Gross Regional Domestic Products (GRDP) Per Capita using random effect model (REM)

VARIABLES	(1) GRDPpercapita	(2) GRDPpercapita
Ln (oil palm plantation area/total surface)	-0.101	
	(0.181)	
HDI	-0.0300	-0.0381
	(0.0550)	(0.0574)
Total Investment	0.0129	0.0132
	(0.0113)	(0.0116)
Ln (oil palm total price/population)		-0.256*
		(0.142)
Constant	5.480	7.513*
	(3.865)	(3.971)
Observations	246	229
Number of Provinces	25	24

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: STATA output

Table 5 shows empirical estimation for gross regional domestic product (GRDP) per capita. The measurement used for gross regional domestic product (GRDP) per capita is gross regional domestic product (GRDP) per capita using constant price as basis. Gross regional domestic product (GRDP) per capita measures its relation to oil palm plantation and oil palm production. Moreover, from the table, it can be seen that there are 246 observations come from 25 provinces cultivated oil palm in Indonesia. In column (1), as independent variable, oil palm plantation uses ratio of oil palm plantation area and total surface in each province as measurement. Column (1) shows the result of interaction between gross regional domestic product (GRDP) per capita and oil palm plantation. For this regression, this study utilises oil palm plantation area divided by total surface in each province (in logarithm form) as first regressor. Then adds it one by one with control variables. This study employs human development index (HDI) and total investment as control variable. Column (1) shows the result of this regression. This research finds evidence that for every increasing of 1 unit oil palm plantation area will reduce 0.101 unit of gross regional domestic product (GRDP) per capita, which means that there is no significant correlation between gross regional domestic product (GRDP) per capita and oil palm plantation. Probably this condition because of the practises of decentralisation under Law 33/2004 on fiscal balance between the central and regional government. This law said that profit sharing fund from tuition of forest concession paid by private estate (including oil palm plantation) companies is only 80% distributed for regional government.

Column (2) figures out the relation of oil palm production and gross regional domestic product (GRDP) per capita. In this sense, oil palm production measured by

total oil palm production in each province divided by population in its province. The expected result of this regression is oil palm production will have positive effect to gross regional domestic product (GRDP) per capita. However, it seems that using significance at 10% level, increasing of 1unit oil palm production will decrease gross regional domestic product (GRDP) per capita by 0.256 unit.

As well as oil palm plantation, human development index and total investment has no statistically significant association with gross regional domestic product (GRDP) per capita. Some large oil palm plantation and oil palm production in Indonesia owned by intra-enterprise linkage, which have been registered as taxpayer in Jakarta as central business. Thus, it obligation to pay corporate income tax and value added tax is integrated based on tax office they have registered. They only pay their individual income tax and estate tax in regional tax office, which amount of both taxes are less compare to corporate income tax and value added tax. This condition happened in other country as well, as researched in Guatemala (Dürr 2017). This study found that the linkage between oil palm plantation and regional development was too weak, because of they were part of intra-enterprise network.

5.2 Unemployment Rate Empirical Result

This section provides empirical result using unemployment rate as dependent variable.

Table 6 Unemployment using Fixed Effect Model (FEM)

VARIABLES	(1) Unemployment	(2) Unemployment
Ln (oil palm plantation area/total surface)	-1.103***	
	(0.196)	
Ln (years of schooling)	-5.947**	-13.59***
	(2.844)	(3.383)
Total Investment	0.00356	0.00680
	(0.00683)	(0.00738)
Ln (oil palm production/population)		-0.203
		(0.231)
Constant	14.82**	33.70***
	(6.126)	(7.176)
Observations	245	229
R-squared	0.198	0.113
Number of Provinces	25	24

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: STATA output

Table 6 presents the regression result for unemployment. The expected finding is negative relation between oil palm plantation and unemployment rate. Unemployment rate is proxied by Statistics Indonesia adopted definition from International Labour Organisation (ILO). From the column (1), it apperars that oil palm plantation as independent variable, using ratio of oil palm plantation area and total surface from each province as measurement. In addition, it adds years of schooling (in logarithm form) and total investment as control variable. The regression result of those two variables shows negatively correlated between oil palm plantation on unemployment rate. It means oil palm plantation has contribution to lower unemployment rate. Taking an example, for every increasing of 1 unit oil palm plantation area will reduce unemployment rate by 1.103 unit in average (significance at 1% level). Hence, oil palm expansion has contributed to reduce poverty through alleviate unemployment (Deininger and Byerlee 2011).

Column (2) points out the empirical finding for unemployment rate as dependent variable related to oil palm production as independent variable. The expected result is oil palm production will contribute to reduce unemployment. Meanwhile, proxy for oil palm production is total palm oil production in each province divided by population in each province. To see the effect of oil palm production to unemployment in regional level, this study adds years of schooling (in logarithm form) and total investment as control variables. The finding can be said negatively insignificant. Taking an example, for 1 unit increasing of oil palm production, it will reduce 0.203 unit on average of unemployment rate.

On the other hand, years of schooling (in logarithm form) has negatively correlated with unemployment rate as can be shown in table 6. Using oil palm plantation as dependent variable and years of schooling as control variable, for every 1 unit increasing of years of schooling, will reduce unemployment rate. It seems that years of schooling has positive impact on alleviation unemployment. In contrast, the other control variable, total investment has no significant relationship with unemployment rate.

Comparing the results in column (1) and column (2), it seems that oil palm plantation absorbs more labour force than oil palm production sector. As an estate corps, oil palm plantation in large scale needs a huge amount of worker to build and run out the plantation. The average number of worker could be 91 person per days for a hectares plantation area per year (Budidarsono et al. 2011).

5.3 Environmental Quality Index Empirical Result

This section uses environmental quality index as dependent variable. In particular this part uses fixed effect model (FEM) to analyse the relation between environmental quality index and oil palm plantation and oil palm production.

Table 7 Environmental quality index using fixed effect model (FEM)

VARIABLES	(1) Environmental quality index	(2) Environmental quality index
Ln (number of motor vehicle/population)	-8.049**	-8.242**
	(3.549)	(3.529)
Production of logs forest consessions	0.213	0.120
	(0.649)	(0.654)
Ln (oil palm plantation	3.362	

area/population)		
	(3.022)	
Ln (oil palm production/population)		2.914
		(2.481)
Constant	72.12***	68.60***
	(6.319)	(3.546)
Observations	143	139
R-squared	0.041	0.044
Number of Provinces	17	17

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: STATA output

Table 7 illustrates the relation between environmental impact and oil palm plantation and oil palm production. This study utilises environmental impact as dependent variable. To measure the environmental impact, this research uses environmental quality index in regional level as indicator. The expected result for this correlation is increasing of oil palm production and plantation will reduce environmental quality index. Environmental quality index is proxied by Ministry of Forestry and Environmental using three indicators as follows: air quality, water quality and land cover. The range of this index is 0 to 100, which means less than 30 as alert and more than 80 as very good. As independent variable, oil palm plantation measures as ratio of oil palm plantation area and total population in each province. To support this regression, it adds two control variables. Those two control variables are number of motor vehicle (in logarithm form) and productions of logs forest concession. Both variables claimed as contributor for environmental damage. Based on column (1), the finding for relation between oil palm plantation an environment impact (with proxy environmental quality index) is insignificant correlated.

