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Impact of Development on Regional Pollution

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Abstract

Economic development is one of the government's priority programs. However, in the middle of the development process, it turns out that evolution harms the environment. The environmental impact that usually occurs is pollution. This study aims to determine the role of development on pollution. This study uses a composite index calculation of the presence of pollution from each village/kelurahan area in Indonesia. Multiple linear regression was used to determine the effect of GRDP on the pollution composition index. The results of this study indicate that GRDP has a positive and significant impact on regional pollution. Special efforts are needed from the government to tackle pollution problems due to development activities. The government can issue regulations so that companies, as polluters' main polluters, can pay more attention to the environmental impacts they cause.

Keywords: development, economy, pollution, composite index.

1. Introduction

A region's economy is one of Indonesia's targets for achieving development. Where the result of a country is the aggregation of the development of the smallest administrative area, namely the village/kelurahan (Faradiba & Lodewik, 2020; Pain & Hansen, 2019; Van der Ploeg et al., 2017). Development has two opposite impacts; on the one hand, it has a positive effect, but growth also produces residuals that harm life. The positive impacts of development include community welfare, labour force participation, and people's purchasing power (Ahmed & Shimada, 2019; Mohsin et al., 2019; Sarkodie & Strezov, 2019). Meanwhile, the negative impacts of development include pollution, climate change, and land degradation (Alfsen et al., 1997; Gan et al., 2020; Stern, 2015).

Pollution is one of the many negative impacts caused by development performance. A concrete example is when many factories produce a product, it will undoubtedly have various kinds of pollution, including soil, water, and air. The pollution produced in relatively small quantities will not make the community nervous. Still, the accumulation of pollution that lasts a long time will undoubtedly cause new problems, such as health and the environment. (Azizullah et al., 2011; Naddafi et al., 2012; Waseq, 2020).

Policymakers are often more inclined to achieve development (Alesina et al., 1996; Campbell, 2009; Checherita-Westphal & Rother, 2012). This is because evolution has multiple effects on various aspects of life that can be felt in a relatively short time. In contrast to the environmental factor, this aspect has a relatively long impact, and its achievement is difficult to measure. Measurements on environmental aspects often use the regional pollution approach (Flanders, 1994; Karppinen et al., 2000; Tudose et al., 2011). Pollution measurement often uses measuring instruments, but there is no comprehensive measurement in every village/kelurahan area in Indonesia (Marsden & Bell, 2001; Wang et al., 2009). Pollution measurement often uses measuring instruments, but there is no comprehensive measurement in every village/kelurahan area in Indonesia.

Many studies have examined the relationship between the economy and pollution. However, they are still limited in analyzing the breakdown comprehensively, both from the aspect of the land, water, and air. (Gautam & B Bolia, 2020; Reddy & Behera, 2006; Saha et al., 2017). Besides, research is still limited using primary data at the village/kelurahan level. This study aims to analyze the impact of development on pollution. The resulting pollution

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will be aggregated according to its type, so it will be seen what kind of pollution has the most significant impact on development activities.

2. Research Method and Materials

This study uses the 2018 Village Potential data collection (PODES 2018) to calculate the Regency/City pollution index and Gross Regional Domestic Product (GRDP) data. Pollution index calculation using composite index calculation method (Christian et al., 2008; Effendi, 2016; Iqbal et al., 2021). The analysis of the composite index considers the number of villages/kelurahan experiencing pollution and is aggregated at the Regency/City level. The calculation of the pollution index uses the following formula:

$$IP_x = \frac{Polluted\ village_{regency/city}}{Number\ of\ villages_{regency/city}}\ x\ 100 \quad \text{.....(1)}$$

Notes:

IP_x : Index for each type of pollution

$$IP = IPA + IPT + IPU \quad \text{.....(2)}$$

Notes:

IP : Pollution index for each Regency/City
IPA : Water pollution index for each Regency/City
IPT : Soil pollution index for each Regency/City
IPU : Air pollution index for each Regency/City

The higher composite index indicates that the level of pollution in the region tends to be high and vice versa. The analysis is continued by calculating the regression between GRDP to pollution (Freund et al., 2006; Liang & Zeger, 1993; Sarstedt & Mooi, 2019). The regression calculation was disaggregated for each type of pollution and pollution thoroughly. Regression calculation uses control variables, namely disadvantaged areas and per capita GRDP.

$$IP = \alpha + \beta_1 GRDP + \beta_2 Underdeveloped + \beta_3 GRDP\_cap + \varepsilon, \quad \text{.....(3)}$$

In this study, quadrants will also be formed to determine areas categorized as good and evil.

