

Urbanization Consequences on Environmental Conditions in Indonesia

Hadi Sasana ^{1*}, Jalu Aji Prakoso ², Yuliani Setyaningsih³

¹ Department Economic Development, Faculty of Economics and Business, Diponegoro University, Semarang – Indonesia

² Department Economic Development, Faculty of Economics, Tidar University, Magelang – Indonesia

³ Faculty of Public Health, Diponegoro University, Semarang – Indonesia

Abstract. Urbanization is still the main step taken by the community to get improved living conditions. Many developing countries have a high level of urbanization in cities due to the certainty of higher income levels. However, the problems that arise as a result of urbanization concern the environmental and social impacts of society. The purpose of this study is to show that the consequences of urbanization carried out by the community have a serious impact on environmental conditions. Urbanization, FDI, and fuel consumption affect environmental conditions as seen from the indicator of increasing carbon dioxide emissions (CO₂) in Indonesia in 1990-2016.

Keywords: **Urbanization; FDI; Fuel Consumption; CO₂.**

1 Preliminary

Urbanization is still the main step taken by the community to get improved living conditions. Many developing countries have a high level of urbanization in cities due to the certainty of higher income levels [1]. Urban areas offer higher economies scale conditions and a better market structure. Urban concentrations are attached to metropolitan cities with a high population and a very dense population of square meters. The consequence is that the metropolitan area is divided into central regions and distribution areas. The central metropolitan area is focused on service centers and research and development, while the surrounding areas become manufacturing development [2]. The condition of the surrounding metropolitan area that tends to be used for access to manufacturing production provides the attraction of non-formal work. In the urbanization paradigm, non-competent residents will come to the area around metropolitan to get jobs even in the informal sector [3]. In addition, the attractiveness of urban areas is urban bias because of the higher level of investment. The existence of economic, educational and health access makes the city more attractive to encourage the creation of urbanization. The logical consequence that arises is that almost 3 billion people throughout the world live in urban areas. This condition causes many problems in the social and environmental conditions that occur [4].

The speed and conditions of unplanned urbanization in urban areas are closely related to the problem of

poverty, a decrease in environmental quality and low health conditions [5]. The declining health condition of the community is related to poor environmental conditions and access to health services that are not accessible to the poor [6]. The low social condition of the community due to high urbanization in urban areas is a further impact of the decline in environmental quality in urban areas. The decrease in environmental quality is caused by the population concentration that is too high in urban areas. These conditions have a systemic impact on the decline in the quality of humans living inside. One of the drivers of environmental damage in urban areas is the high consumption of fuel oil in urban areas. Increasing the consumption of fuel oil in urban areas will increase environmental emissions [7]. The high emissions in cities are directly proportional to the increase in economic growth [8]. The desire to further improve the regional economy has logical consequences for high fuel consumption so that emissions in urban areas are high [9]. That causes a decrease in the quality of the environment and its systemic impact until social problems arise in the community.

Efforts to reduce the high decline in environmental quality can be done through deepening the study of the effects of urbanization on environmental conditions. The use of excess energy is the main driver of carbon emissions in urban areas. The high emissions are the result of urbanization so that consumption of fossil fuels continues to increase [11] states that the consumption of fuel oil and population growth affects the high carbon emissions in urban areas. Meanwhile, the use of renewable fuels has a relative impact on

* Corresponding author: hadisasana@live.undip.ac.id

reducing the occurrence of carbon emissions [12]. Several studies have provided empirical evidence that excessive use of energy causes higher carbon emissions. This study tried to close the gap between previous researches. The focus of the study lies in the impact caused by the existence of urbanization on the decline in environmental conditions that can have an impact on the social problems of the people in Indonesia.

2 Literature Review

Urbanization can be interpreted as the movement of people from rural to urban areas. However, there is an understanding of urbanization that is more comprehensive in interpreting conditions compared to these conditions [13]. Urbanization is actually the proportion of the population living in urban areas. Urban (urban area) is not the same as the city (city). Urban area is an area or region that meets 3 requirements, namely:

1. The density of a population of 500 people or more per square kilometers,
2. Number of households working in the agricultural sector is 25 percent or less, and
3. It has eight or more types of urban facilities.

The increase in population living in urban areas can be caused by several factors, namely: 1) natural births that occur in the area, 2) population movements, both from other cities and from rural areas, 3) annexation, and 4) reclassification. Thus, the movement of people from villages to cities is only part of the factors that influence the level of urbanization.

