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Regional Inclusive Green Growth in Indonesia: Unraveling Determinants and Disparities

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Abstract

This research develops a regional framework for inclusive green growth in Indonesia and assesses the efficiency of government expenditure in driving it. Using cross-sectional data from 33 provinces in 2021, the study constructs an Inclusive Green Growth Index (IGGI) based on economic growth, social equity, and environmental sustainability, following the Asian Development Bank's framework. Data Envelopment Analysis (DEA) is employed to evaluate government spending efficiency. This study fills a research gap by providing a standardized tool to measure economic inclusivity and sustainability at the regional level. Additionally, it introduces a novel approach by analyzing budget efficiency in promoting inclusive green growth across provinces. Findings reveal significant regional disparities, with Papua and Nusa Tenggara Barat lagging while Kalimantan Timur and DKI Jakarta lead. Inefficient government spending is identified as a key factor, though some regions, such as East Kalimantan and East Java, demonstrate better resource utilization. This research contributes by encouraging local governments to integrate IGGI into policy planning. The index helps the central government identify regional disparities and formulate equitable development strategies. Additionally, it emphasizes optimizing government financing for inclusive and sustainable economic programs, providing insights for improving policy effectiveness.

Keywords:
inclusive green growth, regional disparities, Data Envelopment Analysis (DEA)

1. Introduction

The Indonesian economy has significant potential, with strong and steady growth rates surpassing those of many similar countries. In 2023, the national economic growth exceeded that of Malaysia (3.77%), the Republic of Korea (1.36%), the United States (2.5%), France (0.9%), and Germany, which had a contraction of -0.3%, as shown in Figure 1 (World Bank, 2023). Despite good signs of economic growth, Indonesia's economic prosperity nevertheless encounters substantial obstacles. Economic inequality has increased, as shown by a 0.007 rise in the Gini Index in 2023 (BPS, 2023). Indonesia's economic growth is significant, but its inclusion is lacking, which hinders progress towards sustainable development.

The inclusive green growth model combines social equity principles with sustainable economic development, taking into account environmental aspects (Li et al., 2021). This involves distributing the advantages of economic growth fairly across all sectors of society while considering the efficient utilization of natural resources and cost-effective green technologies. This approach highlights the significance of achieving equilibrium between economic advancement and environmental conservation as a fundamental requirement for long-term sustainability (Aznar-Márquez & Ruiz-Tamarit, 2016).

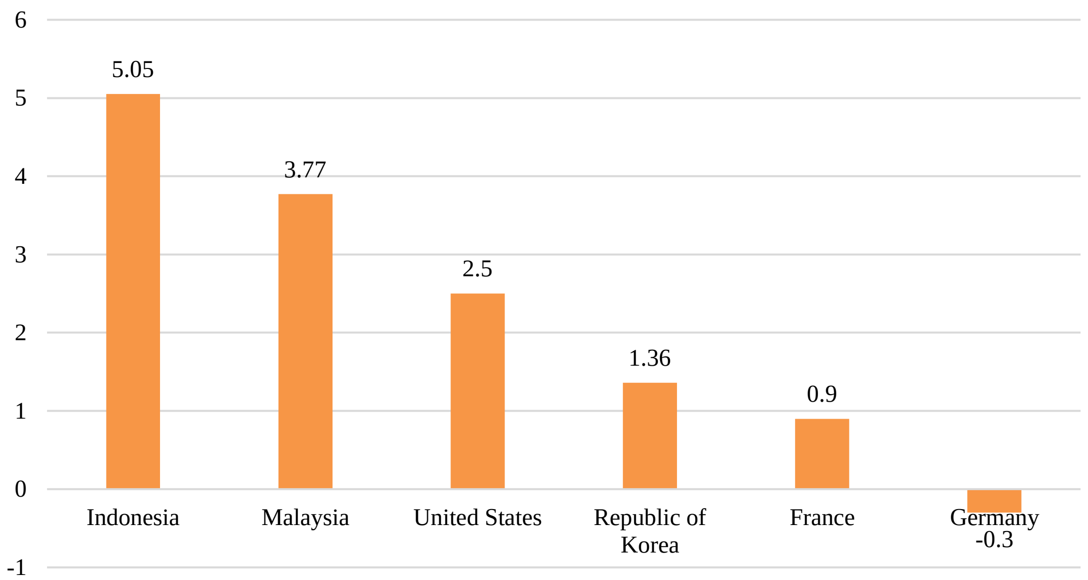

Figure 1. The economic growth of Indonesia is relative to other countries (World Bank, 2024).

