Fiscal policy and environmental quality in Indonesia

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Abstract. Environmental quality at the national level as measured by the Environmental Quality Index (IKLH) in the last ten years has fluctuated, even though the regional government and the central government pay great attention to addressing environmental issues related to the importance of achieving sustainable development, population pressure and limited natural resources. Thus the purpose of this study is to spatially examine environmental quality and government budget allocations in overcoming these problems and analyse the impact of fiscal policies on environmental quality. The results of the analysis show that only a portion of the provinces with good environmental quality are due to the fact that most of the province's water and land cover conditions (TL) are still relatively low. Based on the Klassen Typology analysis, the provinces that have the greatest role in the environmental quality problems of water and TL are all provinces in Java except DI Yogyakarta, Southeast Sulawesi, Bengkulu, Bali and East Kalimantan. While the results of the econometric model analysis of panel data show that fiscal policy has a significant effect on improving environmental quality, only inelastic. To increase the effectiveness of fiscal policies in handling environmental quality, the government budget allocation must be more focused on improving the quality of the water environment and TL in the province that most contribute to the problem.

Keywords: deconcentration funds, panel data, the environmental quality index, provinces

1. Introduction

Environmental issues change the development paradigm from economic growth orientation to more sustainable development. Bappenas (2015) states that the pattern of future development is sustainable development that is not only oriented to the economic aspects, but also includes social institutional and environmental aspects. It is not easy to fulfill the three pillars of development at the same time because often an increase in economic and social standard of living must be paid quite expensive with environmental damage with many natural disasters caused [1]. Population pressure and industrial development cause continued environmental degradation, both damage to the water, land and air environment [2], [3].

Therefore in the 2005-2025 National Long-Term Development Plan (RPJPN) environmental issues have become a strategic issue so that one of the mandatory matters for both the central and regional governments is to continue to deal with environmental control. In this regard, the Indonesian Government is committed to the world in reducing greenhouse gas emissions either independently or with international support expected to be achieved in 2020.

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The real effort of the government in preserving the function of the environment is through fiscal policy whereby the central and regional governments are required to apply environmental economic instruments, one of which is the environmental economic instruments as environmental funding, as Article 45 of Law No. 32 of 2009. However, on average, the environmental function budget in the regions is relatively small, less than one percent of the total regional budget (APBD). The low environment-based budget in the regions due to limited fiscal capacity pushes the central government to allocate environmental deconcentration funds to the provincial level, where the limited allocation of the regional budget is feared to hamper the achievement of national priority targets in controlling environmental damage.

The central government's fiscal conditions that make it possible and the commitment in mainstreaming environmental sustainability in economic development, causes the allocation of deconcentrated funds in the environmental sector to continue to increase from year to year. Even since 2012 the allocation of these funds varies between regions depending on resource conditions and environmental problems faced with the hope of meeting the target of key performance indicators in the field of environmental management, such as achieving efforts to reduce the burden of pollution, control of environmental damage, and increase capacity. Related to the problem of environmental degradation is creating a consistent, coherent and effective environmental policy framework is essential in order to maintain a natural environment that supports wellbeing and enables long-term economic growth and development [4]. The same thing was stated that the environmental budget (green budgeting) is an important factor for a sustainable economy [5].

However, the quality of the environment measured by the Environmental Quality Index (IKLH) in the period 2009 to 2017 is relatively stagnant (figure 1) so the main question in this study is how the influence of fiscal policy, specifically the allocation of deconcentrated funds to environmental quality conditions? To answer this problem, the objectives of this study are (1) to assess the condition of environmental quality spatially based on total conditions and according to the three environmental aspects, namely the Water Quality Index (IKA), Air Quality Index (IKU) and Land Cover Quality Index (IKTL) and (2) Analysing the impact of fiscal policy, the allocation of deconcentrated funds on environmental quality.

2. Method of the Research
This study uses secondary panel data which includes annual time series data for the period 2009-2017 and cross section data of 34 provinces in Indonesia. The main data or variables used in this study were obtained from Central Bureau of Statistics or BPS Statistics Indonesia and Ministry of environment and forestry.

In answering the purpose of the study, the analytical method used is Klassen Typology and econometric models. Klassen's Typology analysis method is used to assess environmental quality spatially and according to its aspects. While the econometric model is used to analyze the impact of fiscal policy on environmental quality.

