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Does Population Matter for Sustainability Development? The Case in Sumatera, Indonesia

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Abstract:

Sustainable development is a new paradigm in the economic development literature and an important issue, that is, development of welfare and environmental approaches. Because without regard to sustainable development, it will lose the potential of a green economy in the GDP. Hence Population becomes an issue that is not simple for sustainable development, regarding quantity and quality, this becomes necessary to understand and find the positive and negative impact of population growth. The purpose of this study was to analyze the interdependence relationship between population growth and sustainable development using panel data in five provinces in Sumatera for the period 2005-2016, with the Fixed Effect Model (FEM) approach. The results showed that there is simultaneously a significant influence on population growth and all variables of sustainable development, partially some variables are not relevant. The relationship of Population growth and birth rate indicators has no effect on food security, population displacement variables and birth rates have no significant impact on the exploitation of natural resources, on signs of petroleum lifting. The results of this study are expected to be considered in the decision making of the Indonesian government, especially Sumatera, to establish a clear policy on environmental issues concerning forests, food security, and energy security. It is expected that the Government makes a serious breakthrough on the quantity and quality of life of the population so that the people do not become an obstacle to sustainable development but become the trigger of development in the long term.

Keywords: *Population growth, environmental degradation sustainable development, food availability, natural resource exploitation, Fixed Effect Model (FEM)*

1. Introduction

Population and development are two things that cannot be alienated because development cannot happen without the population, and the population will not prosper without the development. Every year about 80 million human beings are born and increase the world population which now amounts to billions of people, most of the population growth, 97%, comes from third world countries. The world population is expected to increase to 8.1 trillion by 2025 and 9.6 trillion by 2050 (World Population Report, 2015). Much of this growth will take place in developing countries.

On one side, the population is the trigger of development, but on the other hand, the inhabitants become the barrier of development, the community that triggers development is a productive and consumptive population, while the population that impedes development are more productive than productive, as well as if the population quantity is out of control.

Adam Smith and Malthus was the first to discuss the importance of controlling population growth, Malthus Theory "Principle of Political Economic, more reality in analyzing population growth associated with economic development. Population growth is not just a matter of numbers; it cannot happen without an increase in comparable well-being. (Simone, 2011). Malthus' theory is supported by Barro and Becker (1989) (Barro.Becker, 1989) the population as a threat to development. If the source of the economy remains or does not vary, there are no sources of technical progress. Food production cannot meet the pressures of rapid population growth. Thus some of the investigation is allocated to meet the needs of an increasing population. Indonesia is one of the developing countries, which has experienced a faster population increase. In 2016, the number of Indonesians has reached 265 million, while in the North Sumatera Province 4.8 million. According to the national census of 2016, the population has now increased by about 1.8 percent annually. The consequences of increasing the population on the sustainable development make sustainable development objectives in Sumatera disturbed. For example, the forest destruction every year extends an average of 21,000 ha/year, land transfer 700,321ha / year, water pollution increases, 3.5 percent with less polluted status, high population movement, water supply shrinks an

average of 2.1 % per annum. The population around the forest area is difficult to get the consumption water. So is the availability of water for agricultural land shrink, so that agricultural productivity is low.

Descriptive representation of sustainable development on food security shows that the volume of national food imports increased for 2016 by the US \$ 111, 3 billion, rice imports reached 2.98 million (37% of domestic demand), 60% of local soybean market, (FAO, 2016). For Sumatra the shortage of food each year is 80, 3%. (Report-RI, 2016)(Food Security Report - RI, 2016). Food insecurity in 2030 is expected to increase further. The number of natural resource conflicts increases every year. According to the Ministry of Energy and Mineral Resources (2016), Indonesia's average raw energy reserves are being produced for the next two decades. By using this assumption, no new oil fields are found as fossil energy. Indonesia experienced an increase from 2008-2015, averaging 2.37 from 764.40 million to 945.52 million MSB. For the type of consumption, fuel is the highest energy consumption, followed by Gas, electricity, and coal. Later, the supply shrank 2-3 percent.

The previous study only looks at physical development problems, as measured by macroeconomic performance figures, such as economic growth, per capitational income as in the study of(Gao & Shao, 2016) entitled The Relationship China's Population Structure Change in Minority Areas, Economic Growth and Demographic Dividend-Based and Empirical Analysis. Other studies on population growth and sustainable development are done spatially. For example, they were only looking at changes in a population with Poverty, Urbanization (Shaita, 2010). Population And Natural Resources, (Pech and Sunada;2008). Examined population and water pollution with time series data and Population and food security at Household by Pahari and Murai (2008). Kempt (2004) studied population and water pollution with time series data, generally the previous research using time series data for both primary and secondary data. Seldom was research done with panel data or in some areas. Some of their research shows that the level of urbanization and food availability shows a positive and significant relationship (Shannon, lee, Holloway, Bown, & Bell, 2014). The degree of urbanization and household size have no effect on water pollution (Cole.MA, 2004).(Pool, 2010)Show of population variable is regarded from fixed fertility rate and mortality rates, this study has not been representative of direct sustainable development indicator. Pahari and Murai (1999) were who see the population Density on Deforestation on a Global basis through time series data. (S.Abdalla, 2016) concluded the research, high population growth is an obstacle to balanced nutrition intake for protein and calories, it is difficult to ensure adequate nutrition for households with large household members.

