

CARBON EMISSION (CO₂) AND POVERTY ON HUMAN DEVELOPMENT INDEX EVIDENCE IN EAST JAVA

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Abstract

Carbon emission is exhaust gas that exist around us. According to data estimation of the Intergovernmental Panel on Climate Change (IPCC), carbon emission in Indonesia was 201 million tons and sharply increase in 2024 that will reach 383 million tons. This paper explains about the effect of CO₂ emission levels and poverty on the human development index. The data that used is a time series of secondary data within the year of 2012 to 2016 and a cross-sector with 38 regencies in East Java. This research use panel data regressions analysis method. The result concluded that the emissions level in East Java affect positively and significantly towards the human development index. Those, caused by the emission of CO₂ levels in East Java still in a good category, means that the environment is still capable of tolerating the emission level. The poverty level effect negatively and significantly into the human development index.

Keywords: *carbon emissions; CO₂; poverty; human development index word; development*

INTRODUCTION

Economic growth does not always lead to increased welfare, for example poverty reduction. Once again, study from Anakusara & Jamal (2019) have proved that growth does not have a negative effect on poverty reduction.

Economic growth is just an indicator to determine the human quality of one country. With high economic growth, a country's development will be more successful. Moreover, economic growth is one indicator to determine the quality of life (Hitam & Borhan, 2012). However, the quality of a country cannot be determined solely from the gross regional domestic product or national income, but also the quality of life of its citizens.

Usually, high economic growth is driven by the support of secondary and tertiary sectors such as industry and services. There is a positive connection between economic growth and industrialization. The study in 67 developing countries from Szirmai (2012) concluded that engine of growth is industrialization. However, high economic growth has also caused a high level of pollution. This aims to improve the society welfare by promoting advanced and high quality living standard. Wang, Zhou, Li, & Feng, (2016) explained that rapid economic growth is caused by industrialization process from the use of energy resource that resulted in CO₂

emission. The main objective of industrialization sometimes turning to the wrong direction. This is caused by there are many producers who ignore the environmental issues during production. Neglected environmental quality will leads to high emission gas. Hassan, Zaman, & Gul, (2015a) explains that in a short term, economic growth and carbon emission has a negative relationship. Saepudin & A (2016) explain about community empowerment to reduce poverty.

Air pollution can be defined as the presence of foreign substances in the air that leads to a change on the air composition from its normal state (NIEHS, 2019). There are two factors that causing air pollution, namely internal factor (naturally) and external factor (due to human activity). Air pollution has become a serious issue in the surrounding area near with industrial area. This condition not only affect the environment but also the quality of life of the community.

New machine and utilities usage in industry sector as well as technology implementation to achieve high quality product is expected to increase the quality of life. However, in reality, industry and technology reduces the quality of environment and the quality of life.

The air that polluted with carbon dioxide will mixed with hemoglobin and affect bloods' capability to bind oxygen. This process is crucial in energy formulation in human body. When the process is hampered, the energy

produced will be reduced, which leads to inefficiency in human body activity.

Health development started to decrease because of the carbon pollution in the air and other dangerous particles. Ghorani-Azam, Riahi-Zanjani, & Balali-Mood (2016); Sugiarti (2015), dan Patz, Frumkin, Holloway, Vimont, & Haines, (2014) explain that carbon emission reduction is important for the sustainability of human life in the future.

Knight & Howley (2017) from York University examine the living satisfaction in several cities that have high pollution. They find that emission reduction will be beneficial for the community. According to them, pollution is causing the death of thousand people in Europe.

When the environment does not support human activities, there will be a dissonance which leads to slums area. The level of poverty become a problem for both developed and developing countries, which extended to smaller scope at municipality or city level. Poor community tend to use the available resource without any renewal. Therefore, when poverty level increase the environment quality will decreased. Moreover, most of the population that live under the poverty level will be more focused to cover their basic needs such as food, clothing, and housing. In general, they rarely think about how to fulfill their life quality such as education and health, thus it decreases their life quality.