Urbanization with a traditional paradigm in addition to having a negative connotation is also considered to have positive aspects. Swastika [3] reveals the positive side of traditional urbanization among others: (1) modernizing rural communities; (2) increasing knowledge of rural communities; (3) creating cultural acculturation and cooperation between rural communities and urban communities; (4) offset the composition of the population of urban origin with rural residents. But very few people have a positive view of traditional urbanization. More scientists or social observers see the negative side of traditional urbanization, especially if the urbanization process is under control. Facts on the field show that the negative side appears more on the surface than on the positive side. One of the negative impacts of urbanization is a decrease in the environmental quality caused by an increase in carbon dioxide emissions.

Research about the relationship between urbanization and carbon emissions over the past few decades. Most previous studies have shown that increased urbanization causes higher levels of carbon emissions. For example, research conducted by [14] with a much larger dataset of 137 countries. Cole [15] uses data from 86 countries and shows that an increase of 10 percent urbanization causes a 7 percent increase in carbon emissions. However, several studies were

carried out in recent years contradict this finding. For example, in the context of developing countries. Fan [16] claim that there is a negative relationship between urbanization and CO₂ emissions. In the case of 17 developed countries, [17] concluded that the positive impact of urbanization on carbon emissions was not significant when carbon emissions were used in the aggregate. The sectoral analysis uses carbon emissions from the transportation sector; however, it shows the positive and significant impact of urbanization on carbon dioxide emissions.

3 Research Methodology

This research was carried out by using quantitative data sourced from reports from (secondary) data providers. Data analysis used the Ordinary Least Square (OLS) technique to determine the effect of urbanization on environmental conditions in Indonesia from 1990 to 2016. Urbanization was measured using proxy data on the level of rural urbanization to cities, fuel consumption, Foreign Direct Investment (FDI), and economic growth. As for the environmental conditions that are affected by urbanization, it is measured by using CO₂ emission level data. Analysis with multiple linear regression requires the preparation of mathematical models to determine the interrelationships between variables. The mathematically structured model for analyzing the influence of urbanization on environmental conditions in Indonesia in 1990-2016 is arranged as follows:

$$\text{Environment Condition} = f(\text{Urbanization}) \quad (1)$$

$$CO_{2t} = \alpha_0 + \alpha_1 U_t + \alpha_2 FDI_t + \alpha_3 FOS_t + \alpha_4 EG_t + \mu_t \quad (2)$$

Information

| | |
|--|--|
| CO_2 | : Total carbon dioxide emission (CO ₂) |
| U | : Level of Urbanization |
| FDI | : Investment |
| FOS | : Fuel Consumption |
| EG | : Economic Growth |
| α_0 | : Intercept |
| $\alpha_1, \alpha_2, \alpha_3, \alpha_4$ | : Coefficient |
| μ | : Error term |

4 Analysis and Discussion

The structural equation model is used to determine the effect of the dependent variable on the independent variable. The dependent variable in this study is the value of carbon dioxide (CO₂) emissions in Indonesia. This variable is used as a proxy for environmental degradation in Indonesia because of the influence of independent variables. The independent variables in this study consist of the level of urbanization (UR), the value of direct investment (FDI), fuel consumption (FOS) and economic growth (EG).

Table 1. Descriptive Statistics of Urbanization and Environmental Research Data in Indonesia

| | CO ₂ | UR | FDI | FOS | EG |
|------------------|-----------------|----------|-----------|----------|-----------|
| Mean | 335.6181 | 43.46370 | 1.215556 | 18.70963 | 4.996296 |
| Median | 352.0400 | 44.67000 | 1.300000 | 14.98000 | 5.700000 |
| Maximum | 491.4600 | 55.60000 | 3.330000 | 42.43000 | 8.200000 |
| Minimum | 162.0000 | 30.21000 | -2.590000 | 8.650000 | -13.10000 |
| Std. Dev. | 100.7347 | 7.330262 | 1.443490 | 9.840805 | 3.900146 |
| Observ. | 27 | 27 | 27 | 27 | 27 |

Table 1 shows the distribution of data from research variables which have a total of 27 observations in the study year. The highest of carbon dioxide emissions in Indonesia reached level 491.46 in 2015. The high carbon emissions in the year indicated that efforts to increase economic growth by the government had an impact on environmental conditions. The highest urbanization rate in Indonesia reached 55.6 percent in 2016. The trend of urbanization in Indonesia tends to increase every year. From 1991-2015 the level of urbanization was getting higher. These conditions prove that urban bias is still an attraction for urbanization activities carried out by the community. Urban bias occurs because access to capital in the city is better because of investment activities. The highest

amount of direct investment in Indonesia was in 2015 of 3.33 percent. This value is in line with the amount of carbon emissions in 2015.

