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Integration of Environmental and Economic Aspects in Green GRDP Calculation on the Industrial Sector in West Bandung District, Indonesia

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Abstract
West Bandung Regency is a developing district in West Java, Indonesia. As a developing city, the industrial sector is one sector that has a large share of Regional GDP in this district, which is 39%. On the other hand, based on the concept of sustainable development, the calculation of Regional GDP or Gross Regional Domestic Product (GRDP) has not paid attention to aspects of resources depletion and environmental degradation. Therefore, Regional GDP is difficult to measure the business benefits of the industrial sector in the concept of sustainable development. This paper introduces concept of green Regional GDP and its contribution to regional income. This paper analyzes the value of depleted resources and degraded environments in the region, from 2015 to 2017. Resource depletion is focused on depletion of water resources. Whereas the degradation that occurs is focused on congestion and damage to water resources due to industrial waste. The industrial sector Green Regional GDP has resulted in a reduction in Regional GDP of 1.17% in 2015, 1.12% in 2016 and 1.06% in 2017. Therefore, an appropriate policy is needed in overcoming this problem, especially reducing environmental damage, namely reducing congestion and reducing environmental pollution in order to achieve sustainable development.

Keywords: Sustainable development, Depletion, Degradation, Water, Congestion, Damage

1. Introduction

Increasing national income in almost all countries on earth has driven to the natural resources depletion and environmental damage. This condition has become Club of Rome concerny in 1972 (Kuncoro, 2003) and also the leaders of countries in the world on the earth summit, Rio de Janeiro in 1991. To avoid the increasingly severe development impact on natural and environmental resources, a new paradigm needs to be adopted, which improves the environmental development approach, making the development become sustainable. Sustainable development is defined as a development with natural resource management in such a way that its availability and quality is guaranteed for future generations (Callan, 2002). Therefore, the development paradigm should be changed, no longer using GDP calculation on the basis of System of National Account (SNA), but based on Green GDP calculation on the basis of an integrated calculation system concept between the environment and economy or integrated environmental and economic Account system (United Nations, 1993). Sustainable economic indicators were formally introduced by Hartwick in 1990. This measurement method is known as the Solow-Hartwick Rules, because it is a continuation of the efforts made by Solow in 1974 (Fauzi, 2004). Appreciation of the environment as a factor of economic production, also stated by Pearce and Worford (1993).
The concept of green GRDP (Gross Regional Domestic Product) emerged in the early

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1990s as a reaction to conventional GRDP deficiencies, hereinafter referred to brown GRDP. Green GRDP calculations have calculated depletion of natural resources and environmental degradation that occur as a deduction cost of Brown GRDP. Thus, Green GRDP is a more suitable indicator for measuring the level of welfare of people in a region. In addition, Green GRDP can also be used as a basis for sustainable planning by taking into account the existence of natural and environmental resource factors in an area (Wu, 2010).

Green GRDP rules in Indonesia are based on Law No. 32 of 2009 concerning Environmental Protection and Management, which is stated in Article 43 paragraph (1) that "development planning instrument and economic activities as referred to in Article 42 paragraph (2) letter a includes the balance of natural resource and the environment, and the compilation of GDP and GRDP which includes depreciation of natural resources and environmental damage ".

West Bandung District is one of the regions that has prepared Green GRDP analysis. This can be seen from the development of studies on Green GRDP in West Bandung District. The Government of West Bandung District has prepared a Green GRDP analysis, among others, with the availability of a Green GRDP development guide book and Green GRDP analysis from 2013-2015.

Therefore, this paper will discuss the impact of Green GRDP as a sustainability indicator of development planning in West Bandung District from 2015-2017 on the industrial sector.

2. Green Economy

The impact of production based on natural resources and environment makes most natural resources depleted and environment degraded. As a result of the damage to natural resources and the environment that occurs is the increased cost natural resources utilization and environment due to extinction and damage to natural resources and environment, then from developing economic aspects where externalities from production are then internalized by integrating environmental problems due to production into production planning and calculation.