Column (2) shows the regression result of oil palm production and environmental quality index. Using total oil palm production divided by total population in each province. This regression uses the same control variables as column (1). In addition, the finding is same as oil palm plantation's result. There is no significant correlation between oil palm production and environmental impact (using environmental quality index as measurement).

In contrast, palm oil is well-known as major driver of deforestation recently. However, researched by Abood et.al (2015) examined four large industries as cause of forest loss. According to them, the primary contributor of deforestation is fiber plantation and logging concession, surprisingly not palm oil. Palm oil accounted as number three of forest loss driver. Perhaps, it can be interpreted that there is no significant correlation between oil palm plantation and oil palm production with environment impact, other industries could be supported forest loss as well.

There is different finding for two control variables in this research. First control variable for oil palm plantation is number of motor vehicle. To measure this variable, it utilises ratio of number of motor vehicle (in each province) divided by total population in each province. Furthermore, the result of this regression shows that number of motor vehicle has significant effect for environment quality index. For example, for every 1 unit increasing of number motor vehicle, will reduce 8.049 (significance at 5%). However, the other control variable shows different result. From column (2) it seems production of logs forest concession as control variable has no significant

correlation with environment equality index. Perhaps, it is because of the number of observations that reduce more or less 50% after adds production of logs forest recession in this regression.

5.4 Alternative empirical result

This part illustrates the alternative result. In this section, this study examines the relation of gross regional domestic product as dependent variable with independent variable uses fixed effect model (FEM). Furthermore, unemployment rate and environment quality index utilises random effect model (REM) to analysis. Additionally, there are slightly different findings produced using different method.

Table 8 Alternative regressor

VARIABLES	(1) GDRPpercapita	(2) GDRPpercapita	(3) Unemployment	(4) Unemployment	(5) Environment	(6) Environment
Ln (oil palm plantation area/total surface)	-0.355					
	(0.309)					
HDI	-0.0328	-0.0700				
	(0.0637)	(0.0694)				
Ln (number of motor vehicle/population)					-2.259	-1.919
					(1.410)	(1.410)
Ln (oil palm plantation area/population)			-0.856***		2.368***	
			(0.175)		(0.843)	
Ln (oil palm production/population)						1.532**
						(0.674)
Ln (oil palm total price/population)		-0.937***		-0.329**		
		(0.359)		(0.143)		
Ln (years of schooling)			-0.960	-3.778		
			(2.395)	(2.534)		
Total Investment	0.0125	0.0120	0.00815	0.00857		
	(0.0115)	(0.0117)	(0.00741)	(0.00769)		
Constant	4.824	12.61**	5.464	15.30***	73.91***	70.66***
	(4.362)	(5.195)	(5.079)	(5.221)	(3.045)	(2.572)
Observations	246	229	234	229	228	223
R-squared	0.014	0.043				
Number of Province	25	24	24	24	24	24

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: STATA output

Table 8 presents the result using different combination regressors. The regression result in column (1) can be said similar with the result in table 5 column (1). The relation between oil palm plantation and gross regional domestic product (GRDP) per capita cannot be defined since there is no significant correlations. It can be interpreted that oil palm plantation does not affect gross regional domestic product (GRDP) per capita. However, column (2) has slightly different findings with column (2) in table 5. In this column, oil palm production has negative significant relation with gross regional domestic product (GRDP) per capita. It means that for every increasing of 1 unit of oil palm production will reduce almost 1 unit gross regional domestic product (GRDP) per capita on average (significance at 1% level).

Column (3) shows the finding result of oil palm plantation and unemployment rate using random effect model (REM). In this result proxy for oil palm plantation is ratio of oil palm plantation area and population. Furthermore, the result is almost similar with the first regression in table 6 column (1). For this part, the result is increasing of oil palm plantation will reduce unemployment rate. It seems that oil palm plantation expansion affects unemployment rate. Regarding oil palm production, column (4) displays positively correlated between oil palm production and unemployment rate. The negative sign in those coefficient means that oil palm production has positive impact on unemployment rate.

Those two last column in table 8 points the relation between environment quality index and oil palm plantation and oil palm production using random effect model (REM). Additionally, this regression excludes production of logs forest concession as control variable. Thus, the result become slightly different with the result in table 7. Using the same proxy for both independent variables, the findings for both variables are significantly positive in different level significance. Without production of logs forest concession, the number of observation become larger, perhaps it is the reason for those differences.

CHAPTER 6
CONCLUSION

6.1 Summary of Findings

This research has three goals. Firstly, it aims at examining the relation between gross regional domestic product per capita and oil palm plantation and oil palm production. Oil palm plantation as independent variable is proxied by oil palm plantation area divided by total surface in each province. To supports this regression, it completed by human development index (HDI) and total investment as control variables. However, the result is unexpected. This study finds gross regional domestic product (GRDP) per capita does not have statistically significant correlation with oil palm plantation and oil palm production. Perhaps, one of the causes is the limitation of regional government to manage their own financial authority, particularly to manage their income from tuition of forest concession.

Meanwhile, oil palm production's indicator is ratio of total price of oil palm production and total population. To find the relation between oil palm production and gross regional domestic product (GRDP) per capita, this regression adds two control variables. Those two variables are human development index (HDI) and total investment, both foreign and domestic investment. In this sense, the finding points the negative significant relation between oil palm production and gross regional domestic product (GRDP) per capita (significance at 10% level). It can be interpreted that oil palm production has significant effect to reduce gross regional domestic product (GRDP) per capita.

Secondly, this paper examines the relation of unemployment rate with oil palm plantation and oil palm production. Using oil palm plantation area divided by total surface in each province as proxy of oil palm plantation, this regression supported by two control variables as well. Those control variables are years of schooling (in logarithm form) and total investment. The outcome from this study is oil palm plantation has contribution to drop the unemployment rate in regional level.

From the other independent variable, oil palm production, the result is slightly different. The finding is negative insignificant relation between oil palm production and unemployment rate. In the other words, oil palm production has insignificant effect to reduce unemployment rate in regional level.

