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# VISUALIZATION OF INDONESIA'S GREEN ECONOMY INDEX (GEI) STATUS MAPPING FOR ECONOMIC TRANSFORMATION TOWARDS SUSTAINABLE DEVELOPMENT

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***Abstract:*** This study aims to map the status of the Green Economy Index (GEI) in Indonesia to support economic transformation towards sustainable development. Using the K-Means clustering method, this study analyzes GEI data from Dual Citizen at the global level and GEI from BAPPENAS at the national level. The results show that Indonesia is in the bottom seventh position globally, with a focus on air quality. Factors such as urbanization, the use of motor vehicles, and industrial activities are the main causes. In addition, at the provincial level, agricultural productivity is the biggest challenge in the green economy dimension. These findings confirm the need for integrated policies to address environmental issues and increase economic productivity. Policy recommendations include the transition to clean energy, the development of environmentally friendly public transportation, the improvement of low-carbon agricultural practices, and the strengthening of collaboration between stakeholders. This research provides important insights to support Indonesia's efforts to improve the GEI ranking and achieve the sustainable development goals.

***Keywords:*** Green Economy, Clustering, Sustainable Development

## 1. INTRODUCTION

The development of the current era, especially in terms of technology that continues to develop rapidly, followed by a growing population, will certainly have an impact on environmental damage and sustainability, global warming and extreme climate change (Jones et al., 2023; Khamidah et al., 2023; DKI Jakarta Province, 2020). These conditions have more extraordinary negative impacts on the survival of mankind, such as major floods, air, water, and soil pollution, heat waves in several countries, and extreme climate change occurring everywhere (David, 2021). While targets have been made to address climate change, current policies still put the world on track towards global warming of around 2.7°C. This is far from the ambitious goal of the Paris Agreement to limit global warming to 1.5 °C (Lenton et al., 2023).

The United Nations (UN) has warned against the emergence of heat waves suspected to be caused by global warming and extreme climate change (Qiao-Franco, 2018). The impact of this extreme weather change affects various countries and various sectors. Indonesia's neighbors such as the Philippines, Thailand, Cambodia, Myanmar, and Vietnam are also experiencing the impact of this extreme weather on their economies (Handayani et al., 2022; Nasir et al., 2019) The world of education has also had an impact so that some schools in India have been forced to close (Roy et al., 2024) even in the agricultural sector in ASEAN has also had an impact (Chandio et al., 2021) Meanwhile, in Indonesia, the Meteorology, Climatology, and Geophysics Agency (BMKG) stated that the maximum air temperature was above 36.5 degrees Celsius in several regions. One of them is in Medan, North Sumatra. The maximum temperature reaches 37.0 degrees Celsius. Then in Saumlaki, Maluku, with a maximum temperature of 37.8 degrees Celsius (Pramudita, 2020)

The Indonesian government also appeals to the public to be aware of extreme weather or changes in extreme weather. The Indonesian government has also prepared a *Green Growth* program as a mitigation measure to deal with global climate change. The *Green Economy* program or green economy is an economic idea that aims to improve people's welfare and social equality, while significantly reducing the risk of environmental damage (Sa'idah et al., 2023)

With the worsening of climate change, the green economy plays an important role in economic and environmental development, and has received great attention from researchers and governments from countries around the world (Mastini et al., 2021) However, the existing literature lacks a comprehensive form of measurement and analysis regarding the green economy. Research by Lee et al. (2022) reflects the green economy as a country's environmentally friendly production capacity in terms of competitiveness, innovation, diversification, and economic complexity. In particular, the first measurement is the Green Complexity *Index (GCI),* which measures a country's environmentally friendly production capacity based on the number and complexity of environmentally friendly products that are able to compete in exports. The second measurement uses Green *Complexity Potential (GCP),* defined as the extent to which each country has the potential to be able to shift its products to technologically advanced green products in the future.

Globally, Dual Citizen has published their method of calculating *the Global Green Economy Index*. The published data is still limited to 2022 only because the index has just been formed. When compared to other countries in the world, Indonesia is in the bottom 7th position. This can be seen in Table 1 below.