The quality of the environment in this study refers to the decree of the Ministry of Environment developed in 2009 in which to measure the quality of the environment in an area to improve or vice versa is to use the environmental quality index (IKLH). The IKLH concept is built on three aspects of quality, namely water quality, air quality and land cover quality, in this case forest cover. Based on the Ministry of Environment (2013), the classification categories of IKLH scores are (1) Superior for IKLH values ≥ 90; (2) Very good, for IKLH value 82 <90; (3) Good, for IKLH value 74 <82; (4) Sufficient, for IKLH 66 ≤ 74; (5) Poor, for IKLH 58 ≤ 66; (6) Very Poor, for IKLH 50 ≤ 58; (7) Be alert, for IKLH value ≤ 50.

The Klassen Typology analysis method is principally used to find a picture of the pattern and structure of economic growth of each region based on two main indicators namely economic growth and regional income per capita so that four regional characteristics are obtained, namely (1) fast-forward and fast- growth (high growth and high income); (2) developed but depressed areas (high income but low growth), (3) fast developing areas (high growth but low income), and relatively disadvantaged areas
In this study, this analysis method was modified specifically in terms of the main indicators used, i.e. indicators of environmental quality values and growth indicators of environmental quality values that include total environmental quality and all aspects (IKLH, IKA, IKU and IKTL) so that four typologies of the region will be produced region or relative position of the region regarding the quality of its environment which is usually described in four quadrants and this time to make it easier to make tabulations based on quadrants as can be seen in Table 1.

**Table 1. The relative position of Environmental Quality each province is based Klassen’s Typology.**

| Quadrant   | The average value and growth of environmental quality is high |
|------------|-------------------------------------------------------------|
| Quadrant 1 | (high growth and high quality of environment)               |
| Quadrant 2 | The Average environmental quality value is low and growth is high |
| Quadrant 3 | (high growth and low quality of environment)                |
| Quadrant 4 | Quadrant 3: The average environmental quality value is high and the growth is low |
| Quadrant 4 | (low growth and high quality of environment)                |
| Quadrant 4 | Quadrant 4: The average and growth of environmental quality values are low |
| Quadrant 4 | (low growth and low quality of environment)                |

To analyze the impact of fiscal policy on environmental quality, the panel data econometric model is used where there are three models analyzed. Based on the results of the Chow test, Hausman test and the Breusch-Pagan Langrange Multiplier test, the best model for this is estimated by the Fixed Effect Model (FEM). The general model takes the following form:

\[
IKLH_{it} = \alpha + \beta_1 FP_{it} + \beta_2 LnLPD_{it} + \beta_3 LnGDRP_{it} + \varepsilon_{it}
\]

Where:
- \(IKLH_{it}\) = Environmental Quality Index of province \(i\) at period \(t\)
- \(FP_{it}\) = Realization of deconcentration funds of province \(i\) at period \(t\) (proxy of fiscal policy)
- \(LPD_{it}\) = Level of Population Density of province \(i\) at period \(t\)
- \(GDRP_{it}\) = Real Gross Regional Domestic Product (GDRP) of province \(i\) at period \(t\)
- \(Ln\) = Logarithm Natural
- \(\alpha\) = Intercept
- \(\beta_i\) = Paramaters estimated
- \(\varepsilon_{it}\) = Error term

### 3. Result and Discussion

**3.1. Spatially Environmental Quality Based on Klassen Typology**

This section will examine environmental quality measured by IKLH spatially according to the type or aspect of the environment, namely the Water Quality Index (IKA), Air Quality Index (IKU) and Land Cover Quality Index (IKTL). Spatial analysis is based on Klassen’s Typology so that it can be analysed the relative position of environmental quality in each province.

Environmental degradation occurs in the water, terrestrial and air environment so that the measurement of environmental quality must cover all three aspects in the form of an environmental quality index (IKLH) [7], [8]. However, bearing in mind that each region has a dominance of natural resources and different industrial developments so that the quality of the environment according to its aspects will differ between regions which will have implications for environmental quality control strategies. For example, the main causes of environmental pollution in South Sulawesi and in Aceh Besar are different [9], [10]. Thus, spatial environmental disaggregation needs to be assessed.

Before the spatial study, IKLH will be discussed in general, which provides an overview of the total environmental quality or IKLH and according to its aspects, IKA, IKU and IKTL in the period 2009-
2017 (figure 1). With reference to the environmental quality value standard, IKLH is on average classified as poor with a value of 64.6 and a range of quality values from 61.9 to 67.5, the value is in the poor to sufficient category. The IKLH value tends to be stagnant, only rising from 64.5 in 2009 to 67.5 in 2017. The relatively stagnant IKLH value is caused during this period for the quality of the water environment or IKA value tends to increase or improve and vice versa with the IKU value and IKTL value. IKLH value is relatively low because the value of IKA and IKTL is relatively low, lower than IKLH; while the IKU value is relatively good, far better than the IKLH value.