Sustainable economic development involves taking into account the effects on future generations, an idea emphasized in the Brundtland report. The paper states that future economic expansion will place overwhelming pressure on the Earth. Abou Zahr Diaz et al. (2019) emphasized that current natural resource consumption patterns aimed at enhancing economic growth would exhaust resources and impede global economic growth. It is essential to evaluate the economic consequences on the environment, as it supplies resources for the creation of commodities and services necessary for different organisms. Here, "green growth" is pertinent as it involves boosting economic activity while optimizing natural resource consumption efficiency and reducing negative environmental repercussions of economic operations (Dogaru, 2021).

Creating measures to encourage inclusive green growth is vital for national governments as a tool to evaluate policies. Various global measures have been created by multilateral entities like the ADB (Jha, 2018), which could be useful evaluation tools. Furthermore, research at the regional level in China has offered useful insights into creating measures appropriate for local dynamics (Liu et al., 2021; Sun et al., 2020). Unfortunately, Indonesia has not yet made equivalent attempts, even though each location in the country has distinct characteristics that necessitate specific and contextual measurement methods. Hence, it is crucial to establish measurements that are appropriate for the Indonesian environment.

Examining government spending is essential when evaluating its effect on inclusive growth in Indonesia. Research on the effects of government spending on inclusive growth is scarce, focusing mainly on nations like China (Wu & Zhou, 2021), with little research done in Indonesia. This research is highly relevant for ensuring that government expenditure effectively supports inclusive green growth. Efforts to expand research are necessary to have a more thorough understanding of how government spending contributes to achieving equitable growth objectives in Indonesia.

This project aims to address the current research gap by developing a regional framework for inclusive green growth across all 33 provinces of Indonesia. Developing the Inclusive Green Growth Index (IGGI) at the regional level is expected to serve as a tool for the government to measure the level of economic inclusivity and sustainability at the regional level. Additionally, this research provides novelty by examining budget efficiency in each region to promote inclusive green economic growth in

Indonesia. This research is expected to contribute to encouraging local governments to integrate this metric into policy formulation, both in short-term and long-term planning. The results of this index calculation can also be utilized by the central government to identify disparities in achievements between regions, thereby providing insights for the central government in formulating strategic programs for more equitable development across Indonesia. Finally, with a focus on inclusive and sustainable policies, government financing can be further enhanced. This study outlines the efficiency of financing conducted by local governments in supporting inclusive and sustainable economic programs.

2. Methods and Materials

The analysis uses data from 33 provinces in Indonesia for the year 2021, considering the most recent data available. The data are used to create regional IGGI indicators in Indonesia, which include 3 pillars and 23 indicators, as shown in Table 1.

The IGGI is created following the methodology outlined by Jha (2018), which includes several stages. However, in Jha's (2018) methodology, there are actually 28 indicators, but our study only uses 25 indicators. This discrepancy arises because some data are not available in Indonesia. Additionally, considering the limitations of available data, there are substitutions of indicators in the Environmental Pillar, referencing Aminata et al. (2022). These differences are highlighted by the use of the Water Quality Index, Air Quality Index, Land Cover Quality Index, Sea Water Quality Index, and Indonesia Disaster Risk Index to replace the indicators for Natural resource rent, Renewable freshwater resources, Air pollution, CO_2 per GDRP, Energy intensity of primary energy, and Use of renewable energy.

2.1 Data Normalization

Normalisation is necessary to standardise the units of measurement in data for the purpose of comparison. The normalised values will vary from 1 to 6, with 1 being the lowest score and 6 representing the highest score. The paper conducted normalisation using the Min-Max Normalisation approach as outlined below:

Indicators with a positive impact on IGGI:

$$Z = 5\,x\,\frac{X - \min(x)}{[\max(x) - \min(x)]} + 6$$

Indicators with a negative impact on IGGI:

$$Z = -5\,x\,\frac{X - \min(x)}{[\max(x) - \min(x)]} + 6$$

Where Z is the result of normalization, X is the value of an indicator, Max (x) is the highest value of an indicator, and Min (x) is the lowest value of an indicator.