In addition, the variable that is expected to support increasing carbon dioxide emissions is an increase in fuel oil consumption. 2016 was the highest year for oil fuel consumption to reach 42.43 tons. The trend of oil fuel consumption in Indonesia has increased every year. The estuary of urbanization of the population from village to city to become an increasingly productive population should contribute to the level of economic growth of the nation. In 1995, Indonesia experienced food self-sufficiency and managed to experience the highest economic growth of 8.2 percent.

Table 2. Results of Dependent and Independent Variable Estimates with OLS

| Dependent Variable: CO ₂ | | | | |
|-------------------------------------|-------------|-----------------------|-------------|----------|
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
| C | -222.7902 | 20.25973 | -10.99670 | 0.0000 |
| UR | 12.34314 | 0.630150 | 19.58760 | 0.0000 |
| FDI | 3.737269 | 1.889552 | 1.977860 | 0.0606 |
| FOS | 0.900781 | 0.516135 | 1.745243 | 0.0949 |
| EG | 0.106837 | 0.581709 | 0.183660 | 0.8560 |
| R-squared | 0.990830 | Mean dependent var | | 335.6181 |
| Adjusted R-squared | 0.989163 | S.D. dependent var | | 100.7347 |
| S.E. of regression | 10.48668 | Akaike info criterion | | 7.703665 |
| Sum squared resid | 2419.352 | Schwarz criterion | | 7.943635 |
| Log likelihood | -98.99948 | Hannan-Quinn criter. | | 7.775021 |
| F-statistic | 594.2845 | Durbin-Watson stat | | 2.133859 |
| Prob(F-statistic) | 0.000000 | | | |

The overall regression estimation results show the R-squared value of 0.99. That is, the structured model is able to explain the phenomenon of the influence of urbanization on changes in environmental conditions in Indonesia by 99 percent. For example, 1 percent is explained by other variables outside the model used. Meanwhile, the probability value (F-statistic) of 0.00 indicates that the independent variables in the form of urbanization (UR), direct investment (FD), fuel oil consumption (FOS), and economic growth (EG) jointly influence the level of carbon dioxide (CO₂) emissions in Indonesia during 1990 - 2016.

Partially, the results of multiple linear regression analysis have shown that urbanization (UR) has a positive and significant effect (0.00) on the level of carbon dioxide (CO₂) emissions in Indonesia at a 5 percent confidence level. The coefficient value of the urbanization variable on the emission level is 12.34. That is, whenever there is an increase in urbanization of 1 percent, the level of carbon dioxide emissions increased by 12.34 units, ceteris paribus. The research results of [18] point to the same conditions that urbanization causes environmental degradation. Other studies that support related urbanization with a decrease in environmental quality [4, 7]. Sustainability

from urbanization is an increase in the poor population in urban areas. The increase in the number of poor people from urbanization is greater than the rate of growth of the poor [19].

The effect of foreign direct investment (FDI) on the carbon dioxide (CO₂) emissions in Indonesia is positive and significant (0.06) in the 10% confidence level. The foreign direct investment coefficient value of carbon emission level is 3.74. That is, every increase in the amount of direct investment by 1 percent will result in an increase in carbon dioxide emissions of 3.74 units, *ceteris paribus*. Efforts can be made to reduce the effect of direct investment in increasing carbon dioxide emissions through policy and legal rules set by the government. The stronger law enforcement and policy, the negative impact of direct investment in the form of carbon increase can be reduced [20, 21]

The use of fuel oil for productivity is one of the drivers of increasing carbon dioxide emissions. The effect of fuel oil consumption (FOS) on the level of carbon dioxide (CO₂) emissions is positive and significant at 10 percent confidence level. The coefficient of consumption of fuel oil to the level of carbon dioxide emissions is 0.90. That is, every increase in the amount of oil fuel consumption by 1 million tons will increase the level of carbon dioxide emissions by 0.90 units, *ceteris paribus*. Increasing fuel causes high carbon dioxide emissions [11, 12].

While economic growth (EG) does not affect the level of carbon dioxide (CO₂) emissions in Indonesia. Economic growth is the final measure of productive activities that produce carbon dioxide emissions. The results of this study have different results from the previous studies by Shahbaz [7] which states that economic growth is the cause of an increase in carbon dioxide emissions in Malaysia.

5 Conclusion

The results of the analysis and discussion carried out in this study concluded as urbanization has a positive and significant influence on the condition of carbon dioxide emissions in Indonesia from 1990 - 2016. These conditions indicate that urbanization activities carried out by the community have an influence on increasing carbon dioxide emissions. Direct investment received by the government has a positive and significant influence on increasing carbon dioxide emissions in Indonesia from 1990 - 2016. The direct investment activities encourage the productivity of the country so that it has an impact on the increasing carbon dioxide emissions. Oil fuel consumption has a positive and significant influence on the emergence of carbon dioxide emissions in Indonesia from 1990 - 2016. The higher the consumption of fuel oil, the level of carbon emissions will experience a similar increase. Economic growth does not affect the level of carbon dioxide emissions in Indonesia.