Figure 1 shows that the purpose of economic growth often has negative consequences on environmental damage. Take, for example, fuel used by industry carries the risk of pollution. The mining sector will deplete natural resource reserves and damage biodiversity, while the transportation sector causes air pollution to get worse.

According to Borhan, Ahmed, & Hitam, (2018a), the human development index will be improved by the level of air pollution, in this case, is CO₂ levels. Every increase in CO₂ will cause an increase in the level of growth and an increase in productivity. The impact of an increase in income will increase, and ultimately the poverty rate will increase. The opinion of Borhan, Ahmed, & Hitam (2018) is supported by Hassan, Zaman, & Gul (2015b) and Knight & Howley (2017).

Poverty causes difficulties to increase quality in their life, because they have been in vicious circle, which is a place where poor people will find it difficult to get out of the poverty trap. Poverty will produce more a low quality generation.

Economics growth has some sectors such as industrial, mining, and transportation. The increase in human needs complexity leads to exploitation of natural resource, which resulted in high carbon emission because of the lack of air absorption such as trees. Moreover, poverty gap will be created, where those who are rich will get richer and vice versa. The level of carbon emission has a significant relationship with the human development index.

The degradation of environmental quality due to high emission will lead to imbalanced environmental condition between the human resource quality and air quality. This condition will lead to increased global warming level. According to World Meteorological Organization (WMO), the level of carbon dioxide in the atmosphere increased rapidly in 2012 for the last decade. In 2012, the level of carbon dioxide in the atmosphere reached 393.1 parts per million (ppm) which increased from 2.2 ppm from the previous year. This level is above the average annual rate, which shows 2.02 ppm over the last few years.

Due to the high level of carbon dioxide, the level of ocean acidity is increased. This is because the CO₂ gas that absorbed in the ocean will remain for hundred years, which is longer than the emission in the atmosphere. Moreover, high emission level will make 52% of the ice on the surface of Greenland melts. These ice melt can be considered as a significant event since 1889 because of the ice melts level is above the average melting rate.

High level of carbon dioxide emission level has become one of world problem. There are organizations that started the actions to reduce carbon emission. One of the action taken is through a new agreement known as Paris Agreement. This agreement is an agreement between certain countries that approves the temperature threshold to be lower than 2°C. Indonesia is of the countries that participate in the agreement. Moreover, the current president of Indonesia, Joko Widodo deliver a commitment to reduce the greenhouse gases emission in 2030 by 29% using national support and 41% of international assistance.

Emission level consists of several particle components with majority of CO₂ gas. Economic sector that uses fossil fuel has the highest contribution to emission compared to other activities with 56.6 percent. Figure 1 explains the composition of contributor to emission level from several human activities.

High emission will reduce environmental balance and quality, which leads to degradation of environment quality and creates unhealthy area or even slum area. As a result, poverty level will increase. East Java is one of industrial area in Indonesia. In 2016, industrial area in East Java contributes to the growth of national manufacturing sector for 21.08 percent. Based on BPS residual data for the year of 2009-2013, East Java Province has a quite high and is almost equivalent to DKI Jakarta compared to other Provinces in the Java Island. Furthermore, the air quality index in East Java in 2013-2015 is under the National Medium-Term Development Plan (RPJMN) at 84 percent. This shows that the air quality in East Java Province is low. Therefore, this research will examine two points, the effect of carbon emission (CO₂) on human development index and the effect of poverty on the human development index of East Java Province community in 2012-2016.

Based on research from Borhan, Ahmed, & Hitam (2018) and Hassan et al., (2015a), we formulated that the level of air pollution (CO₂) will negatively affect the index of human development index. While based on Mirza, (2012) and Adelfina & Jember, (2016), we expressed that the poverty level hypothesis will also adversely affect the index of human development index.

METHODS

This research uses a cross section data from 38 regencies/municipalities in East Java Province and time series data from the year of 2012 to 2016. The analysis method used is panel data regression.

The data used in this research is the data on carbon emission measured using proxy value of climate change and performance index, Gross Regional Domestic Product of regencies/municipalities and Indonesia’s gross domestic product. The data on poverty level and the data on quality of life using the data of Human Development Index, which is obtained from BPS of East Java Province.