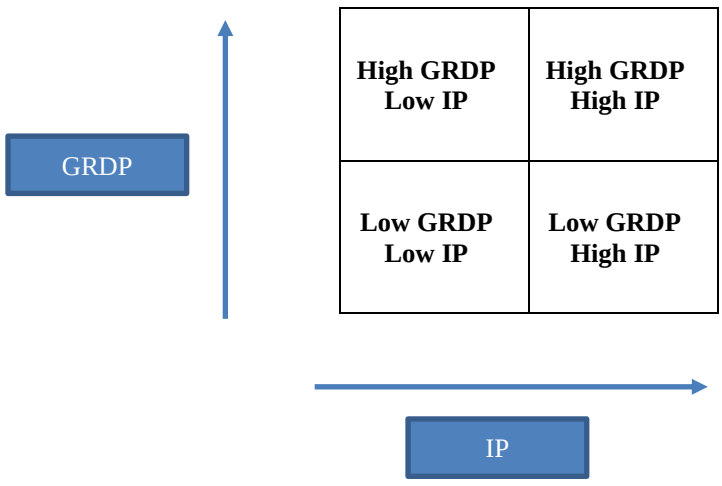

Figure 1. Quadrants of GRDP and IP

3. Results and Discussion

Based on the identification based on quadrants, information is obtained that the regencies/cities with relatively high GRDP and relatively low Pollution Index are South Jakarta, Central Jakarta, East Jakarta, West Jakarta, Karawang, Bogor, Bekasi, Surabaya, and Medan. These regencies/cities can be role models for other local governments in developing the region without neglecting the pollution aspect if observed 4 areas of Jakarta have a relatively good pollution index. This result impacts several government programs, including controlling vehicles through odd-even, centralized waste disposal, etc.

For Karawang Regency to control air pollution, the Karawang Environmental and Hygiene Service requires every company to install an ISPU or Air Pollution Standard Index. This is a program and concrete step for the Department of Environment and Cleanliness to handle and minimize pollution caused by industrial companies. Environmental pollution or air pollution currently occurs in many industrial areas. Air pollution violations that are very difficult to monitor are due to the lack of an Air Pollution Standard Index (ISPU). Law Number 32 of 2009 Article 87, paragraph (1) concerning Environmental Protection and Management, states that: "Every person in charge of a business or activity who commits an unlawful act in the form of environmental pollution or destruction that causes harm to people other parties or the environment must pay compensation or take certain actions." So if business actors violate environmental pollution, they are obliged to provide compensation. The company will be subject to administrative and criminal sanctions (Juliawati et al., 2022).

For Bogor Regency, the local government is repairing sidewalks and adding green open spaces to make people who pass through the city centre comfortable. In addition, the community is expected to be able to use access to public facilities if it is still possible. Planting trees is also likely to reduce pollution in the area (Al-Hakim, 2014). For Bekasi Regency, an integrated policy between local governments and investors is the most effective so that industrial estates have high performance. This is because investors can easily find industrial estates that suit their needs. The research model regarding the attractiveness of industrial estates for investors is based on the availability of facilities, entertainment facilities, ease of access, and land prices (Wikaningrum & Hakiki, 2019).

The city of Surabaya they are optimizing green open space to control pollution. Green open space is vital in creating a wonderful and quality city in realizing an ecological city. Determination of the proportion of 30% by the government is a minimum measure to ensure the balance of urban development. Surabaya is committed to developing public green open space in the physical development and management of green open space. The ecological function of green open space contributes to improving groundwater quality, preventing flooding, reducing air pollution, and supporting microclimate regulation. The analysis results show that the condition of the available space for graves and parks in the city of Surabaya is optimal for carrying out ecological functions. Efforts to improve the quality of public green open space to optimize ecological processes must be synergized with other programs such as biopori development, management, channels and rivers, waste management, and good private green open space management by involving all development stakeholders (Ernawati, 2015).

Medan City they are optimizing public transportation to reduce pollution levels. The rejuvenation of the vehicle is carried out to provide comfort for the community. Through this policy, it is hoped that people can switch their use to public transportation (Siregar et al., 2017).