The concept of sustainable development which is currently known as the Green Economy is a vision of development that abandons economic practices that prioritize short-term impacts on the destruction and pollution of natural resources and the environment, this concept actually provides a view to promoting long-term economic growth that continue to pay attention to the preservation of natural resources and the environment.

To support green economic development the Ministry of Environment continues to disseminate and simultaneously publish the latest legal regulations, namely Law Number 32 of 2009 concerning Environmental Protection and Management. As for the law, there are several recommendations and obligations to support and shape the green economy. The policies that support the development of a green economy in Indonesia include;

1. Development of environmental economic instrument consists of development planning system, insentive or dissinsentive, and environmental investment fund.
2. Development of studies and calculations of Gross Domestic Product/Green Gross

Regional Domestic Product;
3. Development of guidance and application of economic valuation of Natural Resources and Environment (SDALH) and environmental impacts;
4. Development of the implementation of 3R (reuse, reduce, recycle);
5. Development of B3 Waste investment program;
6. Conduct studies on green economy (low carbon development)

3. Methods Analysis

Analysis used primary and secondary data. Primary data was obtained from interviews with 30 people living in the vicinity of the industry. Interviews focused more on the industrial impact on congestion and damage to water resources. Whereas for secondary data, it was obtained from the depletion value. The required data was obtained from BPS data and related institutions in West Bandung District.
Next was the stage of analysis:

3.1 Calculating the Green GRDP of the Industrial Sector

Green Gross Domestic Product, hereinafter referred to as Green GDP, is the value of all goods and services produced by a country or region in a certain period which includes depreciation of natural resources, pollution and/or environmental damage. The stages of calculating Green GRDP in the industrial sector are:
a. GRDP of industrial sector in West Bandung District in year t, hereinafter referred to as conventional GRDP.
b. Assessment of natural resource depletion in year t. Where depletion of natural resources used in the industrial sector is a decrease in natural resource reserves due to human economic activities.
c. Then the Semi Green GRDP assessment is carried out by:
Semi Green GRDP = GRDP industrial sector in West Bandung District t –
The depletion value of natural resources from the industrial sector year t
d. Assessment of environmental degradation from the industrial sector year t. Where environmental degradation is a decrease in environmental quality as indicated by reduced function of natural resources and the environment.
e. Green GRDP value in industrial sector year t will be obtained by:
Green GRDP industrial sector = Semi Green GRDP industrial sector - Value of Environmental Degradation industrial sector year t
Composing green GRDP in the industrial sector begins with Brown GRDP calculation in the industrial sector, natural resources depletion value calculation, in the industrial sector, and added value of the industrial sector substraction in order to obtain the industrial sector of Semi-Green GRDP value, reduced by the degradation value industrial sector environment, hence the value of Green GRDP in the industrial sector is obtained.

3.2 Calculation of Natural Resources Depletion

a. Identification of Depleted Natural Resources

Identification of the use of natural resources utilized by each sub-sector can be different. Some of the resources considered in depletion are water, group C excavated material,

capture fish and forest wood, mangrove forests, coal and petroleum.

b. Volume Quantification

In calculating the quantification of the volume of depleted natural resources, it is necessary to know the number of business units for each type of industry. If the data do not yet exist, then the data is collected through separate surveys, secondary data can be used to determine the type and volume of depleted natural resources and if secondary data is not available, surveys can be carried out by taking a number of samples of industrial business units that experience the most environmental problems.

c. Economic Valuation

The role of economic valuation is very important in the preparation of Green GRDP in the industrial sector, where economic valuation is an effort to determine the price or value of natural resources and environment. For natural resource commodities, the simplest way is using the concept of economic rent as the price of natural resources while still in place.

By obtaining rent unit values for each type of natural resource, then the depletion value is calculated by multiplying the volume of natural resources depleted by the rent unit value that has been obtained. Each total depletion value that has been obtained in various types of natural resources is then summed to obtain the total depletion value of natural resources according to the year concerned.