In this stage the best empirical model between a linear or log-linear model will be chosen. This research uses MWD to determine the best empirical model, MWD test choose the best model to be analyzed in the research . MWD test using the following formula:

$$HDIL_{it} = \alpha_1 + \alpha_2 CO_{2it} + \alpha_3 Poverty_{it} + \mu_{it} \dots\dots\dots(1)$$

$$LHDIL_{it} = \beta_1 + \beta_2 CO_{2it} + \beta_3 Poverty_{it} + Z_2 + \epsilon_{it} \dots\dots(2)$$

Where, HDI is Human Development Index, CO₂ is Carbon Dioxide, and Poverty is a number of households that living under poverty line. LHDI is model logarithm of HDI and μ_{it} & ϵ_{it} are error term.

Panel data regression estimation model has three approaches as follows:

$$Y_{it} = \beta_{1i} + \beta_2 X_{2it} + \beta_3 X_{3it} + \mu_{it} \dots\dots\dots(3)$$

$$Y_{it} = \alpha_1 + \alpha_2 D_{2i} + \alpha_3 D_{3i} + \alpha_4 D_{4i} + \beta_2 X_{2it} + \beta_3 X_{3it} + \mu_{it} \dots\dots(4)$$

$$Y_{it} = \beta_0 + \sum_{k=1}^p \beta_{kt} + \mu_{it} + \epsilon_t \dots\dots\dots(5)$$

Chow test, this test is conducted to determine the estimation between Polled Least Square and Fixed Effect Model. Lagrange Multiplier test, this test is conducted to determine the estimation technique between Pooled Least Square and Random Effect Model. Haussman test, this test is conducted to determine the estimation technique between Fixed Effect Model and Random Effect model. Statistical test is calculated from t statistic, F statistic, and determination coefficient.

RESULTS

Industrial area in East Java Province is an active industrial area. This causing a concern that it will increase carbon emission if the industrial activities

are not followed with a maximum environmental preservation. Beside the industrial activities, other source of pollution in East Java Province are from volcanic mountains, forest fire, dust storm, and transportation (Murniyanto, 2011).

There is a discrepancy of economics development between the rural areas and urban area in East Java Province. As a result, the economics discrepancy in East Java Province is quite high, which leads to higher poverty level. In September 2016 to March 2017 the poverty level increase for 3.92 percent or Rp. 12.920 per capita per month. One of the factor that causing high poverty is the rising in fuel prices which leads to the rise of basic commodities price.

This index is obtained from the proxy of Indonesia’s CO₂ emission index, Gross Regional Domestic Product of regencies/municipalities and Indonesia’s gross domestic product. Based on the calculation result, the highest carbon emission is obtained by Surabaya city with an average carbon emission for 5 years reach 9.5 percent. This is because Surabaya is the industrial center in East Java Province.

The result of the MWD test shows that the Z1 probability value is lower than the significance level at 5%; it means the Z1 is statistically significant. This result indicates that the log-linear model is the best model for this research data. The Z2 probability value is lower than the significance level at 5%, and it means the Z2 is statistically significant. This result shows that the linear model is the best. Based on both Z1 and Z2 values, both models can be used in this research.

Chow test is conducted to compare the best model between pooled least square and fixed effect model. The result of Chow test is presented in Table 1.

Based on the Table 1, the cross-section F probability value is 0.00, which is smaller than 0.05. Furthermore, seen from the F value that equal to 69.06, which greater than F table value of 4.72, it means, Fixed Effect Model is more suitable to estimate the regression of panel data.

Haussman test is conducted to choose between Fixed Effect Model and Random effect. Table 2 presents the result of Haussman test. Based on the result presented in Table 2, the value of random cross-section is 0.00, which is smaller than 0.05, this mean that the suitable model is Fixed Effect. This test determines the extent to which an independent variable affects dependent variable, by assuming that other variables remain unchanged (Ghozali, 2014).

