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Analysis of The Green Economy Sustainability Status in Indonesia using Multidimensional Scaling

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ABSTRAK

Penelitian ini bertujuan untuk mengetahui keberlanjutan penilaian Indeks Ekonomi Hijau di Indonesia. Ekonomi Hijau merupakan model ekonomi yang menjalankan kegiatan ekonomi dengan memperhatikan keberlanjutan lingkungan hidup dan kesejahteraan sosial. Penelitian ini menggunakan teknik *Multidimensional Scaling* dengan pendekatan *Rapid Appraisal for Green Economy Index* (Rap-GEI). Rap-GEI merupakan salah satu teknik penilaian keberlanjutan ekonomi hijau di Indonesia berdasarkan beberapa atribut yang mudah dinilai secara multidimensi. Hasil penelitian menunjukkan bahwa status keberlanjutan penilaian GEI adalah kurang berkelanjutan (45,47%) untuk dimensi lingkungan hidup, cukup berkelanjutan (56,02%) untuk dimensi ekonomi, dan cukup berkelanjutan (55,30%) untuk dimensi sosial. Atribut yang paling sensitif untuk ditingkatkan adalah pengelolaan sampah dan pangsa energi terbarukan (dimensi lingkungan hidup), produktivitas pertanian dan produktivitas tenaga kerja sektor industri (dimensi ekonomi), serta tingkat kemiskinan dan harapan hidup (dimensi sosial). Secara umum hasil penelitian menunjukkan bahwa dua dari tiga dimensi yaitu ekonomi dan sosial mempunyai peringkat cukup baik, namun dimensi lingkungan masih menunjukkan peringkat kurang baik dan perlu ditingkatkan.

Keywords:
Green Economy,
Multidimensional Scaling,
Rap-GEI, *Sustainability*
Status

ABSTRACT

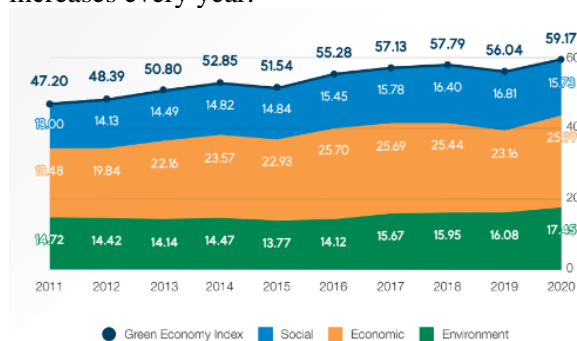
This current study aims to investigate the sustainability of the Green Economy Index assessment in Indonesia. Green Economy is an economic model that carries out economic activities while taking into account environmental sustainability and social welfare. The Multidimensional Scaling through the Rapid Appraisal for Green Economy Index (Rap-GEI) ordination technique was employed in this study. Rap-GEI is a technique for assessing the sustainability of green economy in Indonesia according to a number of attributes that are easy to assess multidimensionally. The results of the current study show that the sustainability status of the GEI assessment is less sustainable (45.47%) for the environmental dimension, quite sustainable (56.02%) for the economic dimension, and quite sustainable (55.30%) for the social dimension. The most sensitive attributes that require improvement are Managed Waste and Share of Renewable Energy (environmental dimension), Agricultural Productivity and Industrial Sector Labor Productivity (economic dimension), as well as Poverty Rate and Life Expectancy (social dimension). In general, the results show that two of the three dimensions, namely economic and social, have a fairly good rating, but the environmental dimension still shows a poor rating and needs to be improved.

1. INTRODUCTION

The Sustainable Development Goals (SDGs) is a program that the government strives to realize in order to improve people's welfare and the development of a country. Until now, the goals of the SDGs are expected to accommodate the changes that have occurred in development at the end of the millennium (Utama et al., 2022). To achieve the SDGs, the government has implemented several programs, one of which is the transformation from Brown Economy to Green Economy. Green Economy is an economic model that applies a new concept by carrying out economic activities while still paying attention to environmental sustainability and social welfare. In other words, the Green Economy is a paradigm that carries out three aspects, including economic, environmental and social (Bappenas, 2022).

The implementation of Green Economy in Indonesia must be monitored in order to find out the achievements and successes. Therefore, BAPPENAS or the Indonesian Ministry of National Development Planning issued the Green Economy Index (GEI) to assess the achievement and effectiveness of Indonesia's economic transformation towards Green Economy. GEI can be a powerful tool for planning the future of the country in formulating Indonesia's development strategy from green economy. GEI itself is structured according to three main pillars, economic, social, and environmental. Each pillar has several indicators with a total of 15 indicators.