2.2 IGGI Calculations

The IGGI calculation starts by summing all the normalised values of indicators within the same pillar. Subsequently, determine the mean value of each pillar and integrate it with the computation of the remaining pillars. The measures are as listed:

$$IGGI = \frac{1}{3}(EPA) + \frac{1}{3}(SIPA) + \frac{1}{3}(ERPA)$$

Where: IGGI is the Inclusive Green Growth Index, EPA is the Economic Pillar Average, SIPA is the Social Equity Pillar Average, and ESPA is the Environmental Sustainability Pillar Average.

Table 1. Indicators comprising the Regional IGGI of Indonesia.

No	Indicators	Operational Definition	Measurement Unit	Source
Economic Growth Pillar				
1	GRDP per Capita Growth Rate	Change in GRDP per capita between two different timeframes	Percent	BPS
2	Inverse of GRDP per Capita Growth	Ratio of average real GRDP per capita growth and its standard deviation	Percent	BPS
3	Trade Openness	Sum of exports and imports in percentage of GRDP	Percent	BPS
4	Age Dependency Ratio	Percentage of people younger than 15 or older than 64 to the working-age population	Percent	BPS
5	Adjusted Net Savings	Funds obtained from the public in the form of savings, current accounts, and deposits.	Billion IDR	OJK
Social Equility Pillar				
6	Employment-Population Ratio	Estimated percentage of employed to the population aged over 15	Percent	BPS
7	Life Expectancy Gender Gap	Comparison of the average estimated number of years that can be lived by males and females from birth.	Percent	BPS
8	Primary Enrollment Gender Gap	Percentage point difference of the proportion of male and of female enrolled in primary education	Index	BPS
9	Life Expectancy at Birth	Number of years a newborn infant would live if prevailing patterns of mortality at the time of their birth were to stay the same throughout their life	Index	BPS
10	Access to Improved Sanitation	Percentage of population with access to improved sanitation	Percent	BPS
11	Access to Improved Water	Percentage of population with access to improved drinking water	Percent	BPS
12	Access to Electricity	Percentage of population with access to electricity and non-solid fuel	Percent	BPS
13	Gini Coefficient on Inequality	The level of income inequality	Index	BPS
14	Poverty Gap	The average expenditure gap for each poor individual relative to the poverty line.	Percent	BPS
15	Mean Years of Schooling	Average number of completed years of education of a country's population	Percent	BPS
16	Primary Completion Rate	Percentage of total enrollment, regardless of age, to the population of the age group that officially corresponds to primary school	Percent	BPS
17	Indonesia Democracy Index	Composite indicators representing the level of democracy development in Indonesia	Index	BPS
Environmental Pillar				
18	Water Quality Index	Condition of water in an area at a particular time	Index	KLHK
19	Air Quality Index	Level of air in an area at a certain period	Index	KLHK
20	Land Cover Quality Index	Area of forest cover and swamp scrub	Index	KLHK
21	Sea Water Quality Index	A Concise measure indicating the overall health and cleanliness of seawater	Index	KLHK
22	Indonesia Disaster Risk Index	A measure of Indonesia's vulnerability to natural disasters and the effectiveness of its disaster risk management	Index	BNPB
23	Water Productivity	Potential Production Capacity of Clean Water Companies	Index	BPS

Note: GRDP – Gross Regional Domestic Product; IDR – Indonesia Rupiah; BPS - Central Bureau Statistics; BNPB - National Disaster Mitigation Agency; OJK - Financial Services Authority of Indonesia; and KLHK - Ministry of Environment and Forestry.

After calculating the IGGI for each province in Indonesia, we analyse the efficiency of provincial government spending functions in driving IGGI by using the Data Envelopment Analysis (DEA), especially the Banker, Charnes, dan Cooper (BCC) model focusing on output. This model is selected because to the unequal comparison between the rise in inputs and the output created annually, or Variable Returns to Scale (VRS). The traditional output-oriented BCC model can be described as follows: There are n Decision Making Units (DMUs) $(DMU_j, j = 1,2, \dots, n)$ using inputs $m(x_i, i = 1,2, \dots, s)$ to generate s outputs $s(y_r, r = 1,2, \dots, s)$.

$$Min \sum_{i=1}^{m} w_i x_{ij} + \mu_0$$
$$s.t. \sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} w_i x_{ij} + \mu_0 \leq 0 \qquad j = 1,2, \dots, n$$
$$\sum_{r=1}^{s} u_r y_{rj} = 1$$
$$\mu_0 \; bebas$$
$$w_i \geq \varepsilon, \quad i = 1,2, \dots, m$$
$$u_r \geq \varepsilon, \quad r = 1,2, \dots, s$$

This study uses the output-oriented DEA BCC analysis approach to determine the relative efficiency of spending functions in several sectors (e.g., economic, environmental, social, health, and education) in each province in Indonesia in 2021. Input variables approximate spending functions, whereas the output variable is the IGGI.