3.3 Calculation of Environmental Degradation

The assessment of the environmental degradation of the industrial sector in West Bandung District in the year t was carried out by the method of valuing the economy of natural resources and environment. The methods for assessing degradation are:

a. Market price

The market price approach is the main approach that must be sought by a researcher. If the impact of economic activity has a market price, then the use of market prices can be said to be mandatory. To calculate the value of the negative impact of economic activity then the market price approach uses economic rent. The formulas used are as follows:

$$NDN = \sum_{n=1}^{i} K\,R$$

$$R = TB - (TC + Profit)$$

NDN = Economic Value of Negative Impact
K = Quantity/amount lost/damaged
R = Economic Rent

b. Loss of income

The value of lost income uses the following formula:

$$NDN = \sum_{n=1}^{i} K\,(\Delta\pi)$$

Where

$$\Delta\pi = \pi_0 - \pi_t$$

Thus

$$NDN = \sum_{n=1}^{i} K\ (\pi_0 - \pi_t)$$

NDN = Economic Value of Negative Impact
K = Quantity/number of recipients of negative impacts (people, units, etc.)

Π_0 = Total income before the occurence of pollution
Π_t = Total income at the time of pollution

c. Replacement cost

Replacement costs are costs incurred to replace lost benefits or which valued based on the value of other goods that have the same benefits. Examples of replacement costs such as: fertilizing the soil, thus soil fertility returns to normal before economic activities occur, the loss of the benefits of using river water for bathing is replaced by utilization of PDAM water.

$NDN = \sum_{n=1}^{i} K \ Cr$

Description:
NDN = Economic Value of Negative Impact
K = Quantity / number of recipients of negative impacts (people, units, etc.)
Cr = Replacement Cost

d. Cost of illness

The cost of illness treatment is the cost incurred due to the impact of damage to resources and the environment. The existence of economic activities will also have an impact on the emergence of several diseases such as ARI, dengue fever, and other diseases caused by damage to resources and environmental pollution. The calculation formula is as follows:

$NDN = \sum_{n=1}^{i} K \ Ci$

Where

$Ci = \sum_{h=1}^{i} T \ C_T$

Description:
NDN = Economic Value of Negative Impact
K = Quantity/number of recipients of negative impact (people)
Ci = Total cost of healing the disease
T = Number of days of treatment
C_T = Cost of treatment / healing per day

4. Result and Discussion

The percentage distribution of GRDP in a sector shows the role of each sector in its contribution to the GRDP as a whole. The greater the percentage of a sector, the greater the influence of the sector in the economic development of a region. The level of contribution to the formation of GRDP can show the contribution of value added for each sector, hence sectors that will trigger growth (mainstay sector) in the region will appear.

In 2017, total GDRP of West Bandung District was IDR 35,048.24 billion. The contribution of the agricultural sector, industrial sector and trade/hotel/restaurant sector to the formation of GRDP is the highest sector compared to other sectors. The industrial sector provides the highest contribution, while the lowest contribution sector is the mining and quarrying sector. Industrial sector contributes approximately 40% to West Bandung District economy. Meanwhile, agriculture sector's share was about 11.36%.

Industrial locations are only found in a number of sub-districts which are the location of industrial gatherings. Industrial areas and industrial centers are found in bordered of Padalarang and Ngamprah Sub-district. Some types of small industries that are mostly found in West Bandung District are woven and food. The largest medium-large type of industry is the textile industry with 30,32 percent. Medium-large industries classified as agro-industries are food and beverage industries, rubber and rubber goods, leather and leather goods, as well as other types supplied by the agricultural sector with a percentage of less than 20 percent.