Overall, Indonesia's GEI shows an increasing trend from 2011 to 2020 based on the index calculation report by Bappenas given in Figure 1. Based on the increase in each indicator in the period of 2011 to 2020, the economic indicator has progressively increased the most. Even though the environmental indicator has the lowest value, it consistently increases every year.



Source: Bappenas, 2022

Figure 1. The Green Economy Index Development in Indonesia

Good Green Economy implementation aims to create prosperity in Indonesia. The Green Economy sustainability concept is sustainability in economic growth that prioritizes environmental sustainability, provides benefits in the short and long term, and reduces inequality for present and future generations (Firmansyah, 2022). One method for assessing the sustainability of Green Economy is the Multidimensional Scaling (MDS) approach. This approach has been used by several researchers to analyze the sustainability in various fields including by (Kuvaini et al., 2019), (Reza et al., 2021) and (Ramadhanty et al., 2022). This MDS approach can use several analytical techniques, one of which is Rapid Appraisal. The Rapid Appraisal method that was first introduced was the Appraisal for Fisheries (Rapfish) method established by the University of British Columbia, Canada, to assess the sustainability status of fisheries in a multidisciplinary manner (Mahida, 2020). Adapting this method, the Rapfish method was developed into the Rap-GEI method, which is the Rapid Appraisal for Green Economy Index.

This present study tries to determine the Green Economy implementation sustainability status in Indonesia. Determining the sustainability status of the Green Economy implementation is crucial for the basis of future policy planning. The sustainability status of Green Economy implementation will be closely related to the quality of policies that support the implementation of Green Economy. If the Green Economy implementation status is found to be not sustainable, it is fair to assume that the conditions for the Green Economy implementation are not going well, and vice versa. In this study, the sustainability status of Green Economy implementation is evaluated from the dimensions of economy, social and environment.

2. METHODOLOGY

The current research is quantitative research. The data analyzed in the current study is secondary data taken from the Ministry of National Development Planning (BAPPENAS) in 2022 regarding the Green Economy Index for the 2011 to 2020 assessment period. The Multidimensional Scaling (MDS) through the Rap-GEI ordination technique was used to analyze the data. Rap-GEI, which is a modification of Rapfish, is a tool for assessing the sustainability of Green Economy in Indonesia based on certain attributes that are easy to assess multidimensionally. Modifications were made to the dimensions and attributes used in the scoring process. The dimensions and attributes are selected

based on the Green Economy Index criteria so that the dimensions and attributes used can describe the sustainability status of the Green Economy Index assessment in Indonesia.

The data used is the Green Economy Index score which consists of three assessment dimensions, environmental, economic and social dimensions. The constituent attributes of each dimension are presented in Table 1.

Table 1. The Green Economy Index Assessment Dimensions and Attributes

Dimensions	Attributes
Environmental	1. Forest Cover
	2. Share of Renewable Energy
	3. Managed Waste
	4. GHG Emission Reduction Percentage
	5. Degraded Peatland Percentage
Economic	1. Emission Intensity
	2. Final Energy Intensity
	3. Gross National Income (GNI)/Capita
	4. Agricultural Productivity
	5. Productivity of Industrial Sector Labor
	6. Productivity of Service Sector Labor
Social	1. Average Year of Schooling
	2. Life Expectancy
	3. Poverty Rate
	4. Unemployment Rate

Source: Bappenas (2022)

The stages in conducting the Rap-GEI analysis in the present study are shown in Figure 2 below.

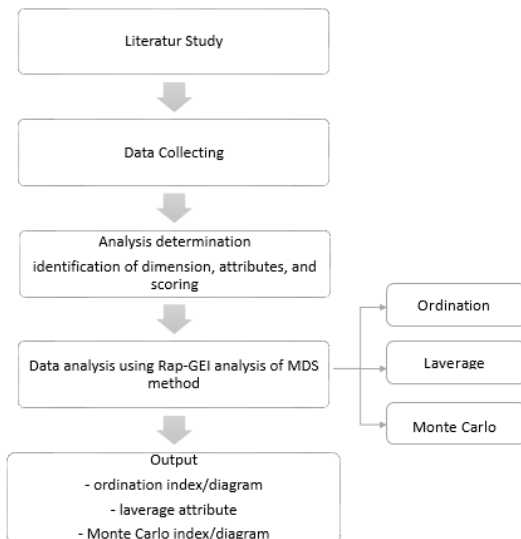


Figure 2. The Conceptual Framework

During the literature study, researchers studied relevant references from credible sources related to the Green Economy Index. Data collection for research was carried out using secondary data, namely indexes related to green economy from the results of data collection from the Ministry of National Development Planning in 2022. The analysis determination is the selection of the method used and followed by the identification of dimensions and attributes which can be seen in Table 1. The scoring process was carried out for converting secondary data to Likert scale according to the indicators on each attribute. The Likert scale used is 1=bad, 2=medium, 3=good, and 4=very good.