Lastly, the third research question is correlation between environmental impact and oil palm plantation and oil palm production. Proxy for environmental effect is regional environment quality index. As independent variable, measurement for oil palm plantation is oil palm plantation area divided by total population in each province. The other independent variable, oil palm production measured by total of oil palm production divided by total population in each province. In addition, this study includes two control variables. Those two variables are number of motor vehicle (in logarithm form) and productions of logs forest concession (in percentage). However, both regression towards both independent variables give the same result. Oil palm plantation and oil palm production does not have statistically significant relation to environmental impact, which proxied by environment quality index.

6.2 Policy Recommendations

Based on the findings, the relation of oil palm development and economic and environmental performance in Indonesia, especially in regional level cannot be defined. There are some indicators produced unexpected result. Thus, it seems that in regional level, oil palm development does not affect the economy sharply. Perhaps, the government should be reviewed some regulations as follows. First, the regulation regarding financial authorisation management regarding Law 33/2004 on fiscal balance between the central and regional government. Previously the proportion of forest concession is 80% for regional government and 20% for central government, it should be greater share for the regional government, since the location is in province. Secondly, improvement in tax regulation for intra-enterprise companies. There should be proportional sharing of corporate income tax and value added tax paid by intra-enterprise palm oil companies for region where the oil palm estates and production exist. Thirdly, it should be regional regulation to rule the proportion of local workers employed by oil palm estates and oil palm production. It is important to reduce unemployment rate in regional level, especially in oil palm producers' region. Lastly, to consider environmental issues, it will be better if there is a component of environmental consequences in corporate income tax paid by palm oil companies. Thus, those amount of tax paid by palm oil companies can be used to repair the damage environment caused by oil palm.

6.3 Limitation

The relationship between oil palm plantation and oil palm production and economic and environmental performance is such an interesting issue. In Indonesia, as a developing country and the biggest producer of palm oil in the world, economic performance side of palm oil is more preferable to examine. However, environmental issue regarding palm oil phenomenon is worldwide debate recently. This study tries to balance the discussion regarding the relation of palm oil with economic and environmental performance from Indonesia's point of view. However, there are several limitations remain.

Firstly, because of limited data source availability and documentation regarding the exact information of oil palm plantation and oil palm production in Indonesia, this research only focuses on secondary data from official institutions. This study uses secondary data regarding oil palm plantation and oil palm production published mostly by Statistics Indonesia and Ministry of Agriculture of the Republic of Indonesia. There is a few data regarding environment performance in Indonesia, since awareness to the environment comes just recently. In Indonesia, environmental performance data is still progressing and improving.

Secondly, many previous studies regarding palm oil examine palm oil in certain and special case using dept analysis and quantitative data. This study uses panel data regression to analyse the relationship of palm oil and economic and environmental performance. However, since the observations are almost all of provinces in Indonesia, especially that produce oil palm, the focus of the research only on quantitative data without depth analysis regarding particular case of palm oil in certain region.

Thirdly, regarding environmental performance and its relation to palm oil, this paper limits the term of environment. In this sense, the term environment only regarding it performance through quality of water, quality of air and land cover and its physically influence to human and its surroundings. Therefore, this study utilises regional environment quality index that measures quality of water, quality of air and land cover. This study does not cover the term "environment" that often used to illustrate the relationship between community who living and interacting with their physical surroundings.

6.4 Future Research

This study tries to examine the relation of palm oil to economic and environmental performance. Yet, the information and data regarding environment performance could not found easily and completely in Indonesia, especially for secondary data. It will be more complete if the future research could combine secondary data dan primary data. Perhaps, the empirical evidence will be strong and illustrates the real condition in the field.

The future research should be considered another mechanism to relate palm oil and environment performance. Even though palm oil has important role in Indonesia, environmental side of oil palm expansion should be calculated. Hence, more comprehensive research combined economic and environmental performance could be more balance.

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No	Province	Gross Regional Domestic Product (GRDP)										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	5,65	-0,29	1,68	0,39	1,13	1,74	0,56	-0,43	-2,61	1,39	2,32
2	North Sumatra	5,71	5,25	4,01	5,36	5,11	4,96	4,65	3,88	3,81	3,94	3,95
3	West Sumatra	4,93	5,48	2,93	4,60	4,88	4,88	4,69	4,53	4,23	4,00	4,06
4	Riau	4,48	4,32	2,88	3,58	2,78	1,06	-0,14	0,13	-2,24	-0,23	0,29
5	Riau Islands	2,45	2,14	-1,22	2,53	3,53	4,27	3,97	3,49	3,03	2,17	-0,66
6	Jambi	3,91	4,69	4,33	4,30	5,82	5,06	4,92	5,49	2,44	2,65	2,97
7	South Sumatra	6,06	4,38	3,17	5,16	4,73	5,23	3,78	3,30	2,98	3,64	4,15
8	Bangka Belitung Islands	2,12	1,74	0,81	3,00	4,52	3,18	2,92	2,43	1,89	1,95	2,39
9	Bengkulu	4,69	4,02	3,89	4,50	4,97	4,98	4,28	3,74	3,44	3,64	3,39
10	Lampung	4,82	4,14	4,24	4,85	5,16	5,09	4,48	3,85	3,95	4,02	4,10
11	Special Region of Jakarta	4,97	4,79	3,60	5,10	5,51	5,34	4,92	4,81	4,84	4,85	5,23
12	West Java	4,86	4,39	2,18	4,49	4,78	4,82	4,70	3,52	3,52	4,16	3,84
13	Banten	3,15	2,92	1,89	3,30	4,53	4,40	4,31	3,24	3,24	3,14	3,63
14	Central Java	5,58	5,13	5,31	5,71	4,40	4,47	4,27	4,46	4,68	4,52	4,53
15	DI Yogyakarta	3,23	3,97	3,38	3,93	3,94	4,11	4,23	3,95	3,75	3,87	4,11
16	East Java	5,24	5,11	4,18	5,93	5,66	5,90	5,37	5,18	4,80	4,96	4,86
17	Bali	3,67	3,75	3,12	3,72	5,31	5,63	5,40	5,47	4,80	5,12	4,44
18	West Nusa Tenggara	3,67	1,64	10,85	5,23	-5,29	-2,92	3,73	3,78	20,20	4,51	-1,09
19	East Nusa Tenggara	3,00	2,72	2,19	3,22	3,85	3,67	3,65	3,32	3,22	3,48	3,50
20	West Kalimantan	5,05	4,51	3,87	4,59	3,68	4,13	4,32	3,37	3,28	3,64	3,66
21	Central Kalimantan	4,19	4,32	3,73	4,70	4,45	4,36	4,89	3,81	4,64	4,06	4,48
22	South Kalimantan	4,00	4,48	3,35	3,70	4,91	3,99	3,43	3,01	2,08	2,71	3,65
23	East Kalimantan	6,16	2,43	3,12	7,71	3,63	2,73	7,52	-0,58	-3,37	-2,48	0,99