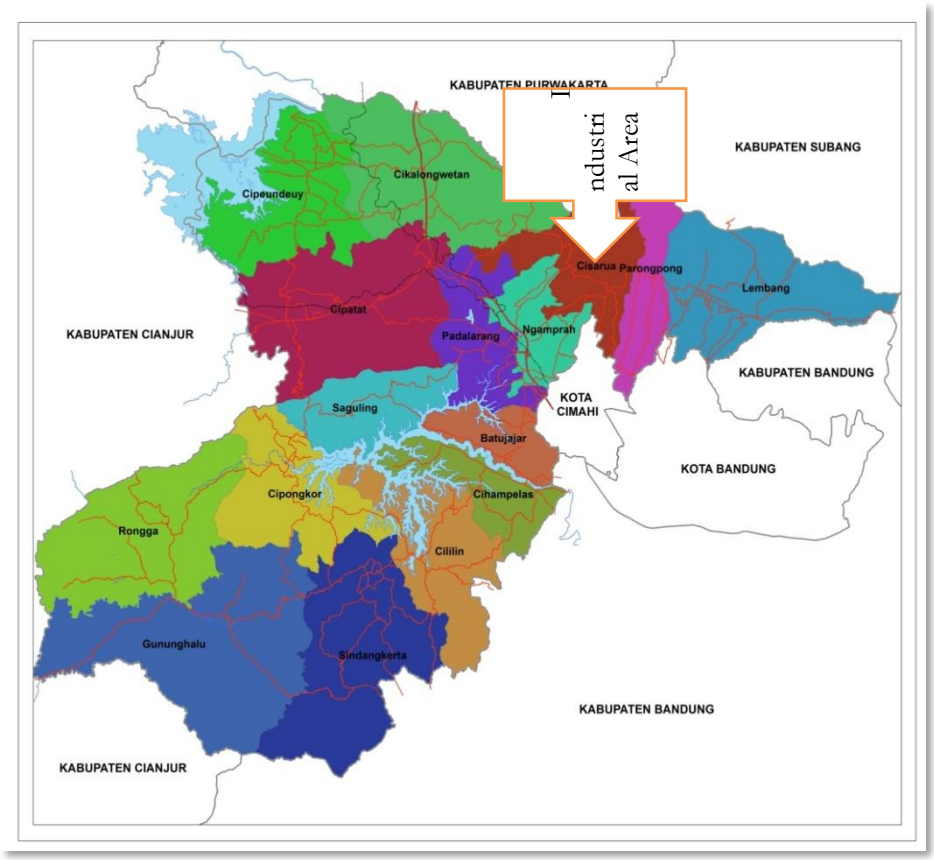

Figure 1. Map of West Bandung District

4.1 Depletion Value of Industrial Sector

Calculation of depletion value for the industrial sector in Gross Regional Domestic Product (GRDP) is a calculation of the reduction of natural resources due to utilization activities. The depletion calculated in the context of Green GRDP in the non-oil and gas industry sector in West Bandung District is more emphasized on depletion of water resources.

In the calculation of natural resource depletion, Bank Indonesia interest rates are used which differ each year, according to the interest rates that apply in the year of calculation.

The Bank Indonesia interest rates as a reference are shown in Table 1.

Table 1. Interest Rates for 2015 – 2017 in Indonesia

Year	Interest Rate of BI (%)
2015	0,075
2016	0,065
2017	0,053

Source: Bank Indonesia from various years

Other assumptions used in this calculation are as follows:
1. Related to resource prices is based on market prices.
2. Production costs are taken from an expert value, in addition to the production of water taken from West Bandung District water company (Tirta Raharja).
3. Whereas the use of water resources is taken from an expert value.
Based on the above assumptions, the value of natural resource depletion can be calculated for each sector. The number of industries in West Bandung District that have been collected by the West Bandung District Central Bureau of Statistics from 2015 to 2017, data is obtained as shown in Table 2.

Table 2. Data on the Number of Industries in West Bandung District 2015 - 2017

Number of industries	2015	2016	2017
Micro	4	4	4
Small	314	314	314
Medium	911	911	911
Large	188	188	188

Source: Analyzed

Assuming the utilization of average water resources for micro and small industries is 3 m^3/day/unit, for medium industries it is 20 m^3/day/unit, and for industrial is 38 m^3/day/unit. With a water price of IDR 5,279/m^3 and the cost of providing clean water is IDR 3,545/m^3.