Based on Table 3, the value of t statistic of CO₂ emission is 4.82 with probability value for CO₂ emission level is 0.00 and degree of freedom (n-k) resulting the t-table value of 1.653. This result shows that t-statistic value is greater than t-table that shows if CO₂ emission level has a significant positive effect on human development index.

The coefficient value CO2 emission is 3.70, this mean that, with an assumption that the independent

variable is constant, when CO₂ emission is increased for one unit the human development index will increase for 3.70 unit, vice versa.

Meanwhile, based on Table 3, the t-statistic value for poverty level is -7.12 with probability value for is 0.00 and degree of freedom (n-k) resulting the t-table value of 1.65. This result shows that t-statistic is greater than t-table, which mean poverty level has a negative significant effect on the human development index. The coefficient value for poverty level is -12.45, this shows that, with an assumption that the independent variable is constant, when poverty level increase for one unit, human development index will decrease for 12.45 unit, vice versa.

F Test shows whether all independent variables in the model simultaneously affects the dependent variable. F-statistic value of 204.84, the F-table value is 3.04, which means that the level of CO₂ emission and poverty level simultaneously affect the level of quality of life with level of confidence of 95%. Coefficient of Determination Test test shows adjusted R-squared is 0,98. This shows that the level of CO₂ emission and poverty explain 97.68% of variations in the quality of life.

The results of data processing as follows:

$$\text{HDI} = 206.5763 + 3.70 \text{ CO}_2 - 12.45 \text{ Poverty (LnK)} \\ (4,82) (-7,16) \dots\dots\dots(6)$$

DISCUSSION

Based on the data analysis, the level of CO₂ emission has significant effect on human quality of life with positive direction and prob value of $0.00 < 0.05$. This result provides an illustration that when CO₂ emission in East Java province is increasing for one point, the human quality of life will increase about 3.7 index points, with an assumption that all other independent variables constant.

This result contradicts the result of study conducted by Borhan et al. (2013) which shows that air pollution can reduce the output and quality of life directly through the decrease in human productivity. Human quality of life has several forming components such as income, health, and education. Among these three components, health has direct relationship with environmental quality or carbon dioxide emission, while income has indirect relationship with the level of carbon emission.

Besides that, the result of study from Hassan et al. (2015) explains that income level also has relationship with economic growth level. When economic growth is increasing, income will increase, which in turn increase or improve human quality of life. However, the increase in economics growth will also increase carbon emission or environment degradation which will affect human quality of life. If these three components are merged, it

will result in human quality of life index. The effect of each component is different, thus direct effect of CO₂ emission on human quality of life might be different from the existing theory.

In contrary, this result is different with Borhan, Ahmed, & Hitam, (2018) and Hassan, Zaman, & Gul, (2015). It stated the level of CO₂ emission in East Java Province has positive relationship with human quality of life. When the economic growth increases, the level of carbon emissions also increases. On the other hand, increased economic growth also has an impact on increasing human quality of life. In accordance with the Environmental Kuznets Curve theory, economic growth will initially make the level of pollution increasing, but the pollution will decrease when awareness of the environment increases (Narayan, Saboori, & Soleymani, 2016). Some experiences in developed countries, government policies also support to reduce emissions when they have achieved high income (Azomahou, Laisney, & Nguyen Van, 2006).

Central Statistics Agency (BPS, 2018) reports there are 17 of the 39 regencies/municipalities in East Java Province have a poverty rate above the provincial poverty average. Based on data from the Central Statistics Agency, the percentage of poor people in East Java in March 2017 was 11.77%. That is, 11.77% of the East Java population still lives below the poverty line. Both poverty and HDI usually have a high level of correlation. When the poverty level has succeeded to decrease, it would be affect to HDI level.

The economic growth increases in East Java has consequences to increase the level of CO₂ emission. Contribution of industrial sector to PDRB Jawa Timur still dominant until 2018 followed by Trade and Agriculture sector. Industrial sectors need fuel to produce and transportation sector also needs fuel to carry the output of the production to other region. Negative impact of raising economic activity is increasing of emissions from fuel.