The conclusions and recommendations of previous research were not obtained comprehensively on sustainable development. Previous research was incapable of providing solutions for a reliable and comprehensive development. The instability of sustainable development in Sumatra-Indonesia happens due to the growing process of birth rate and the increasing rate of population movements. This phenomenon is a dilemma, (Houlmant, Parhusip, Bahagijo & Santoso 2015). We will conduct environmental analysis in Sumatera on this issue with data panel model. This study will contribute to the implementation of the Strategic Plan (RENSTRA) for the national mid-term development plan (RPJMN). With local analysis on panel data of 5 provinces in Sumatra, this research is expected to be a weapon for the government to change the primordial nature of society and high culture. So that, our population is under control and matches with population policies in countries that have effective policies on the population, such as Taiwan, Thailand, and Malaysia. The results of this study are expected to be a consideration in the decision of the government to establish a clear policy on the sustainable development. By this research with more comprehensive variables, it is expected to be capable of generating an implementation solution that is useful for all parties involved in sustainable development for communities, governments, non-government organizations that are donors to the event. This research can provide an implementation solution because it is more quantitative measurable, with methods and research models that can show long-term influence and dynamic relationship between variables. The availability of accurate data, the ease of obtaining data, the validity of the data as it comes directly from the stockholder can produce a more significant research.

The systematic writing of this article begins with a background section of the study period. The study is based on the phenomenon of the increasing population and its impact on several current and future economic development issues. The second part is followed by literature review by the material that is studied, referring to the leading theory by Malthus and Adam Smith underlying the emergence of this study; in 1817, Marthus is the first person who stated that the ever-increasing population exacerbated economic sustainability and was a threat. The available natural resources are unable to keep up with the continuous pressures of the population. The third part is the research method, which involves the scope of the investigation, research variables, methods and research models to complete the purpose of the study. The final section discusses research results and conclusions explaining the effect of population growth on sustainable development with the support of data and related data processing that reflects the presence or absence of a link between population growth and sustainable development.

2. Literature Review

2.1. Population and Problems

Central Statistic Agency, (2016) defines population is as a person domiciled in the geographical area of the Republic of Indonesia for six months or more or those who are domiciled for less than six months but are determined to remain. Population growth is one of the important factors in social, economic problems. The population will affect the financial

condition of one region. We can take as the general theory of the research of Ghao & Shao (2016), that development is more successful in the minority population, the study was conducted with panel data from 1992-2012 in the population with small concentration (minority). The result in the minority population of human capital is increasing, the investment is better so it gives good impact for the growth of the economy. Factors of human capital, physical capital and technical progress have a positive influence on the economy. Human capital is able to spur economic growth in minority areas. Of the four estimation models between population growth variables relate significantly to economic growth. Can we conclude this is the positive impact of population growth?

Nelson and Leibenstein in their book "Theory of Low-Level Equilibrium Trap in Economic underdevelopment" analyzed the direct influence of human development and welfare. The result is that rapid population growth in developing countries causes that level of community welfare does not to experience a significant increase in rates, even may decrease in the long term, (Kuncoro, 2009). Economic development experts (Todaro, 2006) argued that Population is the real problem "...Unrestricted population growth is the underlying cause of poverty, low standards of living, malnutrition, bad health, environmental degradation, and other social problems. Disturbing terms such as "Population Bombs" are often echoed as a warning, even horrific predictions about food shortages and ecological disasters are always based on the rapid rate of population growth.

Hesketh (2016) examined that, in the past few decades, the research results stated that the increase of the Chinese population is often a threat to natural resources and the environment. However, evidence suggests that this is unlikely to happen as a universal consequence of the two-child policy. First, the overall increase in the population will be modest, with a peak of approximately 3% higher than the total population of what happens in a child policy. Secondly, it is true that in 2011 water and land per capita in China decreased by 30% to 36%, respectively, compared to 1979, due to population growth. But the decline occurred on average after 2000, due to the policy of two children. It is predicted that the average cultivable land per person will reach the lowest value around 2029 (decrease by about 2% and 6%, then begin to increase gradually as the total population size will decrease after 2029.

2.2. Relationship between Population Growth and Sustainable Development

Sustainable development can be defined as a continuous increase in the socio-economic standard of living of a country's population. Economic growth associated with externalities, i.e., a development that refer to the utilization of natural resources and human resources optimally, without sacrificing the interests of the next generation (Budihardjo & Sudanti, 1993). Professor Dudley Seers poses a series of fundamental questions about the meaning of development, which then evolves into a new definition, a more realistic and pragmatic development, a development not a matter of per-stage growth rates but continues through generations with maximum welfare. C. Smith & Todaro (2002). The results of Marsiglio (2011) study show the unlimited natural resource renewal capacity cannot always divide sustainably; it depends on the difference between the stationary level of fertility and the mortality rate. If stable productivity is lower than the death rate, roads for sustainable development will not be found, and in such cases, public intervention is necessary for continued economic survival. It can only be done through policies that affect public attention to environmental protection or desired intensity.

2.3. Population Growth

2.3.1. Environmental Degradation

Environmental degradation is defined as a decrease caused by development activities that are characterized by poorly functioning environmental components as appropriate due to the existence of intervention or unnecessary human intervention to the presence of the environment naturally. A study in Pakistan showed that the rate of urbanization and the use of fertilizers in Pakistan affected environmental damage. The results indicate that the population does not affect the environment significantly, the sign is positive, which means that the population may cause an increase in environmental degradation by an indirect 1 percent (Pezzey & Toman, 2002). Massive population increases are one of the main obstacles to sustainable economic development and the major determinants of environmental damage, for example, Kemp (2004: 126,135). Baharuddin, (2008), stated that population growth brought about environmental degradation, such as large-scale agriculture, Urbanization, and industrialization. the growing population each year requires the provision of a number of needs for food, clothing and housing. While the land area does not increase, which in turn causes excessive environmental exploitation. Kemp (2004) also said that population growth and changes in lifestyle and technology produced dangerous waste, population growth and human activity affected water quality, pollution, etc. Population and environment have complex relationships; urbanization affects the environment because of the need for new dwellings; the younger generation will leave the home of their parents so that urban areas become the target of the Environment concern. (Hunter, 2004).

