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# Implementation of Circular Economy and Its Effect on GRDP (Case Study of 15 Provinces in Indonesia)

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**Abstract**

*This research aims to analyze the variable influence of the amount of clean water distributed, waste generation, B3 waste from the manufacturing industry that is managed, and creative economy industry workforce on the GRDP of 15 Provinces in Indonesia. The analytical tool used is panel data regression. In the overall research period, the amount of clean water distributed had a positive and significant effect on GRDP. Meanwhile, waste generation has a positive and insignificant effect on GRDP. Meanwhile, processed B3 waste from the manufacturing industry has a negative and insignificant effect on GRDP. Meanwhile, creative economy industry workforce had a positive and insignificant effect on GRDP throughout the research period.*

Keywords: circular economy, creative economy industrial workforce, distributed clean water, economic growth, managed manufacturing b3 waste, waste generation

## INTRODUCTION

Sustainable Development Goals (SDGs) is a world-scale program established by the United Nations (UN) on September 25, 2015. SDGs are a global and national commitment in an effort to improve the welfare of society. SDGs comprehensively regulate all aspects of human development (Iskandar, 2020). Sustainable Development Goals (SDGs) are developments that maintain the continuous improvement of the economic welfare of society. The SDGs program in Indonesia is very important to realize considering that economic conflict is very high and continues to change from time to time (AM, 2021).

Economic growth is a continuous change in the economic conditions of a country towards rapid development in a certain period. This is characterized by an increase in production capacity which results in an increase in national income, thereby changing the structural transformation from the primary sector to the secondary and tertiary sectors (Tora et al., 2022). The higher the income, the greater the amount spent on goods and services because with With a large income, they tend to use the goods they need (Murwiati & Zulkarnain, 2023). Domestic consumption increases every years due to the increase in population and people's purchasing power (Maimunah et al., 2021). Economic growth shows the extent to which economic activities generate additional income for society over a certain period of time (Afiftah et al., 2019).

The concept of sustainable development is closely related to environmental problems, so it really supports the concept of economic growth which is more concerned with ecological and social aspects. The concept of economic growth is known as the concept of green economic growth. Green economic growth seeks to increase the rate of economic growth by using resources that are more efficient, cleaner and more resilient but does not have an impact on reducing the rate of economic growth (Hallegatte et al., 2012). The concept of green economic growth is known as 5R, namely Reduce, Reuse and Recycle,

Refurbish and Renew. This concept produces new products with economic value where the raw materials used are recycled from waste generation so that it can help reduce the amount of waste disposal and environmental pollution.

Water is infrastructure that plays a role in economic growth. Without water, economic activities can be disrupted. Water (H2) is a chemical compound formed from fundamental compounds that play a role in the needs of living things on earth, namely hydrogen (H2) and oxygen (O2) (Irianto 2015). Water is the most important basic need for the continuity of daily economic activities.

The improvement in the economy which has an impact on the level of people's income and education can cause people's consumption of goods and services to increase. An increase in public consumption of goods and services can cause an increase in the amount of waste generated. Garbage is generally leftover waste from items that are no longer used. The increase in the amount of waste generation caused by economic growth which results in increased public consumption of goods and services indirectly causes the composition of existing waste to become more diverse.

Definition of B3 Waste (Hazardous and Toxic Materials) according to Law no. 32 of 2009, is the remainder of a business and/or activity containing B3, which due to its nature, concentration and/or amount, either directly or indirectly can pollute and/or damage the environment, and/or endanger the environment, health , as well as the survival of humans and other living creatures. B3 waste includes dangerous and toxic raw materials that are no longer used because they are damaged, packaging residues, spills, process residues, and used oil that requires special handling and processing.

Labor productivity can be increased through two types of capital, namely human and fixed capital. According to Todaro & Smith (2003), human capital is defined as a measure of the quality of Human Resources (HR) based on aspects of education, health and other human capacities. Good quality human resources will result in increased productivity. Apart from that, additional fixed capital investment is a way to increase labor productivity (Arnold, 2010). Fixed capital includes machinery and equipment as well as vehicles. On the other hand, labor productivity plays an important role in shaping the competitiveness of a particular sector or the entire economy and helps create the necessary conditions for economic development. Increasing labor productivity is an inseparable part of human resource development (Adam, 2016).