In East Java, although emissions have negative impact but the environmental carrying capacity and environmental capacity still overcoming it. Based on the decision of State Minister for the Environment Number: KEP 45/MENLH/1997 regarding air pollution standard index presented in the following table:

Air pollution in Jawa Timur is on 41 score (KLHK, 2019). Based on Table 8, level of air pollution in East Java Province is still in safe level because it is in the range of 0-50. When emission is in safe category, this shows that air quality has no effect on human or animal health, and has no effect on plants, buildings, or aesthetics. Besides, the result of this study also supported by a study conducted by Murniyanto (2011) which explains that in general, the concentration of CO₂ in East Java is still below the standard value. This shows that the environment in East java Province mostly still tolerates carbon emission.

Based on the data analysis in this study, the level of poverty has significant effect with a negative direction on human quality of life with probability value of $0.0000 < 0.05$. This result provides an illustration that poverty level might reduce human quality of life.

This result supports the proposed hypothesis, which mentions that poverty level has negative relationship with human quality of life in 38 regencies/municipalities in East Java Province during 2012-2016. This result is also supported by the result of study conducted by Mirza (2012) which concludes that poverty level has negative and significant relationship with human quality of life on the 5% level of significance. Besides that, the result of this study also in line with Adelfina and Jember (2016) study in Bali Province, which states that partially, poverty significantly and negatively affects human development index

CONCLUSIONS

Based on the result of testing, we can conclude that the level of CO₂ emission in East Java Province is still in safe level, although it has positive relationship with human quality of life. Poverty level in East Java Province has negative effect on human quality of life.

The step that needs to be taken to prevent the increase in emission is cooperation among the government, people, and industry to obey regulations regarding waste processing and replacement of old engines. Emission occurs due to incomplete combustion. Thus, a check on production machines are needed to suppress current pollution.

The improvement on coordination between stakeholders and agencies are needed in reducing poverty. This step is taken to meet the target of poverty alleviation program.

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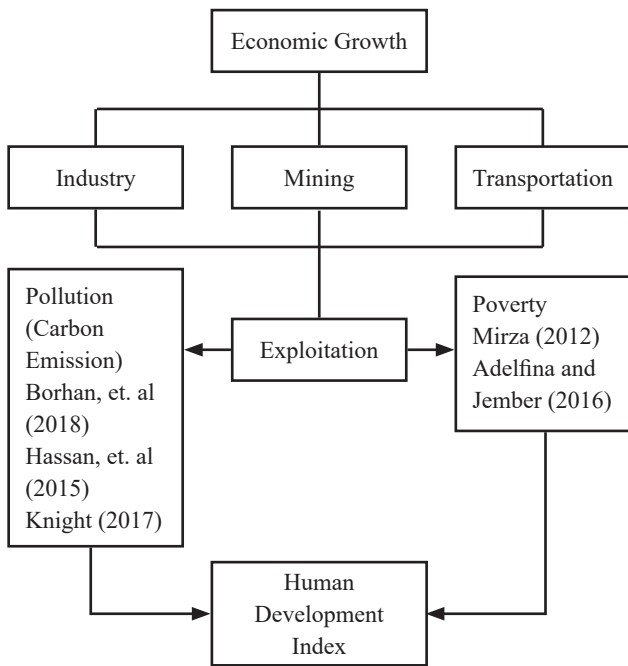


Figure 1. Research Framework

Table 1. Chow Test Estimation Result

Effect Test	Statistic	df	Prob
Cross Section F	69,059	(37,150)	0,00
Cross Section Chi Square	549,537	37	0,00

Source: Data Processing

Table 2. Haussman Test Estimation Result

Test Summary	Prob	Remarks
Cross Section random	0,00	Significant at 5% level

Source: data processing

Table 3. T-statistic Test Result

Variable	Coefficient	t-statistic	Prob
C	206,576	10,33	0,00
CO2	3,70	4,82	0,00
Poverty (LnK)	-12,45	-7,16	0,00
R2	0,98		
Adjusted R2	0,97		
F	204,84		
Prob (F Statistic)	0,00		

Source: Data Processing