2.4. Population Growth and Forest Degradation

Exploitation of forest resources affects other resources. Decree of forestry minister no 677 / kpts - II / 1998 states that State forest is stipulated or established by the minister to be managed by communities living in and around forests for the purpose of sustainable forest use with its functions, emphasize the interests of the welfare of the population. The contribution of gross domestic product of forestry-related business fields over the past six years has reached an average of 2.23% per

year. While the deforestation rate that occurred in 2005 - 2015 in Indonesia showed data of 1.05 million hectares while the conversion of irrigated agricultural land to non-agricultural use reached 331,367 hectares (2010, 2015) (SLHI, 2016). Brush and Turner (1987) modified the model to see other factors affecting land clearing. The result is consumption as a factor of demand for agricultural intensification of the function of population pressure. However, it also includes social forces, kinship, culture, taxes, environmental conditions, and other intensification, such as the use of technology and agricultural inputs (e.g., fertilizers, pesticides, and herbicides). Also, it is considered that this factor also as an alternative cause for the opening of new land.

The theory of Malthus population change must also be understood from the other side about the economy, and the environment. Proximate and period of environmental degradation are interconnected boundaries. (Pahari & Murai, 1999), found that the clearing of forest border not only as a demographic fertility process, but also migration is a major factor behind forest clearance at the border because the boundary areas tend to have very high soil fertility for agriculture.

2.5. Population Growth and Land Depreciation

Does "deforestation" only mean the permanent or temporary loss of forest cover? Two of the primary studies (FAO & Bank, 1997)) implicitly state that permanent or temporary loss of forest cover is deforestation. Thus, it means they consider the shifting cultivation area to be a secondary forest is also deforestation.

Bremmer et al. (2012) suggested using a framework for assessing population, and poverty cycle through Vicious Circle Model (VCM) analysis. According to the VCM model, there is a positive reciprocal relationship among households, population growth, poverty, and environmental degradation. Because of causing a downward spiral for low-income families, the VCM concept suggests that there are some useful inputs, not only to see how population growth affects poverty, but also poverty has an effect on environmental degradation, and environmental degradation has an impact on poverty. Changes in land cover from time to time are caused by human actions commonly associated with the growth of population, economic development, technical and institutional innovation. Land use changes often lead to substantial pressures that generate environmental and socio-economic tensions. Understanding Knowledge of how land clearing and the causes and consequences of sustainable land use is essential, where land users arrive at their land management decisions to avoid adverse outcomes. (Bin & Alousavat, 2012).

They continue their claims from deforestation research due to agricultural expansion or timber production creating scarcity of forest products and reducing the ability of forests to produce economic goods and services. Population growth and economic growth lead to increased demand for forest products and forest services, which can strengthen this scarcity. The price of forest products increases and becomes more profitable by planting trees in forests and gardens. That is the cycle of land degradation will continue to occur.

2.6. Population and Water Pollution

Water quality is defined as water that is safe to consume and appeals to all life on earth. It should not contain chemicals or radioactive substances that are harmful to the health of every life. It should be free of disease-causing organisms and stable regarding corrosion or scaling. Polluted water is unsafe and unhealthy water for humans and animals to drink or wash in. In South Africa, freshwater is scarce, a decrease in water quality due to increased pollution and destruction of river watersheds, caused by urbanization, deforestation, river basin, Wetland destruction, industry, mining, agriculture, energy use. As the population increases, there is a growth in pollution and water resistance, (Rand Water, 2016). Kempt (2004: 277) (DD, 2004) stated that population growth and lifestyle changes and technology brought dangerous waste because nature cannot compete with pollution. Population growth and human activity affect water quality; It can be inferred by the firms that dispose of waste as the cause of water contamination, and the availability of small urban sewage filtering in developing countries like Pakistan. The sanitation and hygiene facilities available for the urban population are limited. It is estimated that 17.5 million tons of solid waste produced annually in Pakistan. Only half were collected and dumped on lowland land without applying proper sanitation methods.

2.7. Population Growth and Clean Water Availability

Tanuguchi, Burnett, & Masuhara (2015) found the results of research on water availability in which some states are limited to the production or the water consumption and production. The research on the availability of water via groundwater and surface water found that the USA and the Philippines had little difference with Canada and Indonesia, where the Indonesian fulfilled availability of fresh water. More than 25% of Countries in the world use groundwater such as Philippines, United States, and Costa Rica. The domination of agriculture on the land causes a higher dependence on ground water mainly for farming. Stream flow differences that exist in Indonesia, China, Canada, Colombia, and Peru are expected to be significant to the ground water storage, yet the reduction of the ground water is much longer than the river water, especially on deep groundwater so as not to accumulate quickly (Tanuguchi, Burneet, Maisura 2004)

Taniguchi, Maisura, & Burneet (2015), examined the availability of water, energy, and food with panel data in Canada, Columbia, USA, Indonesia. The results show a reciprocal relationship to water availability, the observation of surface water and ground water. There was a weak positive correlation between the availability of clean water from population growth with

$R = 0.262$). It means that fresh water is not available as expected, or below 100%. There is a great difference between water sources where surface water sources are more secure than groundwater sources, with 100% self-sufficiency.