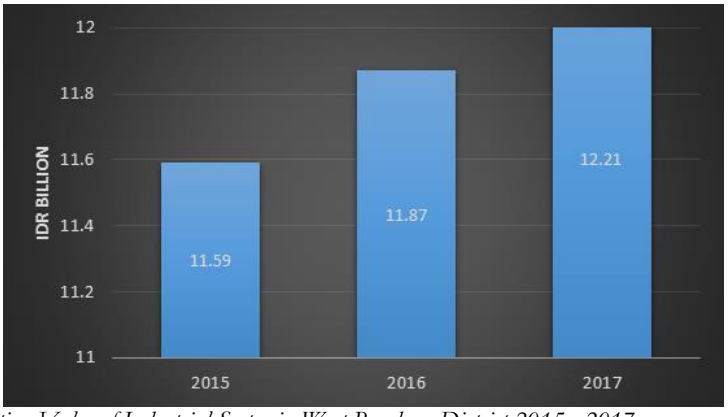

Figure 2. Depletion Value of Industrial Sector in West Bandung District 2015 - 2017
Source: Analyzed

Based on the results of the calculation it was found that the depletion value of water resources in industrial utilization in 2015 was IDR 11.59 billion, the depletion value of water resources utilization of industry and trade increased in 2016 to IDR 11.87 billion, and in 2017 the depletion of water resources in the use of industry and trade continued to increase to IDR 12.21 billion. Depletion value of water resources for industry and trade due to the influence of interest rates (Figure 2).

4.2 Degradation of Industrial Sector

Calculation of the degradation value is conducted to analyze the value of losses from congestion in the Ngamprah area and the damage value of water resources in the Ngamprah Industrial Area.

4.2.1 Congestion Loss

Losses in the Ngamprah industrial area are due to the large number of factory trucks while the roads in the Ngamprah industrial area are considered too small. Congestion occurs in the morning and evening especially when factory workers enter and leave workplace. Based on the primary data taken through interviews, it was found that the value of losses for cars per year was IDR 3.35 million and the average motorbike loss per year was IDR 2.06 million. Thus, with the number of vehicles crossing the Ngamprah industrial area, the value of inefficiency of fuel (BBM) will be obtained. Based on the calculation results, it was found that the value of fuel inefficiency in 2015 was IDR 6.80 million, increasing in 2016 to IDR 7.49 million, and in 2017 it increased to IDR 8.23 million. The increase in the value of losses due to congestion was caused by the increasing number of motorized vehicles experiencing congestion in the Ngamprah area.

4.2.2 Damage of Water Resource in Industrial Area

The industry in the Ngamprah industrial area has made the groundwater quality around it worse. Based on the results of interviews with 30 people it was found that the average household loss in a year was IDR 765.333/household. The value of losses due to damage of water resources in the Ngamprah industrial area in 2015 amounted to IDR 129.67 billion, increased to IDR 133.83 billion in 2016. In 2017 losses of water resource up to IDR.135.26 billion.

4.2.3 Green GRDP of the Industrial Sector

Based on the calculation, depletion value of industrial sector in 2015 was IDR 11.59 billion, meanwhile GRDP of this sector was IDR 12,071.62 billion, according these value, the semi-green GRDP in 2015 was IDR 12,060.03 billion. For 2016, resource depletion value was IDR 11.87 billion, meanwhile GRDP of industrial sector was IDR 12,955.49 billion, consequently semi-green GRDP was IDR 12,943.62 billion. Furthermore, for semi-green GRDP industrial sector in West Bandung District was IDR 13,946.30, it was decreased about IDR 12.21 billion because of resource depletion.

Meanwhile for degradation, degradation caused by industrial sector in 2015 was IDR 129.67 billion, in 2016, degradation value was IDR 133.84 billion, meanwhile degradation value in 2017 was IDR 135.26 billion. According to depletion and degradation values,

green GDRP of industrial sector in West Bandung District at 2015 was IDR 11,930.36, decreased about 1.17%. In 2016, its green GDRP was IDR 12,809.78 billion, decreased about 1.12%. Furthermore, in 2017, value of depletion and degradation was IDR 13,811.04, a decreased by 1.06%.