Several studies conducted by the World Bank related to evaluating the impact of clean water assistance programs in several developing countries generally report a positive influence of access to clean water on community economic activities Imp & Resm (2018). Water is a basic need which is now becoming a concern due to the limited availability of clean water. In each region, it is important to note that meeting the need for clean water can facilitate economic activities so that it can encourage increased regional economic growth.

One economic model that supports the concept of green economic growth is the circular economy model. The circular economy is an alternative to the traditional economy where economic activities are carried out by preserving resources as long as possible, retaining their value when used, and reusing them to produce new products at the end of

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their useful life (Shirvanimoghaddam et.al., 2020). A circular economy can be a solution to harmonize the goals of pursuing economic growth and protecting the environment (Anbumozhi & Kimura, 2018).

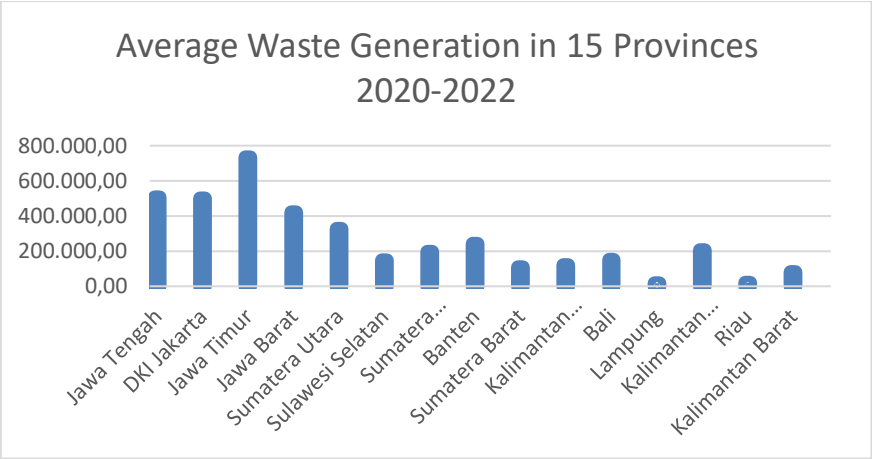
Circular Economy is a model that seeks to extend the useful value of materials raw materials, finished products and existing resources so that they can be used and reused (Emalia et al., 2023) Several previous studies confirm the influence of the circular economy on aspects of environmental, economic and social goals. Research by Androniceanu et al. (2021) which is related to sustainable development, applying circular economy theory in European Union member countries. Research by Su et al. (2013) explains that circular economy indicators refer to 4 dimensions (case study of Dalian City, China).

The concept of sustainable development will refer to the concept put forward by (Korhonen et al., 2018). Circular economy indicators in the dimensions of resource efficiency and waste disposal show that when the indicator value in these dimensions decreases, circular economic activity occurs. In addition, circular economy activities from the waste management dimension are considered to increase if there is an increase in waste management.

Majeed & Luni's research (2020), using global panel data from 131 countries, explains that the implementation of a circular economy has a significant effect on environmental quality. This is a main indicator in implementing a circular economy related to innovation and competition, which generally includes waste recycling methods. In addition, Busu's (2019) research with a case study in the European Union explains that the circular economy model is determined by resource productivity, labor employed for environmental protection, urban waste recycling rates, and the use of renewable resources. Busu (2019), using panel data regression analysis tools and correlation coefficient descriptive statistics, confirmed that there is a positive influence from implementing the circular economy model to increase employment opportunities, urban income, and profits obtained by entrepreneurs who pay attention to environmental aspects.

Based on the research description, the author adopted the research of Su et al. (2013) which was successfully implemented in Dalian City, China. This research only uses 3 dimensions of the circular economy as independent variables, namely resource efficiency, disposal and management of waste/garbage and the workforce employed. The resource efficiency dimension will be proxied by the amount of clean water distributed; the waste disposal dimension will be proxied by the waste generation variable; waste management will be proxied by the manufacturing industry B3 waste variable managed; and the dimension of labor employed for environmental protection is proxied by the total labor productivity of the creative economy industry.