2.8. Population and Food Security

Definition of food security is seen from four dimensions, that is; Available, Stable, Safe, and Access. The World Food Summit (FAO) defines food as per its views, that is, the term of food security is when everyone is satisfied and has physical and economic access to adequate, safe, nutritious food to meet food needs and have a food preference for an active and healthy living. "Food safety is related to food quality, not just the amount of food available. If they cannot consume without risk, especially health problems, worldwide is concerned about food for access that provides support to basic needs concerning the Price of spikes in 2007-2008, triggers the long-term and short-term complex factors (FAO, 2009).

The Food Agriculture Organization (FAO) predicts that by 2015-2030 food production will decline by about 1.9% annually, but still higher than the 1.8% annual rate of population growth. The agricultural sector is expected to meet the percentage of population increase from birth and urbanization levels. The availability of food should be accompanied by adequate nutrition distribution channels such as technological transport and the availability of food outlets. In the rural areas, this becomes a problem, especially in developing countries.

The conclusion of (2009) (Matchuce, 2009) study published in the FAO publisher explained the relationship between population migration and food safety and comparing food diversity maps for 2005 and 2015, indicating potential food safety points in the future. We found that the migration has a profound effect on all dimensions of food security and city infrastructure investment will be needed in small towns and medium enterprises.

2.9. Population and Energy Security (Exploitation of Natural Resources)

Thomas Malthus is the first person who elaborates a systematic analysis of demographic and natural resources, followed by Karl Marx who has a radically different perspective of Malthus. Both these theories come from various sources of literature. Karl Marx underlined the different viewpoints between them about the population and scarcity of natural resources. Between 1980 and 1990, the world population increased by more than 800 people, the largest increase in a decade, leading many to believe that the value of natural resources can be precious. (Tietenberg, 2004)

Higher population density usually places natural resources under increasing pressure. Therefore, it affects the environment and overall development. However, as indicated in the Mekong Delta, it can also allow positive impacts, a large population can provide sufficient and encouraging labor social and economic change through new ideas and innovations. This kind of achievement is positively correlated depending on the broader context (Keskinen, 2008).

3. Methodology

3.1. Data and Variables

This research was conducted by using explicit and quantitative methods to analyze the relationship between population growth and sustainable development. The analytical tool used is the Least Square Model Panel approach (PLS), the Fixed Effect Model. The data consists of secondary data in the cross section and time series (Data panel) sourced from the Central Statistics Agency (BPS), the Indonesian Environment Status (SLHI) of various editions, Food Statistics (KP-Nasional) different publications, and the Mining Ministry and Energy (EMR).

This study used variables as contained in the table with the 2005 annual data frequency, various provinces on the island of Sumatra. The variable of Population growth consists of natural birth rate and growth of migration, while sustainable development is related to environmental degradation variables, such as land cover, forest depletion, water pollution, water supply. Another variable is the exploitation of natural resources, which consists of oil lifting, natural gas lifting. Furthermore, the variable of sustainable development is food security, consisting of food availability, food consumption, and food import.

Variable	Indicator	Scale
W	Fertility rate in each province	Percentage
TrPo	The rate of population movement in each province	Percentage
FClo	Forest cover area due to transfer function	Hectare (Ha)
LcLo	Land transfer function	Hectare (Ha)
PoHo	contaminated River water and wells index	Mg / L
CH20	Percentage of Clean Water Availability is eligible for	Percentage
Food	consumption and standard Food availability available	(Kg / Cal)
Cfoo	Total consumption of calories and protein per year	(Kg / Cal)
IMFo	The number of food imports each year per province	Dollar / Ton
LfGo	The amount of oil is lifting each year.	MMBTU / Barrel
LfNG	Natural Gas lifting amount annually per province.	MMBTU / Barrel

Table 1: Operational Definition of Variables

3.1.1. Panel Data Regression Model

Panel data is a combination of cross-data and time series data. In panel data, the same cross-section unit is measured over several periods and times. Data regression model in this study used independent variables, that is, population growth of birth rate (Pgow), population transfer rate (Trpo). The dependent variables are sustainable developments, that is, forest cover (FCLo), land transfer (Lclo), Water Pollution (PoHo), Water Supply (CH2o), food security with food availability indicator, Food Consumption (Cfoo), Import of food (Imfo), and exploitation of Natural Resources with Lifting Petroleum Lifting (LfGo), lifting natural gas (LfNG). The regression equation can be written in mathematical functions:

$$Y_{it} = \alpha_{it} + \beta_1 X_{it} + \beta_2 X_{it} + \varepsilon_{it}$$

With,

Y_{it} : Unit-I cross section into for t

β_1 : constant 1xk

X_{it} : vector observation on an independent variable.

ε_{it} : Error Component (0, σ^2)

The regression equation in panel data modeling in this study is as follows.