24	North Kalimantan								4,11	-0,43	-0,05	2,77
25	North Sulawesi	5,11	9,47	6,49	5,88	4,87	5,60	5,17	5,14	5,00	5,09	5,28
26	Gorontalo	5,11	5,38	5,18	5,40	5,91	6,14	5,94	5,57	4,57	4,90	5,15
27	Central Sulawesi	5,19	5,39	5,97	6,70	7,91	7,67	7,77	3,37	13,68	8,29	5,53
28	South Sulawesi	5,11	6,56	5,03	7,02	6,86	7,63	6,43	6,39	6,08	6,35	6,20
29	West Sulawesi	4,61	9,14	3,28	9,11	8,59	7,15	4,89	6,79	5,30	4,04	4,71
30	Southeast Sulawesi	5,74	5,10	5,40	6,09	8,18	9,22	5,20	4,03	4,68	4,36	4,70
31	Maluku	2,85	1,39	2,58	3,66	4,40	5,22	3,37	4,77	3,66	3,94	4,05
32	North Maluku	3,43	3,45	3,53	5,45	4,41	4,64	4,09	3,29	3,94	3,67	5,59
33	Papua	-1,02	-6,44	15,97	-8,04	-6,19	-0,28	6,45	1,68	5,36	7,16	2,79
34	West Papua	4,69	5,34	5,28	4,76	0,91	0,93	4,60	2,71	1,56	1,96	1,51

No	Province	Unemployment (%)										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	9,84	9,56	8,71	8,37	9,00	9,06	10,12	9,02	9,93	7,57	6,57
2	North Sumatra	10,10	9,10	8,45	7,43	8,18	6,28	6,45	6,23	6,71	5,84	5,60
3	West Sumatra	10,31	8,04	7,97	6,95	8,02	6,65	7,02	6,50	6,89	5,09	5,58
4	Riau	9,79	8,20	8,56	8,72	6,09	4,37	5,48	6,56	7,83	7,43	6,22
5	Jambi	6,22	5,14	5,54	5,39	4,63	3,20	4,76	5,08	4,34	4,00	3,87
6	South Sumatra	9,34	8,08	7,61	6,65	6,60	5,66	4,84	4,96	6,07	4,31	4,39
7	Bengkulu	4,68	4,90	5,08	4,59	3,46	3,62	4,61	3,47	4,91	3,30	3,74
8	Lampung	7,58	7,15	6,62	5,57	6,38	5,20	5,69	4,79	5,14	4,62	4,33
9	Bangka Belitung Islands	6,49	5,99	6,14	5,63	3,86	3,43	3,65	5,14	6,29	2,60	3,78
10	Riau Islands	9,01	8,01	8,11	6,90	5,38	5,08	5,63	6,69	6,20	7,69	7,16
11	Special Region of Jakarta	12,57	12,16	12,15	11,05	11,69	9,67	8,63	8,47	7,23	6,12	7,14
12	West Java	13,08	12,08	10,96	10,33	9,96	9,08	9,16	8,45	8,72	8,89	8,22
13	Central Java	7,70	7,35	7,33	6,21	7,07	5,61	6,01	5,68	4,99	4,63	4,57
14	Special Region of Yogyakarta	6,10	5,38	6,00	5,69	4,39	3,90	3,24	3,33	4,07	2,72	3,02
15	East Java	6,79	6,42	5,08	4,25	5,38	4,11	4,30	4,19	4,47	4,21	4,00
16	Banten	15,75	15,18	14,97	13,68	13,74	9,94	9,54	9,07	9,55	8,92	9,28
17	Bali	3,77	3,31	3,13	3,06	2,95	2,10	1,83	1,90	1,99	1,89	1,48
18	West Nusa Tenggara	6,48	6,13	6,25	5,29	5,25	5,23	5,30	5,75	5,69	3,94	3,32
19	East Nusa Tenggara	3,72	3,73	3,97	3,34	3,11	3,04	3,25	3,26	3,83	3,25	3,27
20	West Kalimantan	6,47	5,41	5,44	4,62	4,60	3,54	3,99	4,04	5,15	4,23	4,36
21	Central Kalimantan	5,11	4,59	4,62	4,14	3,54	3,14	3,00	3,24	4,54	4,82	4,23
22	South Kalimantan	7,62	6,18	6,36	5,25	6,29	5,19	3,66	3,80	4,92	5,45	4,77
23	East Kalimantan	12,07	11,11	10,83	10,10	11,43	9,02	7,95	7,38	7,50	7,95	6,91
24	North Kalimantan	-	-	-	-	-	-	-	-	5,68	5,23	5,54
25	North Sulawesi	12,35	10,65	10,56	9,61	10,10	7,98	6,79	7,54	9,03	6,18	7,18
26	Central Sulawesi	8,39	5,45	5,43	4,61	6,78	3,95	4,19	3,68	4,10	3,29	3,81
27	South Sulawesi	11,25	9,04	8,90	8,37	8,13	6,01	5,10	5,08	5,95	4,80	5,61
28	Southeast Sulawesi	6,40	5,73	4,74	4,61	4,69	4,14	4,38	4,43	5,55	2,72	3,30

29	Gorontalo	7,16	5,65	5,89	5,16	6,74	4,47	4,15	4,18	4,65	2,76	4,28
30	West Sulawesi	5,45	4,57	4,51	3,25	3,35	2,16	2,35	2,08	3,35	3,33	3,21
31	Maluku	12,20	10,67	10,57	9,97	10,81	7,71	9,91	10,51	9,93	7,05	9,29
32	North Maluku	6,05	6,48	6,76	6,03	5,34	4,82	3,80	5,29	6,05	4,01	5,33
33	West Papua	9,46	7,65	7,56	7,68	6,73	5,42	4,40	5,02	8,08	7,46	6,49
34	Papua	5,01	4,39	4,08	3,55	5,02	3,71	3,15	3,44	3,99	3,35	3,62
	Indonesia	**9,11**	**8,39**	**7,87**	**7,14**	**7,48**	**6,13**	**6,17**	**5,94**	**6,18**	**5,61**	**5,50**