**Figure 1.** Average Waste Generation in 15 Provinces 2020-2022




Source: Badan Pusat Statistik

Likewise in Indonesia, there are 15 provinces that have a fairly high average level of waste generation, especially in the 2020-2022 period which is the object of research in this study. In first place, those with the highest amount of waste generation are the provinces of East Java, Central Java, DKI Jakarta, West Java, North Sumatra, Banten, East Kalimantan, South Sumatra, South Sulawesi, Bali, South Kalimantan, West Sumatra, West Kalimantan, Riau, and Lampung.

The economic growth of the 15 provinces did not just increase, but there were several sectors that supported economic growth in each province. East Java is supported by an increase in the processing, construction, transportation and warehousing industrial sectors. In Central Java, in terms of the business sector, the source of growth comes from the processing industry and trade sectors. DKI supports the infocom, trade and corporate services sectors. West Java is supported by the processing industry, trade, and information and communication sectors. North Sumatra is supported by the manufacturing, goods and services industrial sectors. Banten is supported by the manufacturing industry, wholesale and retail trade, and real estate sectors. East Kalimantan is supported by the mining and processing industry, South Sumatra is supported by the mining, processing and agricultural sectors. South Sulawesi supports mining and quarrying business fields. Bali is supported by the tourism and construction sectors. South Kalimantan is supported by mining and processing industries. West Sumatra is supported by construction and transportation. West Kalimantan is supported by agriculture and processing industry. Riau is supported by the processing industry sector. and Lampung to support the agricultural, industrial and trade sectors.

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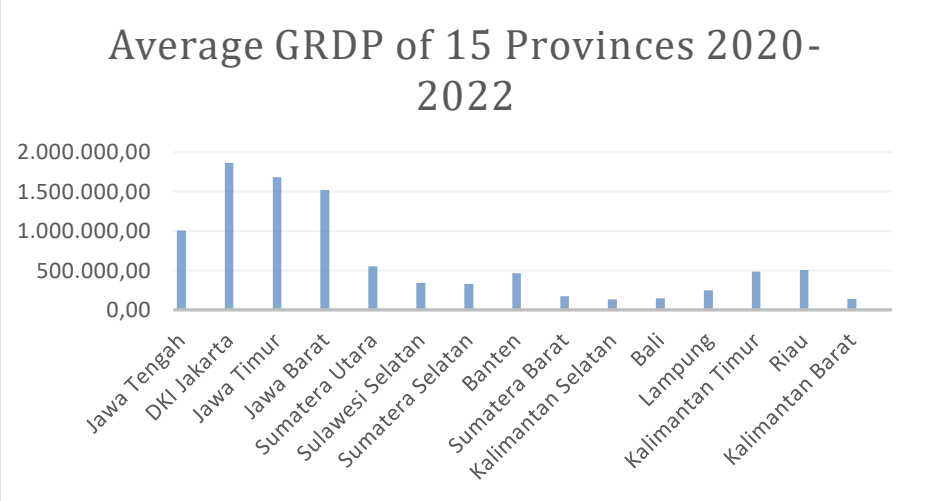
**Figure 2.** Average GRDP of 15 Provinces 2020-2022




Source: Badan Pusat Statistik

Technological progress in the Solow model is specified as a residual component (Solow Residual) to explain economic growth in the long term. The high and low growth of this technology is assumed by Solow and other theorists to be exogenous or not influenced by other factors. The Solow growth model is designed to show how growth in the capital stock, growth in the labor force, and technological progress interact in an economy, as well as how they affect a country's overall output of goods and services. In this model, long-term economic growth is determined exogenously, or in other words determined outside the model. This model predicts that ultimately there will be convergence in the economy towards steady-state growth conditions that depend only on technological developments and labor growth. Mankiw, (2006) in (Masniadi, 2012), said that steady-state conditions indicate a long-term equilibrium economy.

This Neo-Classical growth theory has many variations, but in general they are based on the production function that was developed by Charles Cobb and Paul Douglas which is now known as the Cobb-Douglas production function.