Rap-GEI ordination analysis using the MDS method was performed to determine ordination, leverage attributes, and Monte Carlo values. The ordinated output is used as an assessment of the sustainability status of the Green Economy Index assessment dimensions through sustainability graphs and indexes. The sustainability index obtained in the ordination analysis was then matched with the sustainability categories listed in Table 2.

Table 2. Sustainability Criteria

Index Value	Categories
0.00 – 25.00	Not Sustainable
25.01 – 50.00	Less Sustainable
50.01 – 75.00	Quite Sustainable
75.01 – 100.00	Sustainable

Furthermore, the output leverage attributes were used to perform sensitivity analysis in order to find the most sensitive attribute of each assessment dimension. Sensitivity analysis shows the effect of each attribute on the dimension which can be seen from the change in the Root Mean Square (RMS) value on the X axis. The bigger the RMS value on an attribute, the bigger the place of this attribute in forming values on the sustainability (Kuvaini et al., 2019).

The analysis results need to be validated to decide the goodness of the analysis results. Validity analysis can be concluded from the difference in the MDS and Monte Carlo index values, the coefficient of determination (R^2), and the Stress value. Monte Carlo analysis results in the form of indexes and Monte Carlo graphs are used to see the stability of the MDS results. The difference between Monte Carlo and MDS shows the sustainability status. If the difference value is less than 1, then the sustainability index status value in the MDS and Monte Carlo analysis results does not have much difference and the analysis results are good as a method for analyzing sustainability (Ramadhanty et al., 2022).

3. RESULT AND DISCUSSION

This study aims to find out the Green Economy Index assessment sustainability in Indonesia using the MDS method through the Rap-GEI ordination technique. The Green Economy Index assessment consists of three dimensions, including environmental, economic, and social dimensions. The Green Economy Index score development in Indonesia in all three dimensions from 2011 to 2020 is provided in Figure 3.

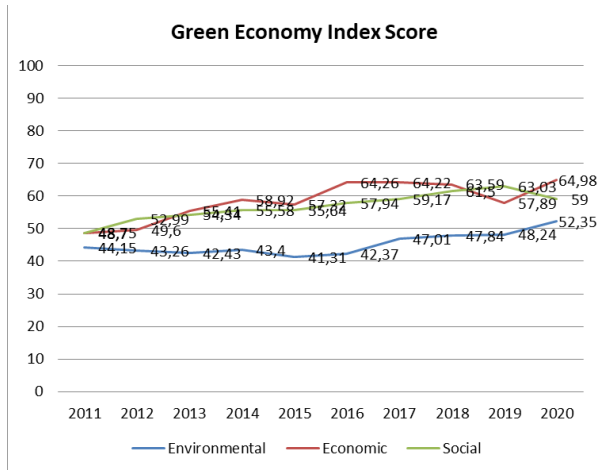


Figure 3. The Green Economy Index Score Development in Indonesia

The Green Economy Index score development on the three dimensions shows an increasing pattern every year, meaning that the development of attributes assessed in the Green Economy Index dimension has improved every year. Overall, the Green Economy Index score in Indonesia in 2020 has reached a score of 59.17% (Bappenas, 2022). When seen from each dimension, it can be said that the economic and social dimensions bear a higher value compared to environmental dimension. The economic dimension has the best progress in 2020 after the COVID-19 pandemic, even though in previous years it did not show a consistent increase (a fluctuating pattern). Meanwhile, the environmental and social dimensions do not show a very high increase, but the pattern of these two dimensions is consistent. The results of Rap-GEI analysis show the sustainability value of each dimension with ordination range of bad (0%) to good (100%). Furthermore, the analysis results also show the most sensitive attributes of each dimension. The results of ordination value of the environmental dimension of Green Economy Index are shown in Figure 4. The sustainability status of the environmental dimension shows poor results because it has an ordination value of 45.47%. The status of being less sustainable in this environmental dimension shows that the attributes

that make up this environmental dimension still need to be improved so that the achievement of Green Economy Index in Indonesia can get better.