Based on the identification based on quadrants, information is obtained that the Regency/City, with a relatively high GRDP and a relatively high Pollution Index, is North Jakarta. The North Jakarta area has good economic performance but still has a big task in solving pollution. Pollution generally occurs around the bay area, where seawater pollution causes problems for the local community (Cordova et al., 2011; Haryati et al., 2013; Susanti & Afrizal, 2018). Water pollution is caused by indiscriminate garbage disposal, so the impact can also cause air pollution (Indrawati, 2011; Ningsih, 2018).

In line with the negative impact caused by economic activity, some areas have a relatively high pollution index but relatively low economic activity. The regencies/cities with relatively low GRDP and relatively high Pollution Index are Tebing Tinggi and Gunung Mas Regencies. This phenomenon is an anomaly, so there may be other factors that cause relatively high pollution in the area. One of the things that cause high pollution is people's behaviour. In the long term, regions in low economic clusters will compete to increase development acceleration in quantity and growth. (Alamsyah, 2009; Hariati & Saputri, 2022). The effect of this development will undoubtedly worsen the condition if it is not anticipated correctly.

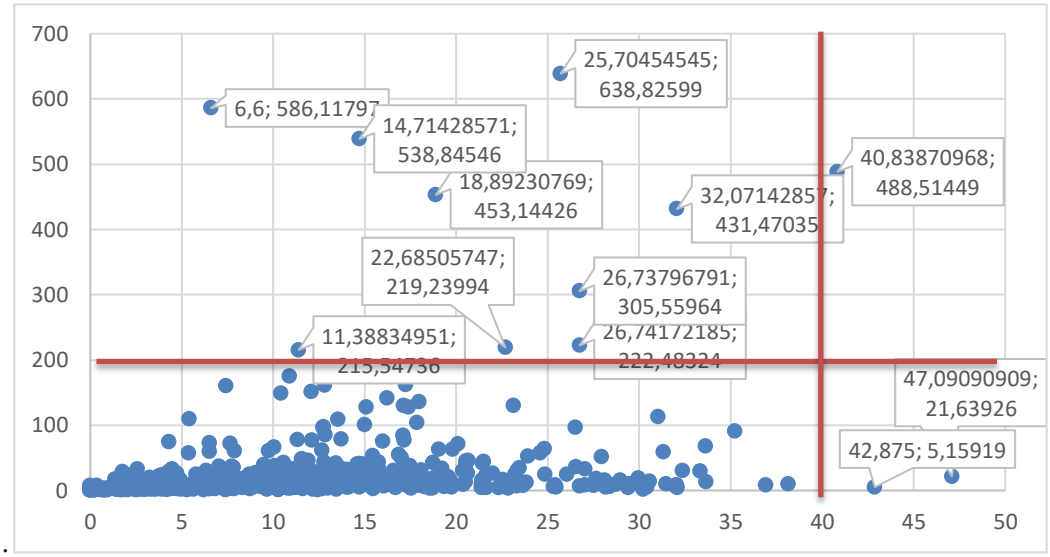

Figure 1. Pollution Index and Gross Regional Domestic Product by District/City Quadrant

Based on the identification, information is obtained that the Regencies/Cities that have a relatively high Pollution Index are Central Bangka Regency, Tebing Tinggi, Gunung Mas, North Jakarta City, and Pekalongan City. It should be noted for the region to anticipate a more severe impact in the future. Pro-Growth and Pro-Environment are essential tasks for policymakers in the future because without realizing it, each area will continue to develop, and one of the residuals from development is pollution (Preece, 2016; Salim, 2015). It is difficult to think about environmental aspects amid accelerating development; sometimes, growth can only achieve development optimization.