3. Results and Discussions

3.1 Regional Inclusive Green Growth Development

The average regional inclusive green growth in Indonesia is 3.33, as indicated by the index construction findings (Figure 2). This value represents the initiatives taken by different regions in Indonesia to encourage sustainable and inclusive economic growth, focusing on green practices and sustainability. Although there has been progress, there is still potential for additional enhancement. This involves implementing additional environmentally friendly policies and procedures while also guaranteeing that the advantages are equitably shared across all sectors of society. Improving cooperation between the government, business sector, and civil society, coupled with greater investment in eco-friendly infrastructure and inclusive programs, could play a crucial role in expediting the progress towards more sustainable and inclusive growth in Indonesia.

The SIPA shows a significant superiority over the EPA and ESPA in terms of strength (Figures 3, 4, and 5). This phenomenon indicates the widespread presence of government protection and action through social aid. In the aim of creating inclusive green growth, social justice is considered the most highlighted and reinforced element within economic and environmental policy and practices. The government's substantial role in promoting fairer access to resources and opportunities and enhancing social safety nets has resulted in a general enhancement in social welfare. The focus on social equality in the context of green growth highlights a policy framework that prioritizes resource redistribution and the preservation of social welfare as the major basis for achieving sustainable economic and environmental development.

East Kalimantan has the highest score of 4.18 in the regional IGGI building results shown in Figure 6, followed by DKI Jakarta with a score of 3.82 and West Kalimantan with a score of 3.80. East Kalimantan's dedication to sustainable, inclusive, and ecologically responsible economic development is evident. The province likely accomplished this by effectively managing its plentiful natural resources and prioritizing environmental protection and sustainable practices in its economic growth.

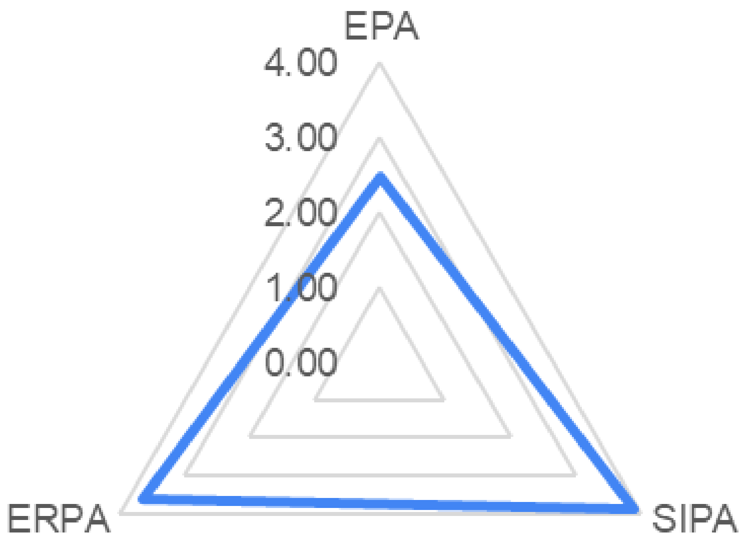

Figure 2. Strength pillars of regional IGGI.

