JEMASI: Jurnal Ekonomi Manajemen dan Akuntansi
Vol. 18, No. 1, Juli 2022
Website: http://ejournal.iba.ac.id/index.php/jemasi
ISSN 1858-2702, e-ISSN 2684-8732

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

Anis Ria Susanti[1],

[1]Universitas Indonesia, Depok, Indonesia, anisr.susanti@gmail.com

ABSTRACT

Indonesia is number one palm oil producer worldwide. 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 impact 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. The results for the relation between oil palm plantation and oil palm production with environmental quality index is quiet similar.

Keywords: *Oil palm plantation, oil palm production, economic development, environment, gross regional domestic product.*

INTRODUCTION

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). It contributes 11% of total exports of non-oil and gas products (Statistics Indonesia 2018a). 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).

By 2018, palm oil exports to European Union was decreased due to environmental issue, especially deforestation (Statistics Indonesia 2018a). 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).

As a developing country with a huge population, Indonesia needs to boost its economy to increase the well-being of the inhabitants. 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.

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.

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. Hence, this paper has aim to describe the relation of oil palm development to economic and environmental performance in Indonesia.

METHOD

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.

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 plantationin regional level
$Palm\_oil\_prod$ = total oil palm productionin regional level
α = intercept
β_1 *and* β_2 = coefficient of independent variables
ε_1 = error term

This study examines the impact of oil palm plantation and oil palm production on 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.

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, knowledge and standard of living	Statistics Indonesia (published year 2007 to 2018)
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)

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.

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.

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.

Control Variable

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.

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.

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.

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.

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.

RESULT AND DISCUSSION

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.

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 4. 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 4 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.

Unemployment Rate Empirical Result

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

Table 5. 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 5 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 5. 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).

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 6. 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 area/population)	3.362	
	(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 6 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.

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 7. 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		-0.937***		-0.329**		

price/population)						
		(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 7 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 4. 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 5 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 7 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 6. 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.

CONCLUSION AND RECOMMENDATION

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. 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.

To find the relation between oil palm production and gross regional domestic product (GRDP) per capita, this regression adds two control variables, 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. 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 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.

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. 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. 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, the amount of taxes paid by palm oil companies can be used to repair the damage environment caused by oil palm.

REFERENCES

Abood, S.A., J.S.H. Lee, Z. Burivalova, J. Garcia-Ulloa and L.P. Koh (2015) 'Relative Contributions of the Logging, Fiber, Oil Palm, and Mining Industries to Forest Loss in Indonesia', *Conservation Letters* 8(1): 58-67.

Basiron, Y. (2002) 'Palm Oil and its Global Supply and Demand Prospects', *Oil palm industry economic journal* 2(1): 1-10.

Basiron, Y., N. Balu and D. Chandramohan (2004) 'Palm Oil: The Driving Force of World Oils and Fats Economy', *Oil palm industry economic journal* 4(1): 1-10.

Budidarsono, S., N. Khasanah, A. Ekadinata, S. Rahayu, S. Dewi, R. Suharto et al. (2011), *Reducing carbon emissions associated with oil palm plantations in Indonesia: accounting for greenhouse gas emissions over the full life cycle on peat and mineral soils and building capacity for and industry response to emerging environmental reg(TRUNCATED)* .

et al Chrisolite H (2017) 'Evaluating Indonesia's Progress on its Climate Commitments' World Research Institute. Accessed February 10, 2019<https://www.wri.org/blog/2017/10/evaluating-indonesias-progress-its-climate-commitments>.

CIFOR (Last updated 2012) 'The Context of REDD+ in Indonesia Drivers, Agents and Institutions' (a webpage of CIFOR). Accessed 9/3 2019 <https://www.cifor.org/publications/pdf_files/WPapers/WP92Resosudarmo.pdf>.

Deininger, K. and D. Byerlee (2011) *Rising Global Interest in Farmland: Can it Yield Sustainable and Equitable Benefits?* The World Bank.

Dürr, J. (2017) 'Sugar-Cane and Oil Palm Expansion in Guatemala and its Consequences for the Regional Economy', *Journal of agrarian change* 17(3): 557-570.

Gujarati, D.N. and D.C. Porter (2003) 'Panel Data Regression Models', *Basic econometrics* 4.

Indonesia Palm Oil Association (2017) 'Oil Palm Megasector and New Management Needs' https://gapki.id. Accessed March 15, 2019<https://gapki.id/news/3152/megasektor-sawit-dan-kebutuhan-pengelolaan-baru>.

Koh, L.P. and J. Ghazoul (2008) 'Biofuels, Biodiversity, and People: Understanding the Conflicts and Finding Opportunities', *Biological Conservation* 141(10): 2450-2460.

Lee, J.S.H., S. Abood, J. Ghazoul, B. Barus, K. Obidzinski and L.P. Koh (2014) 'Environmental Impacts of Large-scale Oil Palm Enterprises Exceed that of Smallholdings in Indonesia', *Conservation letters* 7(1): 25-33.

Obidzinski, K., R. Andriani, H. Komarudin and A. Andrianto (2012) 'Environmental and Social Impacts of Oil Palm Plantations and their Implications for Biofuel Production in Indonesia', *Ecology and Society* 17(1).

Obidzinski, K., A. Dermawan and A. Hadianto (2014) 'Oil Palm Plantation Investments in Indonesia's Forest Frontiers: Limited Economic Multipliers and Uncertain Benefits for Local Communities', *Environment, Development and Sustainability* 16(6): 1177-1196.

Rostow, W.W. and W.W. Rostow (1990) *The Stages of Economic Growth: A Non-Communist Manifesto*. Cambridge university press.

Statistics Indonesia (2018a) 'Indonesia's Foreign Trade Statistics', Exports. Jakarta: Statistics Indonesia.

Statistics Indonesia (2018b) 'StatistikKelapaSawit Indonesia 2017', StatistikKelapaSawit Indonesia 2017, No. 05130.1804. https://www.bps.go.id/publication/2018/11/13/b73ff9a5dc9f8d694d74635f/statistik-kelapa-sawit-indonesia-2017: Statistics Indonesia.

Varkkey, H. (2012) 'Patronage Politics as a Driver of Economic Regionalisation: The I Ndonesian Oil Palm Sector and Transboundary Haze', *Asia Pacific Viewpoint* 53(3): 314-329.

Wicke, B., R. Sikkema, V. Dornburg and A. Faaij (2011) 'Exploring Land use Changes and the Role of Palm Oil Production in Indonesia and Malaysia', *Land Use Policy* 28(1): 193-206.

World Growth (2011) 'The Economic Benefit of Palm Oil to Indonesia', The Economic Benefit of Palm Oil to Indonesia, No. February 2011. http://worldgrowth.org/site/wp-content/uploads/2012/06/WG_Indonesian_Palm_Oil_Benefits_Report-2_11.pdf: World Growth Organisation.

World Research Institute (2017) 'Indonesia' World Research Institute. Accessed February 10, 2019<https://www.wri.org/our-work/topics/indonesia>.