APPENDIX 3

No	Province	Environment Quality Index										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	91,00	82,62	72,47	77,30	64,74	73,65	71,86	72,60	74,83	73,55	77,70
2	North Sumatra	75,16	57,31	62,48	87,17	72,21	62,67	62,98	61,53	69,37	66,47	69,77
3	West Sumatra	90,53	86,56	87,04	81,46	77,00	69,74	67,75	68,91	59,07	60,06	68,16
4	Riau	75,19	66,64	51,65	54,86	56,23	53,79	50,69	52,59	53,07	56,73	68,64
5	Jambi	77,03	83,79	75,04	62,82	64,92	61,16	60,43	62,04	61,85	64,01	64,98
6	South Sumatra	85,79	78,24	69,30	75,70	77,50	55,59	58,53	61,62	69,06	67,27	69,18
7	Bengkulu	70,56	69,77	79,58	96,89	96,77	66,01	67,98	66,76	76,92	72,43	70,18
8	Lampung	79,98	73,37	73,64	86,95	86,57	51,98	54,71	56,42	63,04	60,34	59,72
9	Bangka Belitung Islands	72,09	84,95	52,15	64,92	64,99	58,17	59,41	60,21	71,26	66,88	67,85
10	Riau Islands	0,00	0,00	51,65	54,86	56,23	67,57	68,58	69,27	73,11	70,19	70,34
11	Special Region of Jakarta	58,15	52,13	41,73	41,81	41,31	36,80	31,97	36,88	43,79	38,69	35,78
12	West Java	33,71	33,58	49,69	53,44	50,90	48,18	47,61	45,06	63,49	51,87	50,26
13	Central Java	75,83	71,89	55,40	50,48	49,82	60,96	58,03	60,63	60,78	58,75	58,15
14	Special Region of Yogyakarta	54,19	50,11	53,52	71,91	68,89	53,25	52,01	49,53	50,99	51,37	49,80
15	East Java	55,17	55,95	59,01	49,49	54,49	58,96	56,47	56,48	62,67	58,98	57,46
16	Banten	60,09	60,19	50,86	48,98	48,98	46,77	46,33	43,67	55,36	60,00	51,58
17	Bali	73,50	64,87	85,50	99,65	85,30	59,09	57,49	59,81	73,71	72,59	70,11
18	West Nusa Tenggara	65,05	76,74	73,69	90,15	84,30	66,76	66,97	69,39	58,82	56,53	56,99
19	East Nusa Tenggara	69,13	70,48	66,61	50,72	59,01	65,48	62,81	62,98	63,79	59,23	61,92
20	West Kalimantan	79,17	87,24	71,92	76,39	74,27	70,49	69,08	68,31	75,88	72,24	74,17
21	Central Kalimantan	72,29	76,53	45,70	50,38	63,98	71,22	69,71	70,37	74,09	74,71	71,47
22	South Kalimantan	65,58	53,79	48,25	58,24	60,29	56,74	55,86	57,51	57,47	59,07	69,38
23	East Kalimantan	84,88	85,56	68,63	62,22	70,75	74,07	73,21	74,00	81,15	76,85	75,65
24	North Kalimantan											81,87
25	North Sulawesi	66,60	83,93	88,21	84,18	84,59	65,62	63,66	65,69	66,27	67,07	70,81
26	Central Sulawesi	73,14	70,40	68,51	97,58	98,53	82,65	80,28	76,40	76,43	68,78	69,39
27	South Sulawesi	85,70	65,12	67,62	62,89	62,64	64,72	63,67	64,07	67,01	70,54	73,24

28	Southeast Sulawesi	74,60	73,62	60,53	62,23	52,79	76,68	69,08	72,14	75,18	75,24	70,86
29	Gorontalo	76,59	91,74	0,00	97,93	98,89	74,90	74,48	72,14	71,08	69,30	67,46
30	West Sulawesi	0,00	0,00	67,62	62,89	67,85	71,51	70,21	72,29	68,78	64,54	74,47
31	Maluku	72,08	87,01	78,80	79,72	73,09	73,92	73,51	74,79	76,33	71,66	75,12
32	North Maluku	76,88	87,01	78,80	79,72	73,09	78,24	76,56	77,22	75,97	72,46	74,55
33	West Papua	0,00	80,61	75,30	59,56	68,51	80,67	80,61	84,51	82,33	83,01	85,69
34	Papua	69,52	70,09	75,30	59,56	68,51	82,34	82,91	80,65	81,01	81,35	81,47

APPENDIX 4

No	Province	Human Development Index										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	70.35	70.76	71.31	67.09	67.45	67.81	68.30	68.81	69.45	70	70.60
2	North Sumatra	72.78	73.29	73.80	67.09	67.34	67.74	68.36	68.87	69.51	70	70.57
3	West Sumatra	72.23	72.96	73.44	67.25	67.81	68.36	68.91	69.36	69.98	70.73	71.24
4	Riau	74.63	75.09	75.60	68.65	68.90	69.15	69.91	70.33	70.84	71.20	71.79
5	Jambi	71.46	71.99	72.45	65.39	66.14	66.94	67.76	68.24	68.89	69.62	69.99
6	South Sumatra	71.40	72.05	72.61	64.44	65.12	65.79	66.16	66.75	67.46	68.24	68.86
7	Bengkulu	71.57	72.14	72.55	65.35	65.96	66.61	67.50	68.06	68.59	69.33	69.95
8	Lampung	69.78	70.30	70.93	63.71	64.20	64.87	65.73	66.42	66.95	67.65	68.25
9	Bangka Belitung Islands	71.62	72.19	72.55	66.02	66.59	67.21	67.92	68.27	69.05	69.55	69.99
10	Riau Islands	73.68	74.18	74.54	71.13	71.61	72.36	73.02	73.40	73.75	73.99	74.45
11	Special Region of Jakarta	76.59	77.03	77.36	76.31	76.98	77.53	78.08	78.39	78.99	79.60	80.06
12	West Java	70.71	71.12	71.64	66.15	66.67	67.32	68.25	68.80	69.50	70.05	70.69
13	Central Java	71.60	71.60	72.10	66.08	66.64	67.21	68.02	68.78	69.49	69.98	70.52
14	Special Region of Yogyakarta	74.15	74.88	75.23	75.37	75.93	76.15	76.44	76.81	77.59	78.38	78.89
15	East Java	69.78	69.78	71.06	65.36	66.06	66.74	67.55	68.14	68.95	69.74	70.27
16	Banten	69.29	70.38	70.06	67.54	68.22	68.92	69.47	69.89	70.27	70.96	71.42
17	Bali	70.53	69.70	71.52	70.10	70.87	71.62	72.09	72.48	73.27	73.65	74.30
18	West Nusa Tenggara	63.71	64.12	64.66	61.16	62.14	62.98	63.76	64.31	65.19	65.81	66.58
19	East Nusa Tenggara	65.36	66.15	66.60	59.21	60.24	60.81	61.68	62.26	62.67	63.13	63.73
20	West Kalimantan	67.53	68.17	68.79	61.97	62.35	63.41	64.30	64.89	65.59	65.88	66.26
21	Central Kalimantan	73.49	73.88	74.36	65.96	66.38	66.66	67.41	67.77	68.53	69.13	69.79
22	South Kalimantan	68.01	68.72	69.30	65.20	65.89	66.68	67.17	67.63	68.38	69.05	69.65
23	East Kalimantan	73.77	74.52	75.11	71.31	72.02	72.62	73.21	73.82	74.17	74.59	75.12
24	North Kalimantan							67.99	68.64	68.76	69.20	69.84
25	North Sulawesi	74.68	74.52	75.68	67.83	68.31	69.04	69.49	69.96	70.39	71.05	71.66
26	Central Sulawesi	69.34	70.09	70.70	63.29	64.27	65	65.79	66.43	66.76	67.47	68.11
27	South Sulawesi	69.62	70.22	70.94	66	66.65	67.26	67.92	68.49	69.15	69.76	70.34