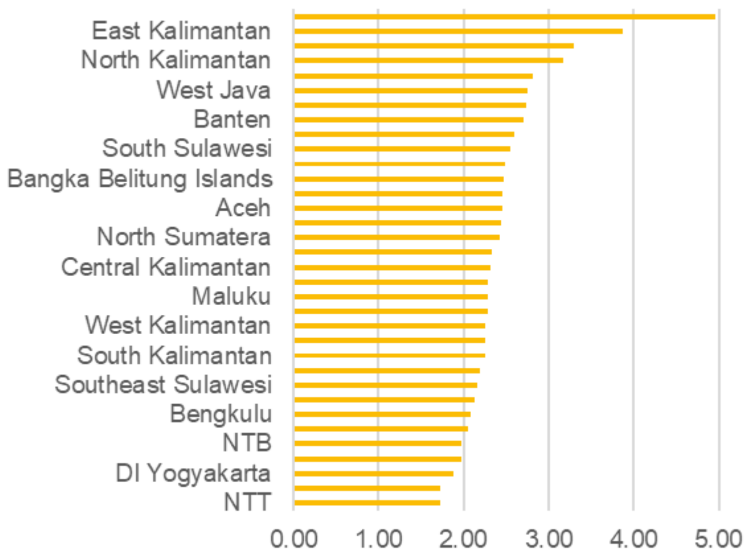

Figure 3. EPA.

DKI Jakarta and West Kalimantan, as second-place finishers with scores of 3.82 and 3.80 accordingly, likewise show a strong commitment to social inclusion and environmental conservation in their economic development. DKI Jakarta, as a center for corporate and government activities, enforced green infrastructure policies and sustainable business practices. Similarly, West Kalimantan, like East Kalimantan, have well-managed natural resources and a firm dedication to environmental preservation. The success of these three provinces highlights the significance of incorporating economic growth, social inclusion, and environmental sustainability into regional development.

Furthermore, East Kalimantan's dedication to sustainable, inclusive, and ecologically responsible economic development is evident. The province accomplished this by effectively managing its plentiful natural resources and prioritizing environmental protection and sustainable practices in its economic growth. A key factor contributing to East Kalimantan's top score is the implementation of the Green Growth Compact (GGC) initiative, which is synergized with the Social Forestry Program. This alignment fosters sustainable land management and community-based forestry practices, promoting both environmental conservation and social inclusion (Wahyuni, 2021). Additionally, East Kalimantan possesses the largest renewable energy reserves in Kalimantan. The establishment of the new capital city with its green energy concept has accelerated developments aimed at supporting the transition towards green energy, further bolstering the province's leadership in inclusive green growth (Putra, 2022).

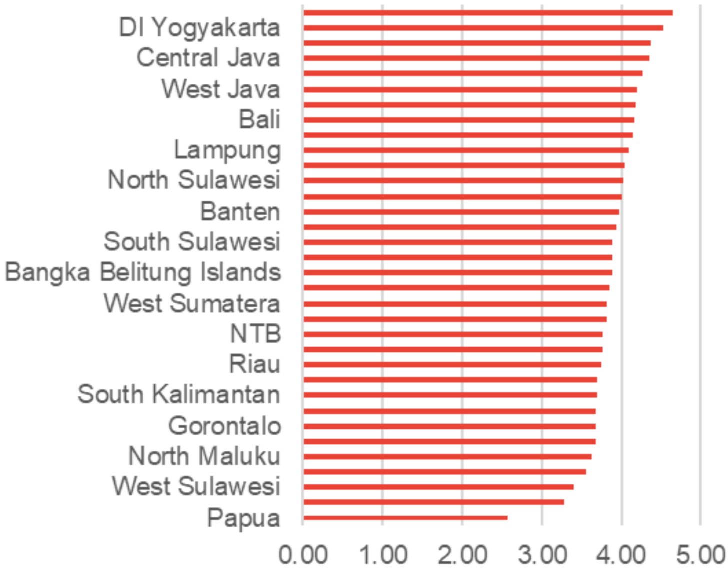

Figure 4. SIPA.

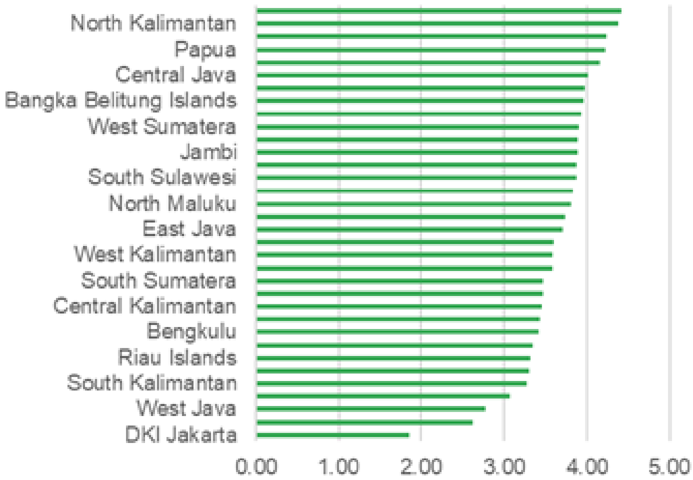

Figure 5. ERPA.