**Table 1. Ranked in the bottom 10 of the Global Green Economy Index**

| Rank | Country | Overall Indicator Percentile |
|---|---|---|
| 160 | Oman | 0.262 |
| 159 | Arab Saudi | 0.314 |
| 158 | Turkmenistan | 0.318 |
| 157 | Trinidad and Tobego | 0.334 |
| 156 | Pakistan | 0.342 |
| 155 | Egypt | 0.357 |
| 154 | Indonesia | 0.363 |
| 153 | Uzbekistan | 0.364 |
| 152 | South Africa | 0.372 |
| 151 | Tajikistan | 0.377 |

Source: Dual Citizen LLC (2024)

The green economy is a trend that is popular around the world. The current literature focuses on widespread awareness of the green economy related to energy savings, expansion of market demand, creation of new jobs, achievement of sustainable economic development, and ultimately poverty alleviation (Huang et al., 2021; Jiang et al., 2020; Xie et al., 2019) In addition, the study underlines that the green economy is better than modern economic development in terms of addressing current economic, social, and environmental problems, including improving human welfare, maintaining social justice, avoiding natural resource depletion, controlling environmental risks, and overcoming the challenges of climate change (Merino-Saum et al., 2020; Tomaselli et al., 2021)

In Indonesia itself, the Ministry of National Development Planning/National Development Planning Agency (Bappenas) is committed to realizing the Green Growth or Green Economy program. In 2022, Bappenas has set a benchmark for the development of indicators to measure the balance between economic

welfare and social equality of the community as well as to mitigate the risk of environmental damage with the Indonesian Green Economy Index (GEI).

In dealing with the problem of environmental damage, grouping problems is a crucial step in realizing a green economy, because it allows the identification and handling of environmental issues in a more focused and effective (Tomich et al., 2004) By grouping problems such as in the economic, environmental, and social sectors, governments and stakeholders can design more specific and measurable solutions, and allocate resources more efficiently. This approach not only helps in reducing negative impacts on the environment, but also encourages green innovation and increases public awareness of the importance of sustainability practices. Through clustering, synergies between the public, private, and community sectors can be strengthened, accelerating the transition to a more sustainable and environmentally friendly economy. In Indonesia itself, there is still no research that maps the *Green Economy Index* (GEI).

## 2. TINJAUAN PUSTAKA

### 2.1. Green Economy Index by Dual Citizen

The Global Green Economy Index (GGEI) evaluates countries' progress towards sustainable economic transformation based on four dimensions with 18 indicators. These dimensions include Climate Change & Social Justice (with indicators of GHG/GDP emissions using exchange rates, GHG emissions/per capita, Income Equality, and Gender Equality in the Workplace), Sectoral Decarbonization (with indicators of Building, Electricity & Heat, Manufacturing & Construction, Transportation, and Waste & Resource Efficiency), ESG Markets & Investment (with indicators of Green Investment Attractiveness, Green Innovation, and Gender Equality in Government), and Environmental Health (with indicators of Agriculture, Air Quality, Biodiversity, Forests, Oceans, and Water Pressure).

### 2.2. Green Economy Index by BAPPENAS

The Indonesia Green Economy Index calculates Indonesia's score in economic transformation towards a green economy by looking at a comparison of the progress of the indicators against the minimum value and the maximum target, which is to be achieved. The minimum value of the indicator is based on Indonesia's historical data from the lowest reference, while the maximum value is based on the targets that have been included in the Indonesia Vision 2045 and the targets in the Low Carbon Development Initiative (LCDI) 2045 model to achieve Net Zero Emission 2060. As for the time span of GEI Indonesia's historical data from 2011 to 2020.There are 15 indicators in GEI Indonesia, which include three pillars, namely economic, social, and environmental, which reflect green economic development. The economic pillar consists of six indicators, including emission intensity, energy intensity, and gross national income (GNP) per capita. The social pillar includes four indicators, namely the unemployment rate, poverty rate, life expectancy, and average length of schooling. Meanwhile, the environmental pillar includes five indicators, namely land cover, degraded peatland, emission reduction, managed waste, and new and renewable energy (Kementerian PPN/Bappenas, 2020).