This function can be written as follows:

$$\mathbf{Q_t = T_k^a K_t L_t^b}$$

Where:

Qt = Production level in year t

Tt = Technology level in year t

Kt = Total stock of capital goods in year t

Lt = number of workers in year t

a = increase in output created by an increase in one unit of capital

b = increase in output created by one additional unit of labor

With this theory, the author wants to know the influence between the variables of the amount of clean water distributed, waste generation, B3 waste from the manufacturing industry, and creative economy industry workforce on the GRDP of 15 Provinces in

Indonesia. A hypothesis is a temporary answer to a research problem. So 4 hypotheses were prepared in this research as follows. It is suspected that the amount of clean water distributed has a positive effect on GRDP in 15 Indonesian Provinces in the 2020-2022 period. It is suspected that waste generation will have a negative effect on GRDP in 15 Indonesian Provinces in the 2020-2022 period. It is suspected that B3 waste from the manufacturing industry is managed to have a positive influence on GRDP in 15 Indonesian Provinces in the 2020-2022 period. It is suspected that the creative economy industry workforce has a positive influence on GRDP in 15 Indonesian Provinces in the 2020-2022 period.

## METHOD

### Type, Period and Data Source

This research uses secondary data in the form of information from other parties and is available for publication. Books, journals, SIPSN and KEMENPAREKRAF and BPS publications that are relevant to the topic studied. Economic growth, the amount of clean water distributed, waste generation, B3 waste from the manufacturing industry managed, creative economy industry workforce in 15 Indonesian Provinces for the 2020–2022 period is used as quantitative data in this research which is processed using certain statistical criteria.

This study aims to examine the influence of the amount of clean water distributed, waste generation, waste recycling, and creative industry workforce productivity on economic growth. A panel data regression model that combines cross section and time series regression models is the model used in this study, namely, 15 Provinces in Indonesia in 2020-2022.

### Variable Operational Definition

The economic growth used in this research is GRDP at constant prices (ADHK) for the 2010 series in Indonesia for the 2020-2022 period which is sourced from the central statistical agency. Amount of Clean Water Distributed. Clean water companies/businesses covered are Drinking Water Companies (PAM), Regional Drinking Water Companies (PDAM) and other private companies. The amount of clean water distributed is used in $m^3$ units in this research. Waste Generation waste that arises from humans in an area, namely the source of waste, type of waste, amount of waste.

Managed B3 waste from the manufacturing industry is the management of materials whose chemical properties and physical conditions have the potential to cause harm to human health, damage and/or environmental pollution originating from the manufacturing industry which includes all B3 waste produced from liquid waste to solid waste in units' tons. Creative industry workforce productivity is an industry that originates from the use of individual creativity, skills and talents to create prosperity and employment opportunities through the creation and utilization of individual creativity and inventiveness in the creative economy sector which has the potential to become a locomotive for increasing labor absorption.

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**Data Analysis Techniques**

This research uses panel data analysis where panel data is a combination of time series data and cross section data. The Cobb-Douglas model is used which is adapted to the Ordinary Least Square (OLS) method which has the following function:

$$\mathbf{Log(GRDP)i = \beta_0 + \beta_1 LOGJAD_{it} + \beta_2 LOGTS_{it} + \beta_3 LOGLSIMD_{it} + \beta_4 LOGTKIEK_{it} + \mu_{it}}$$

Where:

| | |
|---|---|
| GRDP | : GRDP (Billion) |
| $\beta_0$ | : Constant |
| JAD$it$ | : Amount of Clean Water Distributed ($M^3$) |
| TS$it$ | : Waste Generation (Tons) |
| LSIMD$it$ | : Managed B3 Waste from Manufacturing Industry (Tons) |
| TKIEK$it$ | : Creative Economy Industry Workers (Amount) |
| $\beta_1, \beta_2, \beta_3, \beta_4$ | : Regression Coefficients |
| i | : Province |
| t | : Years |
| $\mu it$ | : Error Term |

## RESULTS AND DISCUSSION

**Model Estimation Results**

Ordinary Least Square (OLS) Estimation Results for Panel Data with Random Effect Model:

**Table 1.** REM Model Panel Data Estimation Results

The dependent variable is LOGGRDP.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 5.756518 | 0.674240 | 8.537789 | 0.0000 |
| LOGJAD | 0.245838 | 0.064719 | 3.798531 | 0.0005 |
| LOGTS | 0.002545 | 0.005961 | 0.426843 | 0.6718 |
| LOGLSIMD | -0.002957 | 0.001987 | -1.488287 | 0.1445 |
| LOGTKIEK | 0.317488 | 0.026779 | 11.85567 | 0.0000 |

Source: Eviews 10 Output, Appendix

The estimation results show the value of each regression coefficient or the influence of the independent variable on the dependent variable. The constant value (C) shows a positive sign, namely 5.756518 for the GRDP value of the 15 Indonesian Provinces in 2020-2022 if all independent variables are zero. The LOGJAD coefficient increases by 1% (percent) with other variables considered constant (ceteris paribus), so the GRDP value increases by 0.245838% (percent). The LOGTKIEK coefficient increases by 1% (percent) with other variables considered constant (ceteris paribus), so the GRDP value increases by 0.317488% (percent).