Papua and West Nusa Tenggara (NTB) have the lowest rankings, scoring 2.84 and 3.02, respectively. Several factors drive this, such as difficulties in managing intricate natural resources, insufficient green infrastructure, and restricted community access and involvement in sustainable economic growth. Papua may struggle to sustainably manage its enormous natural resources, while NTB may experience challenges in creating green infrastructure and growing access to green economic services due to its isolated geographical conditions.

On the other hand, there are notable disparities in economic success among provinces in Indonesia within the SIPA (Figure 4). DKI Jakarta excels in the economic category with a score of 4.96, demonstrating robust and inclusive economic growth. Provinces like East Kalimantan, Riau, and North Kalimantan exhibit strong economic success with individual scores. Conversely, provinces such as Papua, East Nusa Tenggara (NTT), and DI Yogyakarta demonstrate less economic success. This indicates substantial obstacles in attaining inclusive economic growth in these provinces.

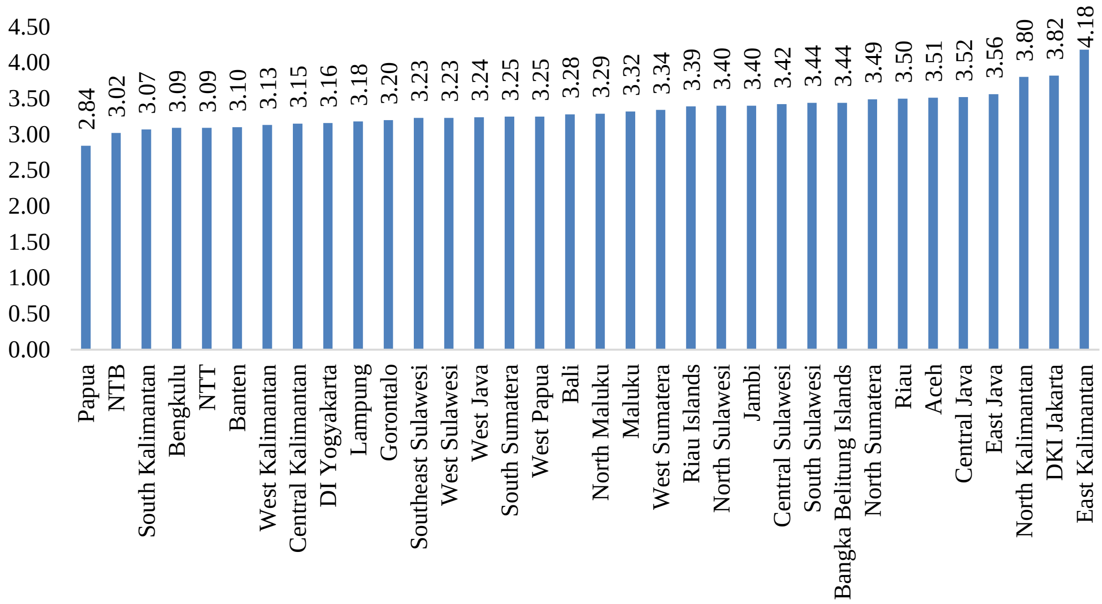

Figure 6. Regional IGGI construction results**.**

Provinces of Java, like Central Java, East Java, and West Java, exhibit comparatively high levels of environmental sustainability in the ERPA (Figure 5). This shows a firm dedication to environmental conservation and sustainable progress in these areas. Provinces outside Java, especially in Kalimantan and Sumatra, such as North Kalimantan and West Sumatra, have poorer levels of environmental sustainability. Provinces such as Papua, Central Sulawesi, and Maluku encounter significant difficulties in environmental conservation, exhibiting poor performance in the environmental aspect.

The analysis shows that differences in attaining inclusive green growth in Indonesia are mostly caused by inefficiencies in government spending to support these initiatives at the regional level. This discovery emphasizes the significance of prudent and efficient budget distribution in advancing inclusive and environmentally sustainable growth. Inadequate allocation of public money for green infrastructure, local economic empowerment, and environmental protection initiatives may impede the sustainable growth of certain regions. Improving efficiency in government expenditure and boosting transparency and accountability in public financial management are essential actions to overcome the remaining gaps in attaining inclusive green growth in Indonesia.