28	Southeast Sulawesi	68.32	69.00	69.52	65.99	66.52	67.07	67.55	68.07	68.75	69.31	69.86
29	Gorontalo	68.83	69.29	69.79	62.65	63.48	64.16	64.70	65.17	65.86	66.29	67.01
30	West Sulawesi	67.72	68.55	69.18	59.74	60.63	61.01	61.53	62.24	62.96	63.60	64.30
31	Maluku	69.96	70.38	70.96	64.27	64.75	65.43	66.09	66.74	67.05	67.60	68.19
32	North Maluku	67.82	68.18	68.63	62.79	63.19	63.93	64.78	65.18	65.91	66.63	67.20
33	West Papua	67.28	67.95	68.58	59.60	59.90	60.30	60.91	61.28	61.73	62.21	62.99
34	Papua	63.41	64.00	64.53	54.45	55.01	55.55	56.25	56.75	57.25	58.05	59.09

APPENDIX 5

No	Province	Investment (%)										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh		-1,000		0,030	4,586	2,493	1,199	0,126	-0,264	-0,024	-0,745
2	North Sumatra		-0,2886	-0,42857	-0,33915	-0,23362	-0,05021	2,794666	-0,48794	-0,1842	0,10099	-0,34769
3	West Sumatra	4,960	-0,521	0,745	-0,671	7,447	0,224	-0,117	-0,007	0,162	1,133	-0,153
4	Riau	0,220	-0,392	-0,045	-0,670	4,126	0,658	-0,007	0,167	-0,309	-0,009	0,367
5	Jambi	17,040	-0,497	-0,095	-0,248	1,389	0,509	-0,206	-0,147	0,929	-0,099	0,551
6	South Sumatra	-0,349	-0,319	0,447	1,255	-0,404	2,344	-0,319	0,974	0,459	-0,227	-0,020
7	Bengkulu	6,691	-0,464	-0,505	2,297	1,976	0,421	-0,375	1,136	-0,351	3,175	-0,579
8	Lampung	-0,744	2,959	0,175	-0,354	3,531	-0,617	1,439	0,746	-0,579	2,085	0,337
9	Bangka Belitung Islands		-0,604	1,095	-0,090	2,970	-0,143	-0,156	-0,047	0,379	1,316	0,215
10	Riau Islands	0,161	-0,453	-0,211	-0,154	3,682	-0,485	-0,318	0,959	0,902	-0,595	0,829
11	Special Region of Jakarta	1,830	0,970	-0,352	0,061	-0,158	-0,146	-0,386	0,940	-0,202	-0,092	0,877
12	West Java	0,146	0,163	-0,172	0,415	0,471	0,062	0,460	0,026	-0,053	0,011	0,032
13	Central Java	0,360	-0,187	1,823	-0,036	0,515	0,340	0,434	-0,342	0,170	0,285	-0,040
14	Special Region of Yogyakarta	-0,727	0,301	-0,361	-0,305	1,909	0,576	0,766	0,066	0,686	0,256	1,174
15	East Java	0,732	0,470	0,718	0,946	0,184	1,158	0,250	0,084	-0,150	0,303	-0,031
16	Banten	1,234	-0,646	0,391	1,725	-0,262	0,583	0,317	-0,342	0,374	-0,150	-0,063
17	Bali	-0,513	0,607	1,781	0,346	0,650	0,555	-0,209	-0,296	0,311	-0,170	0,913
18	West Nusa Tenggara	-0,509	1,441	-0,799	144,291	0,115	0,363	-0,059	-0,058	0,275	-0,256	-0,013
19	East Nusa Tenggara	-0,833	2,500	1,857	-0,047	0,472	0,816	0,113	0,357	9,645	-0,271	0,833
20	West Kalimantan	2,822	0,499	0,326	2,631	1,180	0,050	0,245	0,533	0,356	-0,269	0,139
21	Central Kalimantan	-0,195	-0,001	0,286	4,830	-0,022	0,084	-0,363	0,629	-0,004	-0,009	-0,149
22	South Kalimantan	-0,543	-0,460	3,868	0,612	0,186	0,256	0,482	-0,243	0,558	-0,362	-0,345
23	East Kalimantan	-0,538	-0,799	1,223	21,210	-0,326	0,977	0,011	0,199	-0,032	-0,463	0,269
24	North Kalimantan								2,351	0,861	0,376	-0,483
25	North Sulawesi	57,422	-0,482	0,600	2,771	0,081	-0,545	-0,391	0,476	0,024	6,063	-0,220
26	Central Sulawesi		-1,000			15,856	-0,676	-0,228	-0,843	5,534	0,208	0,972
27	South Sulawesi	-0,120	13,194	0,214	2,987	0,634	0,292	-0,111	1,033	-0,073	0,054	-0,085

28	Southeast Sulawesi	26,028	-0,922	1,760	4,765	-0,784	6,038	-0,163	-0,327	-0,005	0,334	0,868
29	Gorontalo					-0,824	1,500	-0,454	1,114	-0,557	19,883	-0,583
30	West Sulawesi	-1,000		6,200	28,841	-0,617	0,444	1,403	0,524	0,036	0,699	0,940
31	Maluku	-1,000				3,038	-0,244	4,965	-0,752	5,290	0,255	1,087
32	North Maluku				40,695	-0,466	-0,060	1,916	-0,691	0,863	1,120	-0,288
33	West Papua	-0,333	43,500	-0,899	185,281	2,928	-0,084	0,976	-0,468	-0,289	0,297	0,649
34	Papua	-0,955	12,907	-0,807	5,900	4,005	-0,797	1,712	0,699	1,023	0,512	-0,671