![Figure 1](chart.png)

**Figure 1.** Environmental Quality Index (IKLH), Water Quality Index (IKA), Air Quality Index (IKU) and Land Cover Quality Index (IKTL) in Indonesia, 2009-2017.

IKU value, on average is classified as very good with a value of 86.3 and with a range of values between 79.5 to 96.4, the trend has decreased from 91.9 in 2009 to 86.3 in 2017, the value is in the good to superior category. While the quality of the water environment (IKA) on average is classified as very poor with a value of 52.3 and with a range of values between 43.2 to 61.8, but has an upward trend from 44.2 in 2009 to 52.3 in 2017, the value is in the category of alert to very poor. While for the IKTL value, on average it is also classified as very poor with a value of 57.9 and with a range of values between 55.4 to 61.7 and the trend is declining. This value is in the category of very poor to poor. IKTL values tend to be relatively low and tend to decrease is possible due to several factors. The process of land degradation begins with uncontrolled forest conversion and mining business, then followed by land use that is not in accordance with the potential and inappropriate land management. Land degraded both in mineral and peat soils, this is a source of GHG emissions because it is vulnerable to fires in the long dry season [10]. While low water quality, especially seawater or an increase in water quality parameters that has exceeded the maximum standard quality comes from natural sources and domestic waste from community activities is quite high [11].

Furthermore, the relative position of the environmental quality of each province based on Klassen's typology can be seen in table 2 to table 5. The results of the analysis using this method will map the environmental quality values of each province for the whole and each aspect into four quadrants based on values environmental quality and the growth of the quality of the environment per year. So that the analysis results are more clearly seen, they are displayed in tabular form.

The relative position of total environmental quality or IKLH per province is shown in Table 2. The results of the analysis show that most provinces (21 provinces) have IKLH values above the provincial average which are classified as poor, meaning that there are quite a number of provinces with relatively good IKLH values because all the provinces are in quadrants I and III. Some other provinces (13 provinces) have relatively low IKLH, below the provincial average because they are in quadrants II and IV. Among the provinces with relatively low IKLH, there are still quite a number of provinces with
relatively low IKLH growth (quadrant IV), namely there are nine provinces. These provinces are all provinces in Java plus the closest provinces, namely Lampung, Jambi and East Nusa Tenggara (NTT). There are only four provinces with low IKLH but relatively high IKLH growth (quadrant II), namely North Kalimantan, South Kalimantan, Riau and Bangka Belitung Islands. All of these provinces are mining areas. Study show that the effects of mining activities of have been experienced severely in Goa where several agricultural fields and rivers have been polluted [12].

Table 2. The relative position of total environmental quality or IKLH of each province is based Klassen's Typology.

| Quadrant 1: The average value and growth of IKLH is high | Kalimantan Tengah, Sulawesi Selatan, Sulawesi Tenggara, Papua Barat, Kep Riau, Sulawesi Barat, Kalimantan Timur, Papua, Sumatera Utara, Aceh |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Quadrant 2: Average IKLH value is low and growth of IKLH value is high | Kalimantan Utara, Kalimantan Selatan, Riau, Kepulauan Bangka Belitung |
| Quadrant 3: The average IKLH value is high and the growth of the IKLH value is low | Sumatera Selatan, Sumatera Barat,Sulawesi tengah, Kalimantan Barat, Nusatenggara Barat, Gorontalo, Maluku, Sulawesi Utara, Bali, Bengkulu, Maluku Utara |
| Quadrant 4: The average and growth of IKLH values are low | Jawa Tengah, Jawa Timur, Lampung, DKI Jakarta, Nusa Tenggara Timur, Jawa Barat, DI Yogyakarta, Jambi, Banten |

The relative position of environmental quality in terms of the water environment or IKA per province is shown in table 3. The results of the analysis show that most provinces (20 provinces) have IKA below the provincial average which is classified as very low, meaning that many provinces have very poor IKA because all of the provinces are in I and III consciousness. Some other provinces (14 provinces) have relatively high IKA levels, above the provincial average because they are in quadrants II and IV. Among the provinces that have relatively low IKA levels, there are still many provinces that have relatively low IKA growth (quadrant IV), which is 10 provinces. Most of these provinces (60%) are all provinces in Java; the others are West Sumatra, Jambi, NTT and NTB. There are also quite a number of provinces (nine provinces) that have low IKA values but high IKA growth (quadrant II), namely Aceh, Riau, Kalimantan Tengah, Kalimantan Selatan, Kalimantan Timur, Kalimantan Utara, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat. Most of these provinces are mining industry areas. The study shows that mining exploitation causes pollution of the surrounding water by heavy metals Pb that exceeds the specified threshold so that it can be harmful to living things, humans or animals [13].