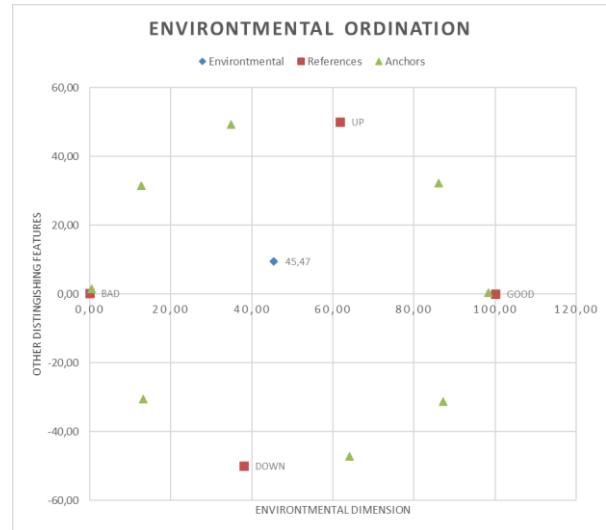


Figure 4. Environmental Dimensions Ordination Chart

To find out the attributes that have the highest level of sensitivity and need improvement, it can be seen from the leverage attributes analysis results presented in Figure 5. The environmental dimension of Green Economy Index is composed of five attributes, namely Forest Cover, Share of Renewable Energy, Managed Waste, GHG Emission Reduction Percentage, and Degraded Peatland Percentage. The most sensitive leverage attribute can be seen from the highest Root Mean Square (RMS) value up to half of each dimension. Based on Figure 5, it shows that there are two attributes that have an RMS value of more than half of the environmental dimension, namely the Managed Waste and Share of Renewable Energy attributes. These two sensitive attributes require more attention and handling to improve the Green Economy Index condition in Indonesia from the environmental perspective.

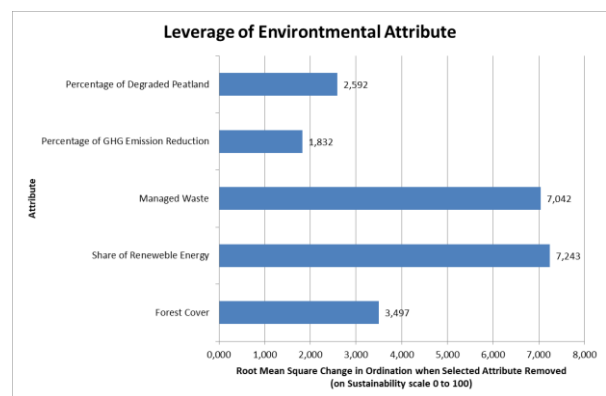


Figure 5. Leverage Attributes of the Environment Dimension

Compared to other attributes, Share of Renewable Energy has the lowest value, especially in the first five years from 2011 to 2015 when it was showing a very low value (close to 9-12%). Then the government issued Presidential Regulation No. 22 of 2017 regarding the National Energy General Plan (Rencana Umum Energi Nasional/RUEN) to accelerate the new and renewable energy development. Consequently, the value of the Share of Renewable Energy attribute has increased 28.9% in 2020, from a value of 9% in 2011. Meanwhile, the Managed Waste attribute is the second-best attribute when viewed from the development of Green Economy Index score (Bappenas, 2022). However, in several cities in Indonesia, waste remains a major problem because it can have an impact on various dimensions, including environment, health, and others (Ritonga & Usiono, 2023) (Lingga et al., 2024). Thus, waste management must continue to be refined integrately and comprehensively.

Furthermore, from the economic dimension of the Green Economy Index assessment, the sustainability analysis results present sufficient results with a value of 56.02% (Figure 6). This value indicates that attributes that make up the economic dimension are quite good, but attention and improvement are still needed because there are still sustainability values that need improvement.



Figure 6. Economic Dimension Ordination Chart

In the economic dimension of the Green Economy Index assessment in Indonesia, there are six attributes used, including Emission Intensity, Intensity of Final Energy, Gross National Income (GNI)/Capita, Productivity of Agriculture, Productivity of Industrial Sector Labor, and Productivity of Service Sector Labor. The leverage attributes analysis results from the economic dimension given in Figure 7 show that there are two

of the most sensitive attributes, Agricultural Productivity and Industrial Sector Labor Productivity. The Productivity of Agriculture indicator is a combination of three sub-indicators that calculate the productivity of food crop cultivation in Indonesia, including productivity of rice field, oil palm, and cultivation. This also supports the leverage attributes results that show that the Agricultural Productivity variable must get attention because the existence of this attribute is related to the food availability in Indonesia. Based on the development of the Green Economy Index score, Industrial Sector Labor Productivity is in the very good category. However, to encourage improvements in people's incomes, it is necessary to increase human resources in industry, for example through training and improving the skills of industrial workers (Widiansyah, 2017).