The decreasing difference between Conventional GRDP and Environmental GRDP indicates that West Bandung District has begun to have major improvements in reducing the level of depletion and environmental degradation. With the reduction based on each sector the data of which sectors suffered losses in the economic development of West Bandung District will be obtained.

5. Conclusion

The industrial sector has an important role in the economy of West Bandung District, it shares about 39.83% from total GDRP, IDR 35,048.24 billion.

The contribution of the agricultural sector, industrial sector and trade/hotel/restaurant sector to the formation of GRDP is the highest sector compared to other sectors. The industrial sector provides the highest contribution, while the lowest contribution sector is the mining and quarrying sector. Industrial sector contributes approximately 40% to West Bandung District economy. Meanwhile, agriculture sector's share was about 11.36%. The industrial sector has a positive impact on the economy, but the industrial sector also has negative impact, such as depletion of water resource, damage of water resource and loss due to congestion.

Green GDP is an alternative indicator to calculate GDP which includes depreciation of natural resources, pollution and/or environmental damage. Green GRDP is derived from conventional GRDP minus depletion and degradation. Based on the results of the analysis, the value of Green GRDP from 2015 to 2017 has decreased. The value of green GRDP in 2015 was IDR 11.930.36 billion, then in 2016 it increased to IDR 12,809.78 billion, and in 2017 it increased again to 13,811.04 billion. The percentage of the decrease in the value of green GRDP in industrial sector was 1.17% in 2015, decreasing to 1.12% in 2016 and down to 1,06% in 2017.

6. Policy Implications

1. The other biggest depletion of resources is the water resources utilization, among community, industrial and other activities. The impact happened to the community was quite significant, as it was difficult for the community to get clean water. Therefore, it is necessary to save water resources, such as Rain Water Harvesting, Flow Restrictor, and socialization of water use.

a. At present, rainwater management techniques through run-off models are directly channeled to drainage with conventional types of drainage. The impact of the use of this concept can result in droughts, floods, landslides occurring everywhere. One way to control rainwater runoff so that it can be used as a source of water, infiltrated and evaporation (as in the natural cycle of water), hence inundation or floods and droughts can be minimized, namely the development approach based on the concept of Low Impact Development (LID). The concept of LID is applied to treat rainwater which is

runoff water, therefore it can be used as a water source with Rainwater Harvesting. The principles of LID are: utilizing shelter in artificial or other buildings or ponds/lakes, drainage infrastructure, and structuring their land in an effort to hold down the flow of rainwater to the downstream area, reducing the change of land into watertight land; multiply ground cover plants such as land covered with grass and plants; prolong the concentration time by extending the flow path; conservation of natural drainage systems to reduce the peak of flooding; permanent or temporary water storage is needed to control the volume and peak of floods, and the quality of runoff water.

b. Using a water restrictor or flow restrictor, this can save water usage.

c. Industrial water needs are also quite high, which results in increased value of water depletion in industrial business. One way to overcome this problem, West Bandung District Government can create a water treatment from water that has been used, to be used again in the industrial business field.

d. Socialization of the savings in water use needs to be conducted considering the use of water by the population is very high.

2. The highest degradation originates from the transportation sector, namely by the occurrence of fuel losses due to congestion, resulting in fuel inefficiencies. Reducing Congestion in Ngamprah Area. The West Bandung District Government can first implement a comprehensive policy, such as providing crossing bridges to workers, so as not to disturb road users. Furthermore, a special parking area for pickers or public transportation is added, and there is a guardrail so that pedestrian uses bridge to cross the roads.

3. Another degradation is water degradation in the Ngamprah area. This is necessary to construct water resources processing used that can once be reused. The industrial sector must have wastewater treatment, but water damage in this area still occurs. Therefore the West Bandung District Government can carry out tighter supervision of WWTPs utilization.

In principle there are three things that can be done in the context of preservation, prevention, and overcoming environmental damage due to pollution, namely taking actions administratively, using technology, and through education.

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