3.2 Efficiency of Government Spending for Regional Inclusive Green Growth Development

This study attempts to assess the effectiveness of government spending per capita in several sectors, such as economic, environmental, social, educational, and health, in each province of Indonesia in influencing the Regional IGGI. The output-oriented DEA approach is used to assess efficiency. Table 2 shows the results of the examination of spending efficiency on IGGI by province.

The DEA results offer a fascinating perspective on the efficiency of Indonesian provinces in promoting the IGGI. Most provinces have reached high-efficiency levels, with many provinces achieving a score of 1, indicating they have achieved maximum efficiency in using inputs to produce IGGI outputs. There is diversity in efficiency levels among provinces, indicating discrepancies in their efforts to achieve inclusive green growth.

Upon analysing the DEA data by island, it is clear that Java Island and the majority of provinces in Kalimantan consistently demonstrate great efficiency in generating IGGI. Provinces on Java Island (East Java, Central Java, and West Java) and provinces in Kalimantan (East Kalimantan and Central Kalimantan) exhibit high-efficiency levels. Some provinces show high efficiency due to the superior infrastructure on both islands compared to provinces in other regions (Chotia & Rao, 2017). Efficient infrastructure optimises the utilisation of resources like energy and natural resources to produce significant outcomes for sustainable development. Moreover, these provinces benefit from enhanced access to public services like education and healthcare, as well as a high abundance of skilled human resources, which greatly enhances the efficiency of government spending in such regions (Farida et al., 2021a; Iek & Blesia, 2019a).

Table 2. Spending efficiency score by province.

Province	Efficiency Score	Benchmarking
Aceh	0.98	East Java (0.964598); East Kalimantan (0.035402)
North Sumatera	1.00	North Sumatera (1)
West Sumatera	1.00	Sumatera Barat(1)
Riau	1.00	Riau(1)
Jambi	0.97	Riau(0.920665); East Java (0.000005); Bali(0.07933)
South Sumatera	1.00	South Sumatera (1)
Bengkulu	1.00	Bengkulu(1)
Lampung	1.00	Lampung(1)
Bangka Belitung Islands	0.99	Riau(0.782892); East Java (0.000032);Bali(0.217076)
Riau Islands	1.00	Riau Islands(1)
DKI Jakarta	0.91	East Kalimantan (1)
West Java	1.00	West Java (1)
Central Java	1.00	Central Java (1)
DI Yogyakarta	0.96	Riau(0.357257);West Kalimantan (0.548519)
East Java	1.00	East Java (1)
Banten	0.90	Central Java (0.345181);South Sulawesi (0.453373)
Bali	1.00	Bali(1)
NTB	1.00	NTB(1)
NTT	1.00	NTT(1)
West Kalimantan Barat	1.00	West Kalimantan (1)
Central Kalimantan	1.00	Central Kalimantan (1)
South Kalimantan	0.87	Riau(0.941324); North Maluku (0.058674)
East Kalimantan	1.00	East Kalimantan (1)
North Kalimantan	1.00	East Kalimantan (1)
North Sulawesi	0.96	Riau(0.936775); North Maluku (0.063225)
Central Sulawesi	0.97	Riau(0.963166);North Kalimantan (0.036833)
South Sulawesi	1.00	South Sulawesi (1)
Southeast Sulawesi	0.94	Riau(0.798239);South Sumatera (0.171667)
Gorontalo	0.91	Riau(0.937001);North Kalimantan (0.062993)
West Sulawesi	0.95	Riau(0.254719); Riau Islands (0.346244);Maluku(0.399033)
Maluku	1.00	Maluku(1)
North Maluku	1.00	North Maluku (1)
West Papua	0.84	North Sumatera (0.431585); East Kalimantan (0.568415)
Papua	0.84	Riau(0.50761);South Sumatera (0.306339)

Provinces outside of the two islands, particularly in Papua, demonstrate lower efficiency levels in driving IGGI as shown in Figure 7. While the provinces generally operate efficiently, there are discrepancies in efficiency when it comes to driving IGGI, particularly in Papua Island. Provinces in Papua, like West Papua and Papua, show low efficiency in converting inputs into IGGI outputs, suggesting major obstacles in attaining inclusive green growth in those areas. Various reasons like limited infrastructure, restricted access to public services, and insufficient investment in human resource development can impact these phenomena, especially in Papua (Nugraha & Prayitno, 2020; Sihombing, 2019; Sukwika, 2018) Furthermore, political and social instability can also be factors influencing the level of efficiency in driving inclusive economic growth. Therefore, special attention and greater efforts from the government and stakeholders are needed to enhance efficiency and achieve inclusive green growth in lagging regions, especially in Papua. Thus, appropriate strategies and concrete steps can be formulated to ensure that all provinces can contribute optimally to driving inclusive green growth in Indonesia.