**Classical Assumption Test**

**Residual Normality Test**

**Table 2.** Normality Test

| Observation Period | Jarque-Bera Value | Probability |
|---|---|---|
| Overall Sample | 1.074049 | 0.584485. |

Source: Eviews 10 Output, Appendix

The decision-making criterion for the normality test is if the probability value of the Jarque-Bera statistic is greater than 0.05, then it does not reject the hypothesis that the residuals are normally distributed. If the probability value of the Jarque-Bera statistic is smaller than 0.05, then it rejects the hypothesis that the residuals are normally distributed. The image above is the test result which gives a Jarque-Bera (JB) result of 1.074049 with a probability value of 0.584485. These results mean that the data is normally distributed, because it is greater than the probability value of 0.05 (0.05 < 0.584485).

**Multicollinearity Detection**

**Table 3.** Multicollinearity Detection

| Variable | Coefficient Variance | Uncentered VIF | Centered VIF |
|---|---|---|---|
| C | 0.454599 | 24.41817 | NA |
| LOGJAD | 0.004189 | 34.04226 | 1.540299 |
| LOGTS | 3.55E-05 | 1.586083 | 1.238115 |
| LOGLSIMD | 3.95E-06 | 1.096543 | 1.066214 |
| LOGTKIEK | 0.000717 | 8.319650 | 1.320233 |

Source: Eviews 10 Output, Appendix

Multicollinearity can be seen through the VIF (Variance Inflating Factor) value. If the value is between 0 and 10, it indicates that there is no multicollinearity. Based on the results of the eviews output above, it can be seen that the regression model does not contain multicollinearity. This is proven by the Centered VIF value for all variables not more than 10, which means that the model does not have multicollinearity problems.

**Heteroscedasticity Test**

**Table 4.** Heteroscedasticity Test

| **Variable** | **Coefficient** | **Std. Error** | **t-Statistic** | **Prob.** |
|---|---|---|---|---|
| C | 5.756518 | 0.674240 | 8.537789 | 0.0000 |
| LOGJAD | 0.245838 | 0.064719 | 3.798531 | 0.0005 |
| LOGTS | 0.002545 | 0.005961 | 0.426843 | 0.6718 |
| LOGLSIMD | -0.002957 | 0.001987 | -1.488287 | 0.1445 |
| LOGTKIEK | 0.317488 | 0.026779 | 11.85567 | 0.0000 |

Source: Eviews 10 Output, Appendix

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One method used to detect whether a regression model contains elements of heteroscedasticity is to test whether the independent variables have the same variance. If the probability value of each independent variable is greater than alpha (0.05), it can be concluded that it is free from heteroscedasticity problems. Based on the eviews output results above, the t-statistical probability values for the four independent variables are greater than alpha (0.05) or not statistically significant so it can be concluded that there is no heteroscedasticity problem in the model.

**Autocorrelation Test**

From the random effect model used in this research, it shows that the Watson stat value is 1.524. With a total of 45 observations and a total of 4 independent variables. So because 1,524 is between -2 and +2, it can be concluded that there is no autocorrelation.

## CONCLUSION

Based on the results of data analysis that has been carried out in research and discussion, the following are the conclusions. Based on the results of data analysis obtained that the amount of clean water distributed has a positive effect on the GRDP of 15 Provinces in Indonesia in 2020-2022. Based on the results of the data analysis obtained, waste generation has a positive but not significant effect on the GRDP of 15 Provinces in Indonesia in 2020-2022. Based on the results of the data analysis obtained, B3 waste from the manufacturing industry has a negative and insignificant effect on the GRDP of 15 Provinces in Indonesia in 2020-2022. Based on the results of the data analysis obtained, the number of creative economy industry workers has a positive effect on the GRDP of 15 Provinces in Indonesia in 2020-2022.

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