Table 3. The relative position of Water Quality Index (IKA) of each province is based Klassen's Typology.

| Quadrant 1: The average value and growth of IKA is high | Bengkulu, Kepulauan Bangka Belitung, Kepulauan Riau, Bali, Sulawesi Tengah, Papua Barat, Papua Aceh, Riau, Kalimantan Tengah, Kalimantan Selatan, Kalimantan Timur, Kalimantan Utara, Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Barat |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| Quadrant 2: Average IKA value is low and growth of IKA value is high | Sumatera Utara, Sumatera Selatan, Lampung, Kalimantan Barat, Sulawesi Utara, Gorontalo, Maluku, Maluku Utara Sumatera Barat, Jambi, DKI Jakarta, Jawa Barat, Jawa Tengah, DI Yogyakarta, Jawa Timur, Banten, Nusa Tenggara Barat, Nusa Tenggara Timur |

The relative position of environmental quality from the aspect of the air environment or IKU per province is shown in table 4. The results of the analysis show that most provinces (27 provinces) have IKU above the average of provinces which are classified as very good, meaning that quite a number of
provinces have IKU relatively high where all the provinces are in I and III consciousness. Only a small number of provinces (7 provinces) have relatively low IKU levels, below the provincial average because they are in quadrants II and IV. Among the provinces with relatively low IKU levels, there were four provinces with relatively low IKU growth (quadrant IV). All of these provinces are in Java, namely East Java, Banten, DKI Jakarta, West Java. Three other provinces with relatively low IKU levels, but relatively high IKU growths are Riau, Lampung and North Kalimantan. Among the provinces that have relatively low IKU levels, there are four provinces that have relatively low IKU growth (quadrant IV). All of these provinces are in Java, namely East Java, Banten, DKI Jakarta, West Java. Three other provinces that have relatively low IKU levels, but the relatively high IKU growth are Riau, Lampung and North Kalimantan.

**Table 4.** The relative position of Air Quality Index (IKU) of each province is based Klassen's Typology.

| Quadrant | Description | Provinces |
|----------|-------------|-----------|
| Quadrant 1: The average value and growth of IKU is high | Kepulauan Riau, Maluku Utara, Gorontalo, Sumatera Selatan, Nusa Tenggara Timur, Sulawesi Tengah, Sumatera Barat, Bali, Sulawesi Utara, Papua Barat, Kalimantan Tengah, Kepulauan Bangka Belitung |
| Quadrant 2: Average IKU value is low and growth of IKU value is high | Riau, Lampung, Kalimantan Utara |
| Quadrant 3: The average IKU value is high and the growth of the IKU value is low | Aceh, Jambi, DI Yogyakarta, Maluku, Kalimantan Selatan, Sulawesi Selatan, Papua, Sulawesi Barat, Kalimantan Barat, Kalimantan Timur, Sulawesi Tenggara, Sumatera Utara, Nusa Tenggara Barat, Bengkulu, Jawa Tengah |
| Quadrant 4: The average and growth of IKU values are low | Jawa Timur, Banten, DKI Jakarta, Jawa Barat |

The relative position of environmental quality from environmental aspects of land cover or IKTL per province is shown in table 5. The analysis shows that there are 19 provinces that have IKTL above the average of provinces which are classified as very poor, meaning that some provinces have relatively good IKTL because all the provinces are in quadrant I and III. As many as 15 other provinces have relatively low IKTL levels, below the provincial average because they are in quadrants II and IV. Among the provinces with relatively low IKTL levels, only three provinces had relatively low IKTL growth (quadrant IV), namely Lampung, Jambi and the Bangka Belitung Islands. The provinces are all on the southern part of Sumatra Island. There are 12 other provinces with relatively low level of IKTL, but the growth of IKTL is relatively high, namely all provinces in Java Island, some provinces in Sumatra Island plus South Kalimantan and North Kalimantan. The level of forest cover loss varies in the four provinces, with the rate of forest loss in the Provinces of South Sumatra, East Java and East Kalimantan higher than Papua [14].