## 3. METHOD

We group the data using the K-Means clustering method. To analyze the global green economic conditions, we use complete Green Economy Index by Dual Citizen data in 4 dimensions with 18 indicators. For the analysis of green economic conditions in Indonesia, we use the Green Economy Index by Bappenas on the economic dimension only. We used 4 out of 6 indicators of the economic dimension due to data limitations. The emission intensity indicator uses emission intensity data sourced from AKSARA Bappenas. Other indicators are agricultural productivity (using GDP data for the Agriculture, Forestry and Fisheries Sectors), labor productivity in the industrial sector (using the number of GDP data for the Electricity and Gas Supply Sector, GDP for the Construction Sector, GDP for the Manufacturing Industry Sector, GDP for the Mining and Quarrying Sector, and GDP for the Water Supply, Waste Disposal, Waste Management & Recycling Sector), and labor productivity in the service sector (using the amount of GDP data on the Business Services Sector, GDP of the Education Services Sector, GDP of Financial & Insurance Activities, GDP of Human Health & Social Work Activities, GDP of Information & Communications, GDP of Public Administration, Defence & Compulsory Social Security, Property Sector, Transport & Storage Sector, Wholesale & Retail Trade Sector, Motor Vehicle & Motorcycle Repair, and Other Services Sector GDP) sourced from the World Bank: Indonesia Database for Policy and Economic Research.

## 4. HASIL DAN PEMBAHASAN

### 4.1. Condition of the Green Economy Index Globally

We divide the cluster into 4 groups based on the number of dimensions of the Green Economy Index concept globally. These groups can show the focus of green economic problems in a region. The first cluster focuses on climate change and social justice, the second cluster focuses on decarbonizing the sector, the third cluster focuses on ESG markets and investments, and the fourth cluster focuses on environmental health.

**Table 2. Number of Countries in Each Cluster**

| Cluster Groups | Number of Countries |
|---|---|
| 1 | 24 |
| 2 | 45 |
| 3 | 42 |
| 4 | 49 |
| Total | 160 |

Source: Data processed

The number of countries in the entire cluster is 160 countries with conditions where, in order, many countries have a focus on environmental health, decarbonization of the sector, markets and ESG investment. Meanwhile, the problem of climate change and social justice is the focus of the least problem. Indonesia itself has a focus on environmental health.

To find out the main source of the problem, we divided the group again based on the fourth dimensional indicators so that 6 clusters were created. The first cluster has a focus on agricultural change, the second cluster has a focus on air quality, the third cluster has a focus on biodiversity, the fourth cluster has a focus on forests, the fifth cluster has a focus on the ocean, and the sixth cluster has a focus on water pressure.

**Table 3. Number of Countries in Each Global Environmental Health Dimension Cluster**

| Cluster Groups | Number of Countries |
|---|---|
| 1 | 34 |
| 2 | 23 |
| 3 | 14 |
| 4 | 12 |
| 5 | 32 |
| 6 | 45 |
| Total | 160 |

Source: Data processed

The number of countries in all clusters is 160 countries with conditions where in order, many countries have a focus on water pressure, agriculture, oceans, and quality. Meanwhile, the problem of climate change and biodiversity is the focus of the least problem. Indonesia itself has a focus on air quality problems.

### 4.2. Condition of the Green Economy Index in Indonesia

To analyze the condition of the green economy in Indonesia, we used data at the provincial level with a total of 34 provinces. In the division of cluster groups, we divide them into 4 groups based on indicators on the economic dimension in the Green Economy Index concept by Bappenas. The first cluster has a focus on changes in emission intensity, the second cluster has a focus on agricultural productivity, the third cluster has a focus on labor productivity in the industrial sector, and the fourth cluster has a focus on labor productivity in the service sector.

**Table 4. Number of Countries in Each Cluster of Indonesia's Economic Dimension**

| Cluster Groups | Number of Countries |
|---|---|
| 1 | 1 |
| 2 | 27 |
| 3 | 3 |
| 4 | 3 |
| Total | 34 |

Source: Data processed

The number of provinces in all clusters is 34 provinces with conditions where in order, many provinces have a focus on agricultural productivity. Meanwhile, the focus of other problems is such as labor productivity in the service sector, labor productivity in the industrial sector, and emission intensity.

### 4.3. Discussion

The results of the study show that environmental health, especially air quality, is the main focus of problems in Indonesia. This is driven by a variety of factors, including rapid urbanization, an increase in the number of motor vehicles, and unsustainable industrial activities (Kristiani & Soetjipto, 2019) Air pollution, especially in urban areas, has reached alarming levels and has a significant impact on public health, such as an increase in cases of respiratory diseases (Umah & Gusmira, 2024) This result is also supported by other findings, namely in Figure 1, namely there is one province that has a focus on the problem of emission intensity. The province is DKI Jakarta Province which was once the area with the highest pollution level in the world. According to Astriyani et al. (2023) DKI Jakarta is one of the cities with unhealthy air quality, air quality can be determined through air quality measurements carried out by the DKI Jakarta Provincial Environment Agency.