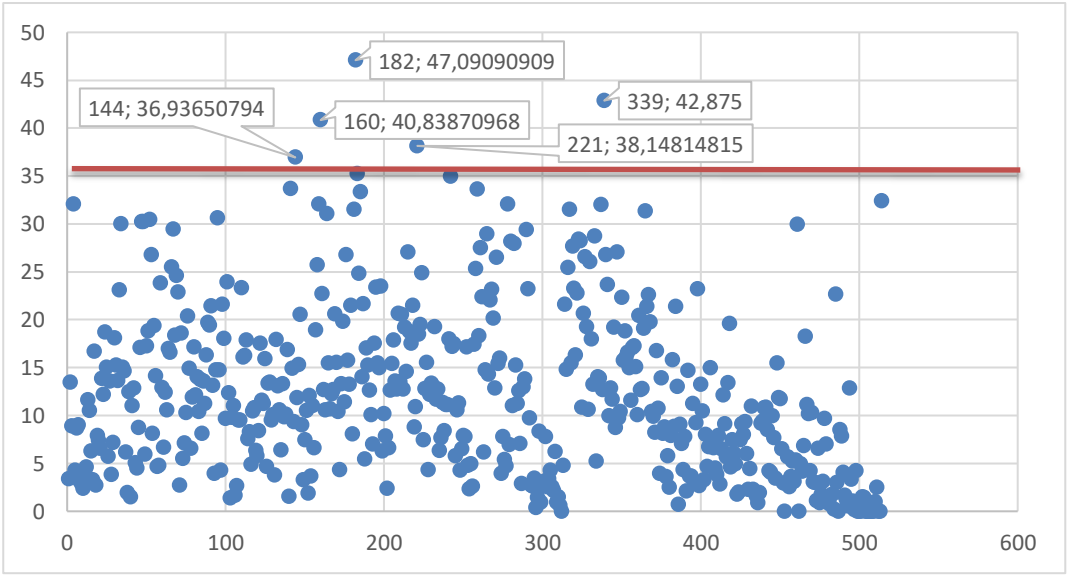

Figure 2. Pollution Index by Regency/City

Regencies/cities with relatively high GRDP are Central Jakarta, North Jakarta, South Jakarta, East Jakarta, and Surabaya. Regencies/cities with increased economic performance tend to be in urban areas. This is because urban areas have a magnet for community activities. Urban areas absorb a lot of labour because economic activity tends to be more advanced (Dwirainaningsih, 2017; Endang Rahayu & Avista, 2018; Maryanti & Rasyad, 2015). In this condition, rural communities will flock to urbanization, and the long-term impact of urban areas will be more advanced.

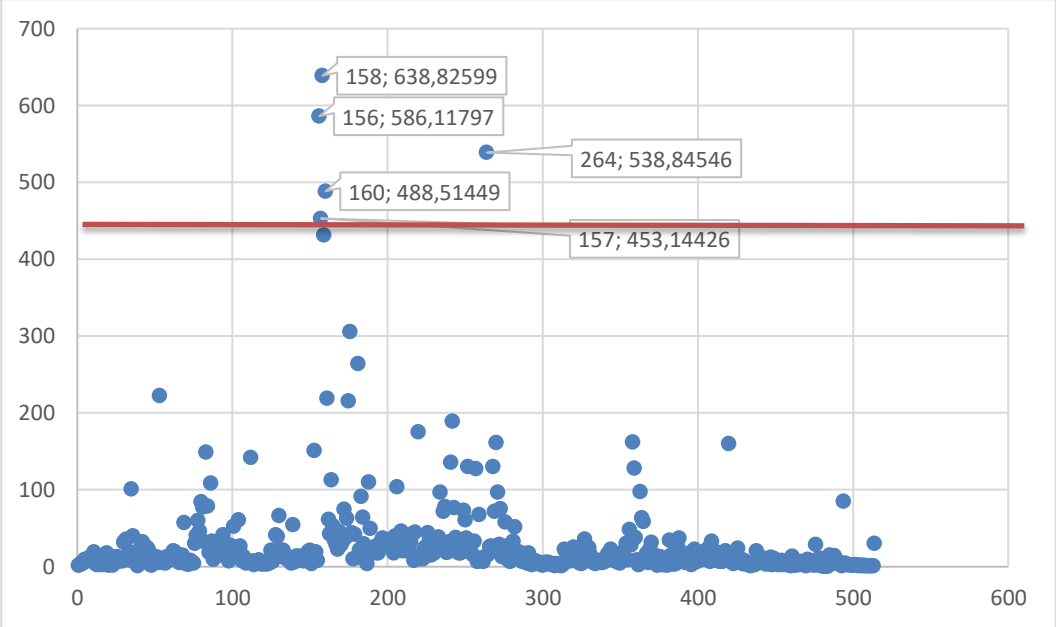

Figure 3. Gross Regional Domestic Product by Regency/City

Based on Table 1, information is obtained that GRDP contributes positively and significantly to the formation of the water pollution index. Many companies show one indicator of development progress. Companies tend to issue various kinds of waste, including liquid waste. This result is in line with previous research, which states that the economy positively impacts water pollution (Ridwan, 2010). The control variables for disadvantaged areas and GRDP per capita used are significant for forming the water pollution index. Underdeveloped regions have a negative coefficient on water pollution. This phenomenon occurs because disadvantaged areas tend to be in remote areas, and there are relatively few companies that produce pollution. Besides, GRDP per capita, as well as this study's interest variable, also positively influences water pollution. GRDP per capita has a population element, which will implicitly detect population density and mobility. Population density and mobility will have a positive impact on pollution.