3.1.2. Population Growth on Environmental Degradation

$$FCLo_{i,t} = \beta Y_{i,t-1} + \mu_1 Pgow_{i,t-1} + M_2 TrPo_{i,t-1} + \epsilon_1$$

$$LCLO_{i,t} = \beta Y_{i,t-1} + \mu_1 Pgow_{i,t-1} + M_2 TrPo_{i,t-1} + \epsilon_2$$

$$Poho_{i,t} = \beta Y_{i,t-1} + \mu_1 Pgow_{i,t-1} + M_2 TrPo_{i,t-1} + \epsilon_3$$

$$CH2O_{i,t} = \beta Y_{i,t-1} + \mu_1 Pgow_{i,t-1} + M_2 TrPo_{i,t-1} + \epsilon_3$$

3.1.3. Population Growth on Food Security

$$Food_{i,t} = \beta Y_{i,t-1} + \epsilon_1 Pgow_{i,t-1} + \epsilon_2 TrPo_{i,t-1} + \beta + 1. \epsilon_1$$

$$Cfoo_{i,t} = \beta Y_{i,t-1} + \epsilon_1 Pgow_{i,t-1} + \epsilon_2 TrPo_{i,t-1} + \beta + 1. \epsilon_2$$

$$Imfo_{i,t} = \beta Y_{i,t-1} + \epsilon_1 Pgow_{i,t-1} + \epsilon_2 TrPo_{i,t-1} + \beta + 1. \epsilon_3$$

3.1.4. Population Growth on Exploitation of Natural Resources

$$LfGo_{i,t} = -1 + \beta Y_{i,t-1} X_1 Pgow_{i,t-1} + X_2 TrPo_{i,t-1} + \epsilon_1$$

$$LfGo_{i,t} = -1 + \beta Y_{i,t-1} X_1 Pgow_{i,t-1} + X_2 TrPo_{i,t-1} + \epsilon_2$$

3.2. Regression Model Selection Test

The estimation of the panel data model uses the Ordinary Least Square model in the joint effect (CEM), with the suitability of the fixed effect (FEM) model, partially from each of the above equations. The above formula can be defined in each variable such as table 3. Where; t = time of observation, j = observation area (5 provinces), α_1 = Elasticity of kn-k variable, ε_1 = error term. Before the model is estimated, a model specification test is performed to determine the appropriate model used.

3.3. Model Significance Test

According to (W.Winarno, 2015), the significant Model Testis begun with Significance Model Test of fixed Effect, an important test to determine the best type, between fixed effects or common effect. The Testing is done by Chow test which is difference test of two regression model by using F test statistic. Next, the Random Effect Significance Test was done. This test aims to determine whether the random effect model is better than the common effect model. The testing is done by using Multiplier Lagrange test statistic. Then it was conducted the Fixed Effect or Random Effect significance test. If one of the above test results show that fixed and random effect model is better than the typical effect method, testing is done to select the best model for fixed effect or random effect. Hausmant (1978) has developed a statistical test to choose whether to use fixed effect or random effect; theHausmant test uses H test statistic that follows the Chi-Square test with a free degree for the number of independent variables.

3.4. Testing of Regression Parameters

The testing of regression parameters needs to be done to know the relation between an independent variable and dependent variable. Regression parameter testing performed simultaneously, for each regression equation. The simultaneous test is used to determine the effect of all independent variables on the dependent variable with the following hypothesis. H_0 is rejected if $F_{count} > (F_{\sigma; k-i, n-k})$ where n is the number of observations and K is the number of parameters.

4. Results and Discussion

The results from field studies of each variable to sustainable development indicator variable in environmental degradation variable with indicator of land function change, water pollution index, water supply, water pollution are in Table 3-1. The food security variable can be seen in Table 3-2 as an indicator of food availability, food import, and food consumption.

The variable of energy security with oil lifting indicator is seen in figure-1 and natural gas lifting in figure-2 with an indicator of exploitation of natural gas, and operation of fuel oil (BBM). A variable dependent is variable seen in figure-3, that is, population growth rate within indicator of the rate of birth rate and level of population migration.

Each shows the data in the table below; the data is selected in five provinces on the Sumatera Island. This island is chosen because the five provinces are provinces that have a warmer environmental issue than other provinces such as Riau, Jambi. The regions selected relatively have many natural resources. Aceh and North Sumatera have high population growth rates; the provinces are considered provinces that represent the data and variables studied.

Province	Forest Cover (FcLo)(Ha)			Land Transfer Function (LcLo) (ha)			Water Pollution Index (PoHo) - (SU-SG)(mg/l)			Clean water Availability (CH2O) (mg/l)		
Aceh	62	192	132	248	724	660	7 11	5,7 5,6	6,8 6,8	74	73	10
North Sumatera	311	137	112	31	304	170	-34 -28	-27 -18	-34 -36	602	679	35
West Sumatera	71	82	59	39	626	84	32 10	48 34	33 37	75	10	10
Jambi	80	50	93	668	758	832	16 23	15 10	37 34	13	85	602
Riau	17	21	18	451	710	600	10 19	20 12	15,7 12,2	28	59	67

Table 2: Outcomes of Indicators for Sustainable Development of Sumatera during 2005-2016
Source: Indonesia's Environment Status (SLHI), 2017, Water Statistics 2017

Water Pollution Index (PoHo), with the description: heavily polluted Water (34-40), Medium polluted (17-33), Uncontaminated (34-40). SG = River Water Pollution. SU = Well Water Pollution. The table above represents the sustainable development specification. The figures in the table are representative data for each indicator of sustainable development and population growth, where environmental degradation uses units (Ha) for land cover, and forest degradation. Water pollution is measured by index (mg / l) which number is determined by the Laboratory of the Environmental Impact Control Agency as the test implementer of air and water pollution testing. The availability of clean water is determined by the percentage by Indonesian Census Statistics Agency of clean water, which indicates the achievement of the rate of safe water use by the people of Sumatera.