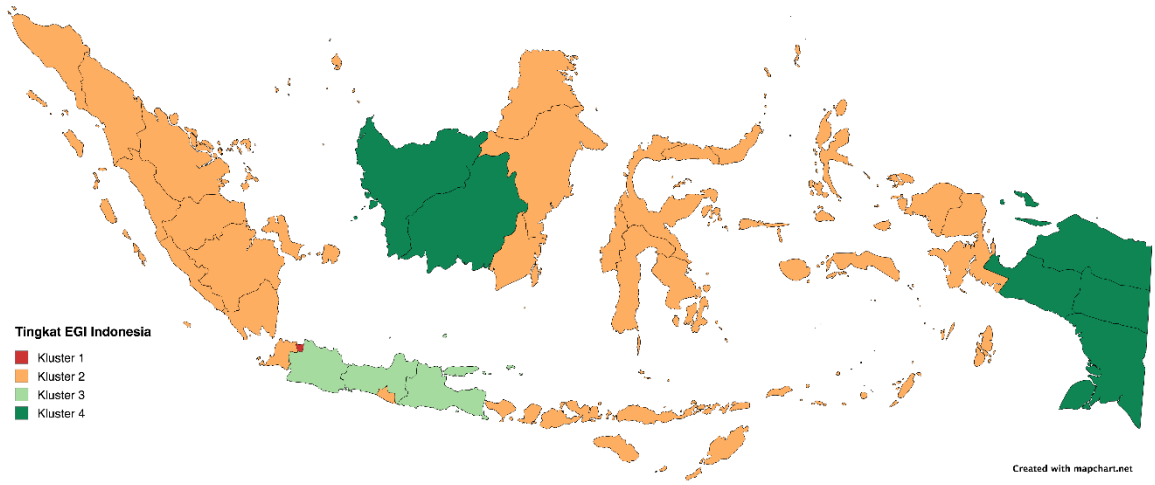


**Figure 1. Visualization of the Green Economy Index in Indonesia**

In addition, frequent forest and land fires have worsened air quality conditions in several regions, especially in Sumatra and a few of them in Kalimantan and Papua. In fact, the three islands are the center of peatlands and forests in Indonesia (Qamariyanti et al., 2023) Agriculture produces more than just crops. Agricultural practices impact a wide range of ecosystem and ecological services, including water quality, nutrient cycling, soil retention, and carbon sequestration (Prakoso et al., 2023) In turn, ecosystem services affect agricultural productivity which affects economic sectors. This indicator shows the alignment of the growth of economic sectors influenced by ecosystem and ecological services.

This issue demands more attention from governments and stakeholders to implement more effective pollution control policies, such as the transition to clean energy, the improvement of green public transportation, and the enforcement of stricter environmental regulations. Collaborative efforts involving communities and the private sector are also needed to create sustainable solutions to improve air quality and improve overall environmental health.

## 5. CONCLUSION

This research highlights the urgency of the transition to a green economy in Indonesia in the face of global challenges such as climate change and environmental degradation. Indonesia's condition which occupies the bottom seventh position in the Global Green Economy Index shows the need for significant steps in the implementation of sustainability policies. Cluster analysis at the provincial level reveals that the main focus of the problem is air quality, which is exacerbated by urbanization, high use of motor vehicles, and industrial activities that are not environmentally friendly. In addition, low agricultural productivity is also a

major challenge in the green economy dimension. These findings show the importance of synergy between government policies, green innovation, and community participation in improving this condition.

The government needs to strengthen air pollution control policies by transitioning to clean energy, such as renewable energy, and promoting environmentally friendly public transportation. Environmental regulations must be strictly enforced to reduce the impact of the industry on air quality. On the other hand, to increase agricultural productivity, the government can develop environmentally friendly agricultural practices through the adoption of low-carbon technologies and incentive programs for farmers. Closer collaboration between the public, private, and community sectors is needed to encourage green innovations that can accelerate economic transformation towards sustainable development.

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