Table 1. Results of GRDP Regression on the Water Pollution Index

Water Pollution Index	Coef.	Robust Std. Error	T	P > |t|	[95 % Conf. Interval]	
GRDP	0.0177037	0.0050402	3.51	0.000	0.0078015	0.0276059
Underdeveloped areas	-2.815633	0.5491608	-5.13	0.000	-3.894528	-1.736737
GRDP per capita	1.313451	0.5916955	2.22	0.027	0.15099	2.475911
Constant	7.126318	0.3386948	21.04	0.000	6.46091	7.791727

Note 1. Dependent Variable : Water Pollution Index
2. Independent Variable : GRDP, Underdeveloped areas, and GRDP per capita

Based on Table 2, relationship between GRDP and soil pollution index has no significant effect. This result does not only occur in the interest variable, but the nonsignificance also occurs in the control variable.

Table 2. Results of GRDP Regression on Soil Pollution Index

Soil Pollution Index	Coef.	Robust Std. Error	T	P > |t|	[95 % Conf. Interval]	
GRDP	0.000907	0.000646	1.40	0.161	-0.00.622	0.0021762
Underdeveloped areas	0.1060615	0.2346205	0.45	0.651	-0.35488	0.5670031
GRDP per capita	-0.505234	0.1158019	-0.44	0.663	-0.2780308	0.1769841
Constant	0.8610714	0.869566	9.90	0.000	0.6902342	0.031909

Note 1. Dependent Variable : Soil Pollution Index
2. Independent Variable : GRDP, Underdeveloped areas, and GRDP per capita

Table 3 shows that GRDP and underdeveloped areas significantly influence the air pollution index. As with water pollution, GRDP has a positive effect, and underdeveloped regions have a negative impact. Air pollution can be in the form of smells or sounds. This result is in line with previous research, which states that economic activity harms air pollution (Santoso et al., 2018).

Table 3. Results of GRDP Regression on the Air Pollution Index

Air Pollution Index	Coef.	Robust Std. Error	T	P > |t|	[95 % Conf. Interval]	
GRDP	0.0085256	0.0033047	2.58	0.010	0.002033	0.0150182
Underdeveloped areas	-2.306193	0.2994934	-7.70	0.000	-2.894586	-1.717801
GRDP per capita	0.1227676	0.3596919	0.34	0.733	-0.5838927	0.8294278
Constant	4.007383	0.2463325	16.27	0.000	3.523432	4.491334

Note 1. Dependent Variable : Air Pollution Index
2. Independent Variable : GRDP, Underdeveloped areas, and GRDP per capita

Table 4 shows that all variables significantly influence the overall pollution index. This result is in line with previous research, which states that economic activity harms regional pollution (Helda et al., 2018). Special efforts are needed from the government to tackle pollution problems due to development activities. The government can issue regulations so that companies, as polluters' main polluters, can pay more attention to the environmental impacts they cause. Besides, it is necessary to prevent and reduce efforts from the community in the form of planting plants so that the pollution that occurs can be reduced.

Table 4. Results of GRDP Regression to the Pollution Index

Pollution Index	Coef.	Robust Std. Error	t	P > |t|	[95 % Conf. Interval]	
GRDP	0.0271363	0.0083619	3.25	0.001	0.0107084	0.0435643
Underdeveloped areas	-5.015764	0.8532398	-5.88	0.000	-6.692062	-3.339467
GRDP per capita	1.385695	0.8313454	1.67	0.096	-0.2475844	3.018978
Constant	11.99477	0.516744	23.21	0.000	10.97956	13.00998

Note 1. Dependent Variable : Pollution Index
2. Independent Variable : GRDP, Underdeveloped areas, and GRDP per capita

4. Conclusion

A region's economy is one of the targets of achieving development in Indonesia. Evolution has a residue in the form of pollution. Pollution is caused by water, soil, and air pollution. Significantly GRDP has a positive and significant influence on the formation of smog. Special efforts are needed from the government to tackle pollution problems due to development activities. The government can issue regulations so that companies, as polluters' main polluters, can pay more attention to the environmental impacts they cause. Besides, it is necessary to prevent and reduce efforts from the community in the form of planting plants so that the pollution that occurs can be reduced.

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