This study shows that there is an activity of residents who move between regions because of the urban bias drive which causes increases the level of

carbon dioxide emissions in urban/urban areas. Systemically, the presence of urbanization is increasingly driven by investments in higher urban areas, so that the level of economic scale has the highest conditions. The consequence is higher fuel consumption in urban areas/cities. The government needs to determine policies to reduce the pace of rural urbanization to cities so that the acceleration of environmental degradation in the city can be reduced. So that the sustainability of natural conditions can always be maintained and can be enjoyed by the next generation.

References

1. D.E. Bloom, D. Canning, G. Fink, *Urbanization and the Wealth of Nations*, Science **319**(5864), 772–775 (2008)
2. C. Pugh, *Urbanization in Developing Countries. Cities* **12**(6), 381–398 (1995)
3. D.K.S. Swastika, *Reformasi Paradigma Urbanisasi: Strategi Percepatan Pengentasan*, 357–383 (2012)
4. B. Cohen, *Urbanization in developing countries: Current trends, future projections, and key challenges for sustainability*, Technology in Society **28**(1–2), 63–80 (2006)
5. M. Moore, P. Gould, B.S. Keary, *Global urbanization and impact on health*, International Journal of Hygiene and Environmental Health **206**(4–5), 269–278 (2003).
6. H. Santoso, *Migrasi, urbanisasi, dan masalah kesehatan di provinsi sumatera utara*, USU E-Journals **9**(2), 167–171 (2000)
7. M. Shahbaz, N. Loganathan, A.T. Muzaffar, K. Ahmed, M.A. Jabran, *How urbanization affects CO₂ emissions in Malaysia? the application of STIRPAT model*, Renewable and Sustainable Energy Reviews **57**, 83–93 (2016)
8. S. Li, Y. Ma, *Urbanization, economic development and environmental change*, Sustainability (Switzerland) **6**(8), 5143–5161 (2014)
9. E. Kalnay, M. Cai, *Impact of urbanization and land-use change on climate*, Nature **423**(6939), 528–531 (2003)
10. Z. He, S. Xu, W. Shen, R. Long, H. Chen, *Impact of urbanization on energy related CO₂ emission at different development levels: Regional difference in China based on panel estimation*, Journal of Cleaner Production **140**(2016), 1719–1730 (2017)
11. H. Sasana, A.E. Putri, *The Increase of Energy Consumption and Carbon Dioxide (CO₂) Emission in Indonesia*, Icenis 2017 **01008**, 5 (2018)
12. H. Sasana, I. Ghozali, *The Impact of Fossil and Renewable Energy Consumption on the Economic Growth in Brazil, Russia, India, China and South Africa*, International Journal of Energy Economics and Policy **7**(3), 194–200 (2017)

13. P. Tjiptoherijanto, *Urbanisasi dan pengembangan kota Indonesia*, Urbanisasi Dan Perkembangan Kota Indonesia **10**(2), 57–72 (1999)
14. R. York, E.A. Rosa, T. Dietz, *STIRPAT, IPAT and ImPACT: Analytic tools for unpacking the driving forces of environmental impacts*, Ecological Economics **46**(3), 351–365 (2003)
15. M.A. Cole, E. Neumayer, *Examining the impact of demographic factors on air pollution*, Population and Environment **26**(1), 5–21 (2004)
16. Y. Fan, L.C. Liu, G. Wu, Y.M. Wei, *Analyzing impact factors of CO₂ emissions using the STIRPAT model*, Environmental Impact Assessment Review **26**(4), 377–395 (2006)
17. B. Liddle, S. Lung, *Age-structure, urbanization, and climate change in developed countries: Revisiting STIRPAT for disaggregated population and consumption-related environmental impacts*, Population and Environment **31**(5), 317–343 (2010)
18. A. Rahman, Y. Kumar, S. Fazal, S. Bhaskaran, *Urbanization and Quality of Urban Environment Using Remote Sensing and GIS Techniques in East Delhi-India*, Journal of Geographic Information System **03**(01), 62–84 (2011)
19. M. Ravallion, M. Ravallion, S. Chen, S. Chen, P. Sangraula, P. Sangraula, *New evidence on the urbanization of global poverty*, **33**(4) (2007)
20. W.J. Henisz, *The institutional environment for infrastructure investment*, Industrial and Corporate Change **11**(2), 355–389 (2002)
21. S. Rose-Ackerman, J. Tobin, *Foreign Direct Investment and the Business Environment in Developing Countries: The Impact of Bilateral Investment Treaties*, Ssrn (293) (2005)