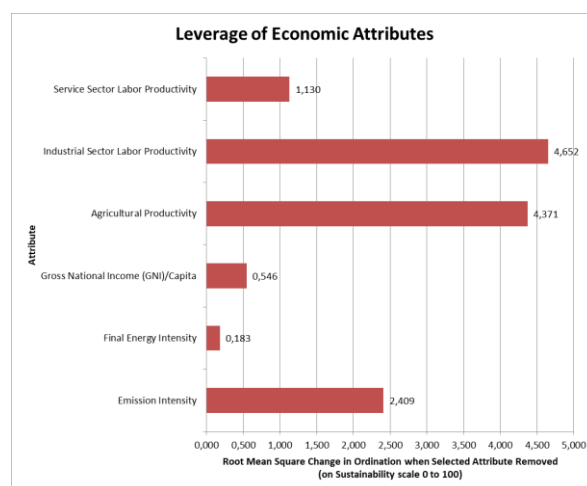


Figure 7. Leverage Attributes of Economic Dimension

Apart from these two attributes, one attribute has a fairly high value, which is the Emission Intensity attribute. This attribute has a fairly high RMS value and is close to half the RMS value of the economic dimension. Hence, improvements to the Emission Intensity attribute also need to be taken into account. This Emission Intensity is strongly influenced by forest conditions, like forest fires. So, if there is a forest fire or a long dry season (as a result of El-Nino) it will greatly impact Emission Intensity in Indonesia (Gautama et al., 2023).

The last dimension in the Green Economy Index assessment is the social dimension. The sustainability analysis on the ordinate chart of Figure 8 shows that the social dimension of sustainability analysis has a value of 55.30%. The ordinate value indicates that the attributes that make up the social dimension are good enough, but not safe enough. It means that the attributes in the social dimension must still be given attention and improvement.

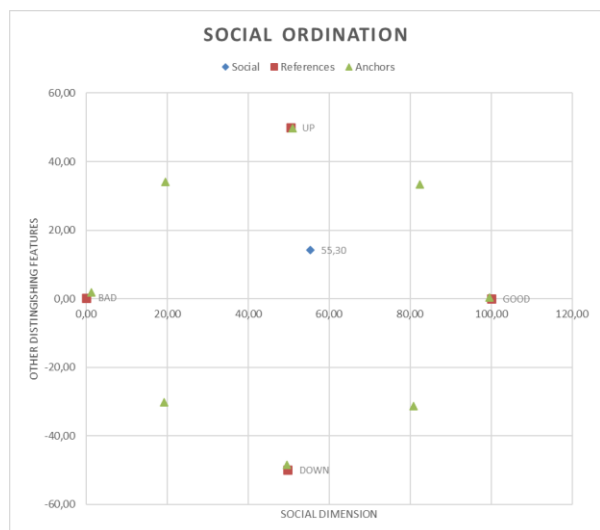


Figure 8. Social Dimension Ordination Chart

The attributes that make up this social dimension consist of four attributes, including the Mean Year of Schooling, Life Expectancy, Poverty Rate, and Unemployment Rate. According to the analysis of the leverage attributes in Figure 9, it is known that there are two attributes that have the most sensitive results and require improvement in terms of the social dimension, which are Poverty Rate and Life Expectancy. In general, the attributes that make up this social dimension tend to have an increasing trend every year, except for 2020, which experienced the COVID-19 pandemic.