APPENDIX 6

No	Province	Number of Motor vehicle										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	1.462.363	1.622.459	1.809.400	1.950.888	2.183.450	2.424.563	2.611.860	2.873.332	2.913.013	3.064.126	3.177.873
2	North Sumatra	3.062.497	3.614.613	3.766.861	4.036.502	4.527.197	5.332.725	5.665.438	5.865.001	6.026.150	6.191.417	7.369.113
3	West Sumatra	1.134.125	1.163.187	1.282.440	1.440.460	1.658.174	1.800.512	1.933.560	2.042.823	2.199.646	2.317.871	2.442.071
4	Riau	1.632.898	1.692.504	1.793.180	1.912.083	2.113.847	2.333.180	2.533.654	2.680.163	2.808.613	2.890.671	3.069.332
5	Jambi	1.434.982	2.174.435	2.452.571	2.582.678	3.031.417	3.420.540	3.643.088	3.970.850	4.103.495	4.932.026	5.524.738
6	South Sumatra	1.316.346	2.269.936	2.549.073	3.135.741	3.500.866	3.793.024	4.172.168	4.391.110	4.963.694	5.128.207	5.580.365
7	Bengkulu	470.319	489.354	550.277	696.965	803.871	873.037	938.474	976.118	1.039.535	1.082.167	1.141.740
8	Lampung	1.075.971	1.152.074	1.278.597	1.510.223	1.699.157	1.975.955	2.577.853	2.718.074	2.977.698	3.116.502	3.267.573
9	Bangka Belitung Islands	369.074	532.418	447.545	523.204	585.744	679.674	867.893	910.445	940.602	977.430	1.052.990
10	Riau Islands	486.107	612.327	685.177	753.451	852.731	957.584	1.068.364	1.133.998	1.231.227	1.402.283	1.445.931
11	Special Region of Jakarta	11.601.724	12.540.807	9.695.077	10.774.473	11.973.874	13.283.545	14.734.601	17.853.804	18.947.642	19.848.324	20.730.267
12	West Java	3.088.771	3.248.364	3.861.644	5.105.735	6.008.983	6.871.721	7.993.846	9.235.835	10.095.831	11.025.188	12.001.487
13	Central Java	7.557.584	7.843.185	8.445.873	9.307.502	10.214.016	11.146.912	12.309.278	13.297.231	14.607.215	15.534.559	16.221.621
14	Special Region of Yogyakarta	2.217.627	2.278.063	2.541.503	2.964.905	3.322.638	3.477.261	3.643.412	3.707.232	3.754.247	3.969.561	4.616.016
15	East Java	8.927.138	9.266.356	9.852.167	10.568.384	11.238.168	12.225.306	13.199.239	13.840.116	14.706.680	15.466.112	16.400.894
16	Banten	609.460	677.144	751.462	881.155	985.140	1.121.170	1.473.344	2.434.156	2.621.342	2.792.788	3.013.257
17	Bali	2.270.411	2.607.602	2.859.195	3.171.824	3.531.824	3.759.490	3.961.644	4.170.073	4.305.966	4.736.813	4.931.597
18	West Nusa Tenggara	678.577	1.024.597	1.153.282	1.393.816	1.556.310	1.649.466	1.783.741	1.904.570	1.937.131	2.078.578	2.190.964
19	East Nusa Tenggara	378.481	634.884	717.801	908.897	1.008.224	1.064.478	1.149.753	1.219.699	1.233.330	1.364.867	1.667.969
20	West Kalimantan	1.162.517	1.248.758	1.361.067	1.501.906	1.663.185	1.868.025	2.267.762	2.382.441	2.560.970	2.702.243	2.818.148

21	Central Kalimantan	647.468	693.154	761.511	846.469	931.088	1.072.144	1.264.844	1.310.009	1.432.351	1.576.455	1.728.666
22	South Kalimantan	1.239.637	1.264.135	1.391.957	1.542.767	1.711.519	1.921.022	2.143.380	2.435.063	2.479.475	2.702.322	2.955.067
23	East Kalimantan	1.468.136	1.497.860	1.391.957	1.542.767	2.102.157	2.305.822	2.518.349	2.656.780	2.780.535	2.844.181	2.966.407
24	North Kalimantan											
25	North Sulawesi	487.818	671.540	755.798	943.177	1.046.124	1.099.021	1.201.652	1.269.636	1.349.806	1.531.205	1.584.839
26	Central Sulawesi	934.226	1.313.624	1.472.956	1.762.837	1.970.016	2.050.281	2.117.502	2.188.552	2.225.230	2.360.767	2.422.682
27	South Sulawesi	1.062.568	1.625.213	1.791.677	2.473.641	2.779.761	3.048.988	3.314.753	3.501.136	3.804.436	4.015.226	4.218.499
28	Southeast Sulawesi	241.283	639.655	734.655	999.183	1.116.731	1.176.558	1.264.661	1.373.260	1.397.098	1.478.725	1.532.732
29	Gorontalo	112.544	200.794	224.819	282.964	305.965	368.560	393.602	419.166	441.159	460.614	
30	West Sulawesi										4.924	19.825
31	Maluku	232.519	235.277	259.130	461.724	517.410	544.236	574.201	595.525	607.270	633.601	863.348
32	North Maluku	23.475	26.842	30.879	39.756	42.619	61.207	75.765	88.758	93.951	119.584	150.856
33	West Papua										108.989	127.263
34	Papua	382.802	412.290	471.729	568.636	619.145	667.317	721.288	763.310	808.847	822.753	829.284