**Table 5.** The relative position of Land Cover Quality Index (IKTL) of each province is based Klassen's Typology.

| Quadrant | Description | Provinces |
|----------|-------------|-----------|
| Quadrant 1: The average value and growth of IKTL is high | Nusa Tenggara Barat, Kalimantan Barat, Kalimantan Tengah (3) |
| Quadrant 2: Average IKTL value is low and growth of IKTL value is high | Sumatera Utara, Riau, Sumatera Selatan, Kepulauan Riau, DKI Jakarta, Jawa Barat, Jawa Tengah, DI Yogyakarta, Jawa Timur, Banten, Kalimantan Selatan, Kalimantan Utara (12) |
| Quadrant 3: The average IKTL value is high and the growth of the IKTL value is low | Aceh, Sumatera Barat, Bengkulu, Bali, Nusa Tenggara Timur, Kalimantan Timur, Sulawesi Utara, Sulawesi Tengah, Sulawesi Selatan, Sulawesi |
3.2. The Impact of Fiscal Policies on Environmental Quality

This section will analyse the impact of fiscal policy on environmental quality as measured by the Environmental Quality Index or IKLH. The fiscal policy in this study is government expenditure, specifically the environmental deconcentration fund allocated by the central government to the provincial government to manage the environment. Analysis uses the econometric model of panel data, specifically the FEM model. Based on F-Statistics and R2 values, it shows that the model used is good and feasible to use to estimate the impact of fiscal policy and other variables on environmental quality (Table 6).

The analysis shows that not only the fiscal policy variable (FP), other variables that are thought to affect the quality of the environment or IKLH, namely the level of population density (LPD) and the level of regional output or real GRDP also have a significant influence on environmental quality or IKLH (Table 6). Fiscal policy and level of population density have a positive effect on IKLH values, while the real GRDP has a negative effect on IKLH. These results indicate that increasing the realization of deconcentrated funds and the level of population density can encourage an increase in the quality of the environment and vice versa with the level of regional output. This indicates that the activities of producing goods and services do not heed the principles of sustainable economic development, the activities of producing goods and services are followed by environmental degradation. This finding is in line with states that in developing countries an inverse relationship is found between GDP and environmental quality of land cover [15]. It also in line with states there is a negative and two-way relationship between environmental degradation with GDP per capita and energy consumption [16]. It is evident that good environmental quality will increase the fulfillment of basic needs [17].

Fiscal policy (FP) in this case the realization of the deconcentration fund has a significant effect on IKLH at the real level of 1% with a positive direction and with a coefficient value of 0.097419. This means that an increase in the realization of deconcentration funds by one percent can improve the quality of the environment or IKLH by 0.097419 percent. The effect is inelastic which shows that the effect of fiscal policy on IKLH is still relatively small. Meanwhile, the effect of population density on IKLH is elastic with a coefficient of 17.85898. This means an increase in population density of one percent can improve the quality of the environment or IKLH by 17.85898 percent. This fact is interesting because it is not in accordance with the hypothesis. Therefore, related to the problem of environmental degradation is creating a consistent, coherent and effective environmental policy framework is essential in order to maintain a natural environment that supports wellbeing and enables long-term economic growth and development [4].

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| C        | 515.1086    | 125.0824   | 2.519209    | 0.0130|
| LnLPD    | 17.85898*** | 4.175135   | 4.277462    | 0.0000|
| LnGDRP   | -10.96521***| 4.249625   | -2.580278   | 0.0110|
| FP       | 0.097419*** | 0.034276   | 2.842219    | 0.0052|
| R2       | 0.8964      |            |             |       |
| F-Statistic | 31.8     |            |             | 0.0000|

4. Conclusion and Policy Implication

Based on IKLH, in general the quality of the environment in Indonesia is classified as poor. However, with disaggregation based on environmental quality aspects (water, air and land cover), air quality (IKU)
is classified as very good, but for land cover and water quality (IKTL and IKA) are classified as very poor (water quality is the worst).

Spatial analysis of environmental quality results for all aspects of environment quality (IKU, IKA, IKTL) shows that there is an inequality of environmental quality so that there are provinces that have good and very good environmental quality, and there are provinces included in the alert category.

The results of econometric analysis show that fiscal policy (the deconcentration fund) has a significant and positive effect on environmental quality, but it is inelastic; while GRDP has a significant and negative effect on environmental quality.

Therefore, to improve the quality of the environment (1) Deconcentration funds are focused on improving water quality and land cover and priority is given to provinces with poor environmental quality with low growth (in this study, there are 12 provinces, namely all provinces in Java, Sumatera Barat, Jambi, NTB, NTB and Kepulauan Bangka Belitung) and (2) To increase effectiveness in overcoming environmental problems, local governments must be able to increase environmental based budgets and economic development must be more environmentally friendly.

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