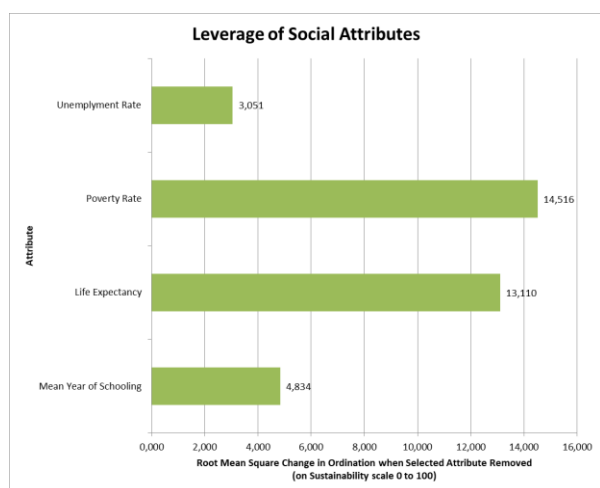


Figure 9. Leverage Attributes of Social Dimension

In summary, results of the sustainability assessment analysis of Green Economy Index with Rap-GEI are given in Table 3. The results of this summary show that two out of the three dimensions have shown a fairly good assessment, which are the economic and social dimensions. However, the environmental dimension still shows an insufficient assessment. This is consistent with the Green Economy Index score development in Figure 3. Thus, it can be said

that the dimension of the Green Economy Index assessment that really needs improvement is the environmental dimension. In Table 3, the sensitive attributes of each dimension are also presented. These sensitive attributes require attention in order to improve assessments on each dimension of the Green Economy Index assessment.

Table 3. Summary of the Rap-GEI Analysis Results on the Sustainability Status of Assessment Dimensions of GEI

Dimension	Sustainable Status	Leverage Attributes
Environmental	Less	1. Managed Waste 2. Share of Renewable Energy
Economic	Quite	1. Agricultural Productivity 2. Industrial Sector Labor Productivity
Social	Quite	1. Poverty Rate 2. Life Expectancy

The results of MDS analysis with Rap-GEI need to be validated to find out the goodness of the analysis results. This validity uses the criterion of the difference in the estimated index from the MDS results with the estimated index from the Monte Carlo results. The small difference in value shows that the error in the analysis is relatively small, the variance in the assessment of each attribute is relatively small, the analysis process is repeated and stable, and the possibility of data input errors is also small (Kuvaini et al., 2019). Mathematical results presenting the MDS (Multidimensional Scaling) calculations, Monte Carlo calculations, and the difference between the two results are given in Table 4. The difference in the MDS and Monte Carlo analysis results on the three dimensions of the Green Economy Index shows a small value (less than 1). This shows that the analysis results from MDS and Monte Carlo do not have much difference and the results from the Rap-GEI analysis are good as a method for analyzing the sustainability dimensions of the Green Economy Index assessment.

Table 4. Comparison of MDS and Monte Carlo Results

Dimension	MDS Result	Monte Carlo Result	Difference
Environmental	45.47	45.56	0.09
Economic	56.02	55.30	0.72
Social	55.30	54.55	0.75

In addition to using the value of the difference in the MDS and Monte Carlo index results, the validity of the analysis results can also be seen from the goodness of fit calculation utilizing the Stress value and the coefficient of determination (R^2). The validity assessment criterion with Stress and R^2 values is that the analysis results are said to be good if they have a Stress value of less than 0.25 and have an R^2 value close to 1. As presented in Table 5, it shows that the Stress values for the three dimensions of the Green Economy Index assessment show a value of less than 0.25. In addition, the R^2 value of the three dimensions also shows a very high value, which is above 0.9 (close to a value of 1). This shows that the validity of the MDS analysis with the Rap-GEI results is good and statistically justifiable. In addition, the results of this validity also show that it is not necessary to add other attributes to the Green Economy Index dimensions, but it only needs to be improved so that the assessment of the three dimensions of the Green Economy Index can get better.

Table 5. Goodness of Fit Value of Analysis Results

Dimension	Stress	R^2
Environmental	0.151	0.939
Economic	0.157	0.938
Social	0.163	0.920

4. CONCLUSION

The analysis results show that the sustainability status of the Green Economy Index assessment is less sustainable (45.47%) for the environmental dimension, quite sustainable (56.02%) for the economic dimension, and quite sustainable (55.30%) for the social dimension. These results indicate that two of the three dimensions (economic and social dimensions) have shown a fairly good assessment, but the environmental dimension still shows a poor assessment and needs improvement. The most sensitive attributes that require improvement are Managed Waste and Share of Renewable Energy (environmental dimension), Agricultural Productivity and Industrial Sector Labor Productivity (economic dimension), as well as

Poverty Rate and Life Expectancy (social dimension). Furthermore, there is a small difference in the MDS and Monte Carlo analysis index values, a small Stress value, and a high R^2 . Thus, it can be concluded that the sustainability of the dimensions of Green Economy Index assessment is good and does not require adding attributes to each dimension, only requiring improvement of the attributes of each dimension of Green Economy Index assessment.

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