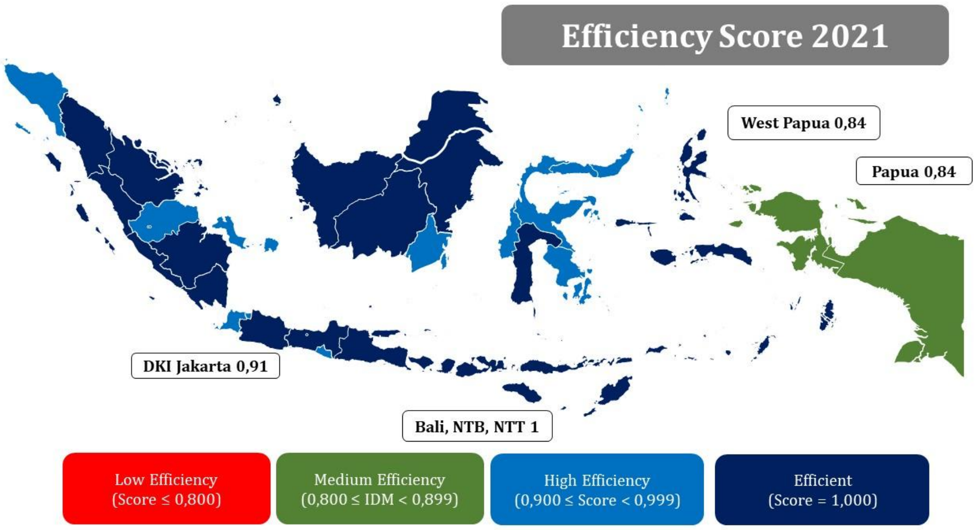

Figure 7. Efficiency score of government spending.

4. Conclusions

This study utilizes the IGGI developed by the ADB, which comprises three pillars: Social, Economic, and Environmental Sustainability. We calculated the IGGI for all provinces in Indonesia to assess the extent of inequality across regions. This study addresses the existing research gap by developing a regional framework for inclusive green growth across Indonesia. Constructing IGGI at the regional level provides a standardized tool for measuring economic inclusivity and sustainability. Additionally, this research introduces a novel approach by analyzing budget efficiency in promoting inclusive green growth across provinces.

The analysis underscores significant regional disparities in inclusive green growth across Indonesia, notably evident in Eastern regions like Papua and Nusa Tenggara Barat, which lag behind, while Kalimantan Timur and DKI Jakarta emerge as leaders. These disparities are primarily attributed to inefficient government spending across the studied regions, with some areas like East Kalimantan and East Java exhibiting better resource utilization. To address this, policy recommendations include targeted funding allocation, capacity building, incentive mechanisms, fostering public-private partnerships, facilitating knowledge sharing, and implementing performance-based budgeting to enhance the efficiency and effectiveness of government spending, thereby promoting inclusive green growth across all regions of Indonesia.

The findings contribute to encouraging local governments to integrate IGGI into policy planning. The index helps the central government identify regional disparities and formulate equitable development strategies. Furthermore, improving government financing efficiency for inclusive and sustainable programs is essential. Policy recommendations include targeted funding allocation, capacity building, incentive mechanisms, fostering public-private partnerships, facilitating knowledge sharing, and implementing performance-based budgeting.

In IGGI Indonesia's calculations, there are data limitations, so certain indicators are adapted by using proxies available in Indonesia, especially in the Environmental Sustainability pillar. For example, data on Natural Resource Rent, CO_2 emissions per GDRP, and Renewable Energy Use are not available, thus encouraging the use of proxy data provided by relevant ministries and agencies. Therefore, data providers in Indonesia, such as BPS, could improve the completeness and granularity of such data to facilitate a more accurate and robust assessment of regional gaps in inclusive green growth across Indonesia.

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