APPENDIX 7

No	Province	Production of log concession (meter cubic)										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	272.006	177.401	236.527	50.778							
2	North Sumatra	183.106	130.262	74.435	49.190	37.698	35.805	135.868	69.573	56.758	62.490	40.763
3	West Sumatra	102.814	85.685	77.893	66.283	102.563	54.159	63.013	70.851	122.588	90.112	98.053
4	Riau	102.814	85.685	77.893	66.283	102.563	54.159	63.013	70.851	122.588	90.112	98.053
5	Jambi	268.342	248.122	183.797	53.096	48.889	61.097	34.266	22.359	8.340	4.045	8.641
6	South Sumatra	180.899	110.679	38.165	38.165	18.079	15.354	13.997	9.758	17.564		
7	Bengkulu							9.501	7.098	4.737	4.368	3.081
8	Lampung											
9	Bangka Belitung Islands											
10	Riau Islands											
11	Special Region of Jakarta											
12	West Java											
13	Central Java											
14	Special Region of Yogya-karta											
15	East Java											
16	Banten											
17	Bali											
18	West Nusa Tenggara									1.199	11.792	17.769
19	East Nusa Tenggara											
20	West Kalimantan	649.214	618.607	651.157	610.137	398.162	290.300	218.593	160.781	200.152	110.790	137.980
21	Central Kalimantan	1.602.611	1.498.483	1.438.384	1.864.961	1.347.132	1.028.302	1.230.431	2.115.912	1.940.649	1.872.489	1.989.093
22	South Kalimantan	153.969	98.012	36.207	83.666	86.066	49.973	7.800	17.096	12.934	17.356	23.585
23	East Kalimantan	2.228.748	2.584.840	2.421.202	2.474.066	2.137.723	1.942.627	1.695.449	1.292.769	1.528.203	1.303.438	1.189.710
24	North Kalimantan								523.643	662.634	774.587	664.468
25	North Sulawesi	59.716	17.430	12.200	12.472	16.043		16.154	13.911		2.065	1.874
26	Central Sulawesi	143.137	88.699	27.633	36.697	31.639	16.986	11.519	29.271	14.767	18.307	7.868
27	South Sulawesi				9.759	20.209						

28	Southeast Sulawesi	27.666	18.247	9.916	278	805	373					
29	Gorontalo	7.921	6.791	29.096	31.462	31.102	29.299					
30	West Sulawesi	99.259	70.229	39.234	10.267	6.441	5.080	7.174	5.728			959
31	Maluku	330.251	321.862	241.217	273.873	232.187	271.091	205.944	85.727	233.731	268.660	280.762
32	North Maluku	35.780	66.892	278.454	340.129	511.308	305.962	36.720	55.820	46.675	111.747	77.750
33	West Papua	53.112	63.742	380.689	466.073	238.019	222.163	291.564	239.832	333.147	437.575	440.248
34	Papua	911.139	637.398	540.439	683.616	969.288	900.720	454.425	512.225	659.712	527.192	451.493

APPENDIX 8

No	Province	Years of schooling										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
1	Aceh	8,50	8,50	8,63	8,28	8,32	8,36	8,44	8,71	8,77	8,86	8,98
2	North Sumatra	8,60	8,60	8,65	8,51	8,61	8,72	8,79	8,93	9,03	9,12	9,25
3	West Sumatra	8,18	8,26	8,45	8,13	8,20	8,27	8,28	8,29	8,42	8,59	8,72
4	Riau	8,40	8,51	8,56	8,25	8,29	8,34	8,38	8,47	8,49	8,59	8,76
5	Jambi	7,63	7,63	7,68	7,34	7,48	7,69	7,80	7,92	7,96	8,07	8,15
6	South Sumatra	7,60	7,60	7,66	7,34	7,42	7,50	7,53	7,66	7,77	7,83	7,99
7	Bengkulu	8,00	8,00	8,23	7,85	7,93	8,01	8,09	8,28	8,29	8,37	8,47
8	Lampung	7,30	7,30	7,49	7,26	7,28	7,30	7,32	7,48	7,56	7,63	7,79
9	Bangka Belitung Islands	7,18	7,37	7,41	7,07	7,19	7,25	7,32	7,35	7,46	7,62	7,78
10	Riau Islands	8,94	8,94	8,96	9,38	9,46	9,58	9,63	9,64	9,65	9,67	9,79
11	Special Region of Jakarta	10,80	10,80	10,90	10,37	10,40	10,43	10,47	10,54	10,70	10,88	11,02
12	West Java	7,50	7,50	7,72	7,40	7,46	7,52	7,58	7,71	7,86	7,95	8,14
13	Central Java	6,80	6,86	7,07	6,71	6,74	6,77	6,80	6,93	7,03	7,15	7,27
14	Special Region of Yogyakarta	8,59	8,71	8,78	8,51	8,53	8,63	8,72	8,84	9,00	9,12	9,19
15	East Java	6,90	6,95	7,20	6,73	6,79	6,85	6,90	7,05	7,14	7,23	7,34
16	Banten	8,10	8,10	8,15	7,92	7,95	8,06	8,17	8,19	8,27	8,37	8,53
17	Bali	7,60	7,81	7,83	7,74	7,77	8,05	8,10	8,11	8,26	8,36	8,55
18	West Nusa Tenggara	6,70	6,70	6,73	5,73	6,07	6,33	6,54	6,67	6,71	6,79	6,90
19	East Nusa Tenggara	6,42	6,55	6,60	6,50	6,60	6,71	6,76	6,85	6,93	7,02	7,15
20	West Kalimantan	6,70	6,70	6,75	6,27	6,32	6,62	6,69	6,83	6,93	6,98	7,05
21	Central Kalimantan	8,00	8,00	8,02	7,62	7,68	7,73	7,79	7,82	8,03	8,13	8,29
22	South Kalimantan	7,40	7,44	7,54	7,25	7,37	7,48	7,59	7,60	7,76	7,89	7,99
23	East Kalimantan	8,80	8,80	8,85	8,56	8,79	8,83	8,87	9,04	9,15	9,24	9,36
24	North Kalimantan	-	-	-	-	-	-	8,10	8,35	8,36	8,49	8,62
25	North Sulawesi	8,80	8,80	8,82	8,66	8,68	8,71	8,79	8,86	8,88	8,96	9,14
26	Central Sulawesi	7,73	7,81	7,89	7,65	7,69	7,73	7,82	7,89	7,97	8,12	8,29
27	South Sulawesi	7,23	7,23	7,41	7,29	7,33	7,37	7,45	7,49	7,64	7,75	7,95

28	Southeast Sulawesi	7,71	7,74	7,90	7,57	7,67	7,76	7,93	8,02	8,18	8,32	8,46
29	Gorontalo	6,91	6,91	7,18	6,85	6,89	6,92	6,96	6,97	7,05	7,12	7,28
30	West Sulawesi	6,51	6,99	7,05	6,63	6,65	6,76	6,87	6,88	6,94	7,14	7,31
31	Maluku	8,60	8,60	8,63	8,64	8,72	8,80	8,81	9,15	9,16	9,27	9,38
32	North Maluku	8,60	8,60	8,61	7,91	7,98	8,04	8,27	8,34	8,37	8,52	8,61
33	West Papua	7,65	7,67	8,01	6,77	6,82	6,87	6,91	6,96	7,01	7,06	7,15
34	Papua	6,52	6,52	6,57	5,59	5,60	5,73	5,74	5,76	5,99	6,15	6,27