Province	Food Availability(Kg/cal)			Food Consumption in Billion(kg /Cal)			Food Import (Thousand US\$)		
	005-008	009-013	014-016	005-008	009-013	014-016	005-008	009-013	014-016
Aceh	3210	4310	3570	5434	577	5303	2300	1580	2780
N. Sum	189	197	230	79	651	731	2042	1511	1770
W. Sum	201	211	2653	612	823	686	72	1560	1540
Jambi	2526	288	298	694	610	640	1651	1572	1410
Riau	1	1214	1911	479	572	331	1710	1530	2440

Table 3: Outcomes of Indicators for Food Security in Sumatera Island during 2005-2016
Source: LAKIP- Food Security of Provinces, 2017

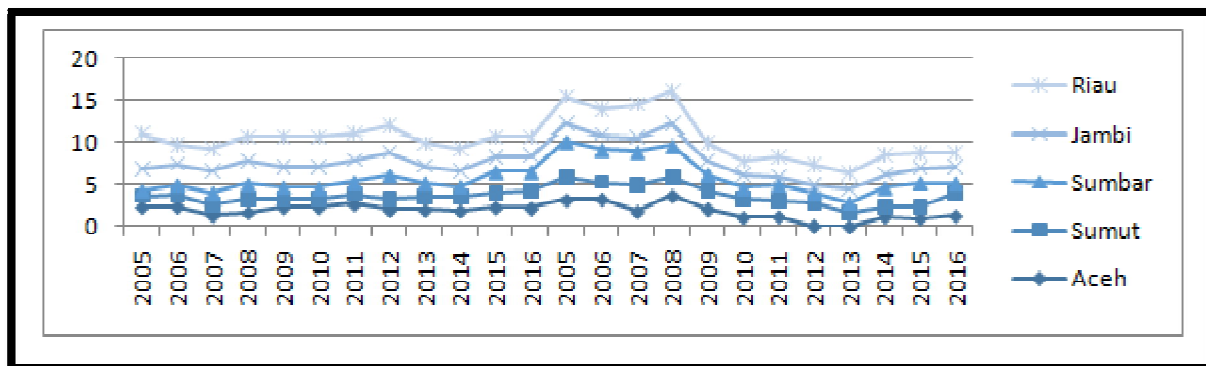


Figure 1: Oil Lifting in Sumatera during 2005-2016
Source: (Magazing, 2016), Ministry Government ESDM

The figure below shows the exploitation variable of natural resources with oil and natural gas lifting indicator during 2005-2016 in Sumatra, with the cubic unit (barrel). The data were obtained through ESDM Ministry. For West Sumatera, oil and gas lifting are zero meaning that in the region there are no natural resources of petroleum and natural gas. Riau Province is a province that has a lot of exploitation of natural resources/energysecurity. Natural resources experienced a decrease of exploitation every year.

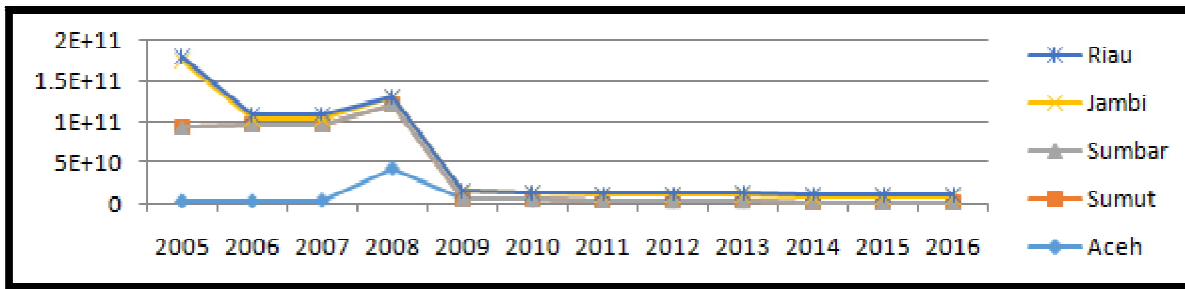


Figure 2: Natural Gas Lifting in Sumatera during 2005-2016
Source: Ministry of Energy and Mineral Resources-Mining Magazine

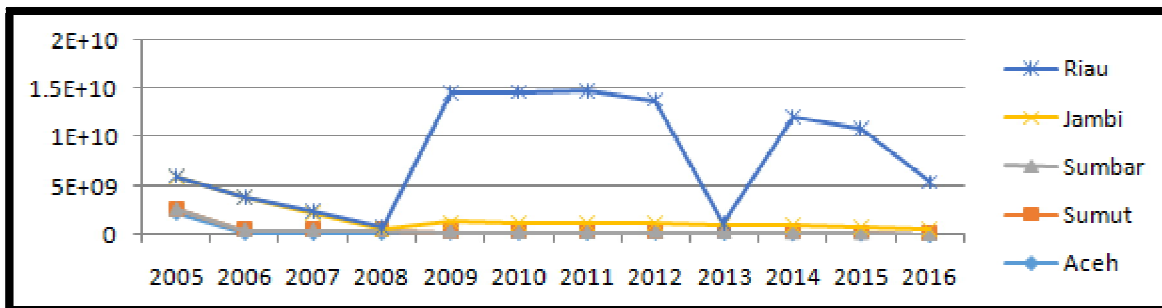


Figure 3: Population Growth Rate in Sumatera during 2005-2016
Source: Central Statistics Agency (Susenasdata, 2017)

Figure.3 shows the rate of population growth in some provinces in Sumatra from 2005 to 2016. Population growth rate happened in Aceh, North Sumatera, West Sumatera, Jambi, and Riau. The rate of population growth in Aceh tended not to fluctuate; the increase was not significant, each year only a difference of 0.5-1 percent. So the form of the data is rather flat. Almost all provinces had decreased population growth rate from 2012-2015. While the province of Riau and Jambi, population growth periods tended to fluctuate, West Sumatera in the last period of population growth increased between the years 2014-2016 with a rate of 1-2 percent.

4.1. Normality Test

The normality test aims to test whether in the regression model the dependent variable or residual has a normal distribution or not (Hl.Gozali, 2009). Normality test method (normal distribution) is done with Jargue-Bera (J-B) test. From the result of Jargue-Bera test it can be concluded that all variables in this study, normally distributed, where Prob-statistic > 0,05, JargueBera value < value x² table.

Variable	Jargue- Bera	Prob *
FcLo	3.5095	0,0000
LcLo	0.0509	0.2477
PoHo	1.1026	0.9753
CH2o	6.6600	0.5701
Food	14.100	0.0008
Cfoo	6.1025	0.2903
IMFo	23.119	0.0000
LfNo	13.009	0.0026
LfNG	12.342	0.0000

Table4: Normality Test Result
Source: Processing Data, Author, 2017

4.1.1. Heteroscedasticity Test

Heteroscedasticity arises if the errors or residuals of the observed model do not have a constant variance from one other observation. By using white test comparing Obs * R-square and X² table, it can be concluded that all variables are free from heteroscedasticity, except for forest cover variable (LcLo) because of sig = 0.0439, as shown by table-3.

Variable	F- Statistic	Obs*R-quare	Sig
FcLo	3.01648	8.10679	0,0439
LcLo	1.05224	0.32350	0.8836
PoHo	2.06381	5.86209	0.1185
CH2o	1.40128	4.18082	0.2426
Food	0.6967	2.14699	0.5425
Cfoo	0.6796	2.14699	0.5425
IMFo	0.5843	1.86018	0.6019
LfNG	1.18328	3.591165	0.3091
LfNo	0.26201	0.856756	0.8358

Table 5: Heteroscedasticity Test Result
Source: Processing Data, Author, 2017

4.2. Multicollinearity Test

The multicollinearity test aims to test whether the regression model found a correlation between independent variables. A good regression model should not be correlated with independent variables. If the value of R² generated in an estimation of the empirical regression model is very high, but individually many independent variables do not significantly affect the dependent variable, this is one indication of multicollinearity (Imam Ghozali, 2005).

The multicollinearity test results of the above variables show that all test results do not occur multicollinearity, as indicated by R² of R* - Square.

4.3. The Results of the Model Accuracy Test

Based on the results, the redundant test (chow test) showed the value of P-value < critical value for each test phase. So that, the fixed effect model (FEM) is considered more appropriate. Based on the trial the Hausman test, the p-value summary < critical value ($\alpha = 0,05$), thus H₀ is rejected. The Fixed effect test model approach is more appropriate than Random effect. The result of panel data analysis in this study is shown in inTable 5. The test is done per-stage according to the above equation.

Variable	Coefficient	Standard Error	P.value
C	-1 6.1007	17 .000	0.6 555
Pgow	- 11.6001	12.800	0. 3202
TrPo	42. 0032	19.826	0. 0211*
FCLo	0.10 06	0. 2311	0. 4120
C	2 8.1100	0.1 100	0.0 281
Pgow	5 1.6600	0. 009	0. 5627
TrPo	-24. 2210	0. 738	0.0123*
LCLo	0.4 0087	0.1 150	0.00 23*
C	2 4.2011	11 .005	0.9194
Pgow	0. 5579	3 .1100	0. 6187
T rPo	- 38.5466	0.0 087	0.0 621**
PoHo	0. 11064	0. 2390	0.0 001
C	32. 2000	18.990	0.01 21*
Pgow	- 18.2340	9 .0086	0.1 221
TrPo	1 7.1167	73 .001	0.0 729**
CH2o	0.4 019	0. 2328	0.0102
C	30 . 9818	5567 4	0. 5421
Pgow	0 7. 5261	2.0131	0.0 662**
TrPo	- 10.0732	20. 341	0.0 431**
Food	0 . 44301	0. 0019	0.000 0
C	97 .3500	1 41.00	0.005 0**
Pgow	-42.0681	4 3.701	0.0 902**
TrPo	0.1220	0.25 12	0.12 19
Cfoo	0. 2340	0.1 3250	0.01 32

Variable	Coefficient	Standard Error	P.value
C	64.9480	3 28177.5	0.0 524*
Pgow	16.964.51	1 2321.02	0. 9010
TrPo	1 0.2310	126 320.4	0.03 11*
IMFo	4 .10011	0.1 8402	0.00 42*
C	-0. 2010	1.7 001	0. 3210
Pgow	1. 03010	0.0 340	0.0 523*
TrPo	- 41.3300	10.25 5	0. 9000**
LfGo	0. 3371	0.1491 0	0.000 3
C	- 5.30311	1 .7200	0. 3100
Pgow	0. 40814	0.0 455	0.0 349*
TrPo	2 .2000	1. 5600	0. 9760
LfNG	-1 0.0179	17 008.9	0.0000 **

Table 6: Estimate Fixed Effect Model (FEM) Cross Sections Weight

Source: Processing Data, Author, 2017.

* = Sig Pada A = 0,05 dan ** = Sig Pada A = 0,1

Variable	R-Square	F- Statistic	F- Prob
FcLo	0.4 091	2 .5603	0. 3250
LcLo	0. 6441	5 .2530	0.00 00
PoHo	0 .8194	7 .0114	0.00 63
CH2o	0. 5200	6 .9031	0.00 54
Food	0. 1604	20 .5100	0.000 0
Cfoo	0. 3240	1 5.1008	0.000 1
IMFo	0. 4350	4. 43603	0.00 17
LfNo	0. 8010	1 7.3012	0. 0000
LfNG	0. 8940	558 .008	0.00 08

Table 7: Fixed Effect Model (Fem) Model Estimation Test Statistic Population Growth

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Source: Processing Data, 2017

4.6. Regression Test Analysis

4.6.1. Population Growth on Environmental Degradation

In table 6, it is shown Prob (F-Statistic) with average value $\alpha = 0.05$. Each variable can be explained that all independent variables (Pgow and Trpo) affect the dependent variable (FcLc, LcLo, PoHo, CH2o, Food, Cfoo, IMFo, LfNG, LfNo).

Based on the partial test results, the variable of birth rate does not affect the area of forest cover in Sumatra, with probability value 0.3250. But the independent variable is only able to explain the influence of both of them only 40%, with $R^2 = 0.4091$). The population growth over land conversion has a significant adverse effect, with the independent variable of only 34 percent. Water pollution variable caused by population growth has an important impact on belief $\alpha = 0,10$. While the variable of population movement explained its effect on water pollution of 81.9 percent on the island of Sumatra, and 19 percent explained by other factors. The population and water pollution, examined by Kemp (2004) with time series data, are significant between population growth and water pollution, due to lifestyle changes. The high urbanization in Pakistan affects the availability of clean water and expand water pollution. In contrast to the research done by Taniguchi, Maisura, Burneet (2015), by using panel data examining the availability of clean water with surface and ground water, found a weak positive relationship, meaning that population growth causes water supply to decline.

Furthermore, the relationship between the population growth velocity and clean water is significant both through birthrate and population movement. The relationship between the two variables can be explained by $R^2 = 81.02$ percent. The results of this test are highly relevant to Pezzey's theory (2002), the population may indirectly affect environmental damage. Ian pool (2010), population changes tend to destroy the environment.

4.7. Population Growth on Food Security

Based on the partial test results, the population displacement variable affects the availability of food in Sumatra, but with the birth rate has no effect. Population growth due to the rate of birth on food consumption has a significant impact on the confidence of 10 percent, with the explanation of 60 percent variable identification. Furthermore, imported food is significantly related to population movement in Sumatera island; there is belief $\alpha = 0,05$, this is the result of research of Matuschke, (2009), (Rueel & Garret, 2004). But the imported food test results are not significant with the birth rate of the

population, where the significance value > 0.05 or 0.8940 is probably due to the percentage of birth rate and food security within the country is still in an enabling ratio. When associated with theory by (FAO, 2015), predicting food supply has decreased due to drought and climate change. However, the results of the test in this model are still relevant when the findings of (Shannon and Sun-lee., 2008) the rate of population movement indicate a significant relationship to food availability.

4.8. Population Growth on Energy Security (Natural Resource Exploitation)

The results of the test of the relationship between population growth and energy security in Sumatra can be explained as in table -1, that, simultaneously, population growth is related to birth rate and population movement correlated significantly with energy security, i.e., petroleum, with a confidence level of 0.5% and 10%. However, partially, oil lifting is not related to birth rate and population movement. However, the lifting of petroleum can be explained by the population growth factor of 74%. Furthermore, population displacement variable correlated significantly with natural gas lifting, at $\alpha = 0.05$, whereas birth rate correlated significantly on belief $\alpha = 0,1$. The interdependence relationship of both variables can be explained by R-Square 0.8920 , meaning that natural gas lifting can be explained by population growth of 89%. While the exploitation of petroleum can be defined by the population growth of R-Square 0.8010 or 80 percent.

The results of this test indicate that population growth on energy security is not entirely significant. As the theory of Thomas Malthus, it does not adequately represent the results of this study. According to Malthus, with a radical perspective, the population continues to increase causing pressure on natural resources. In fact, the product of this research is entirely different pech's and Sunada's (2008) research suggesting that population levels should co-exist with natural resources.

5. Conclusion

The testing of panel data was tested simultaneously for all provinces on the island of Sumatra. The results showed that the independent variables had an effect on all independent variables simultaneously, meaning that the population growth velocity was related to environmental degradation, except that birth rates that did not significantly affect forest cover. The finding is in line with Malthus's theory quoted by Pahari and Sanurai (1999), and Brush's and Turner's (1987) research with the statement that forest destruction was not only due to the demands of population consumption, but because of culture, kinship, and environment and so on. The result of the test on the variable of land function change is related to the population growth, but the interdependence of the variable is weak.

On food security of significance test results, the population growth is simultaneously related to food availability variables, unless the birth rate is not related to food availability and food imports. The variable of energy security shows that the variables of natural resource exploitation positively related to the rate of birth and migration significantly. According to a study by Keskinen (2008), the increasing population will place natural resources under pressure, but partially oil lifting is related to birth rate. Population movement of birth rate is related to natural gas lifting with an independent explanation of enormous variable, 98.2 percent. Not all variables in this study are by Malthus's theory. Policies on population growth should be a serious issue and priority to be addressed, as they have become a serious burden for sustainable development. This ignorance will have an adverse effect in the future, resulting in a "stationary state" situation that Ricardo means, that growth no longer occurs due to saturation, and due to government indecision in the population problem. The government is expected to pay attention to environmental sustainability, food, and Energy, through the application of effective policies to the population.

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