Research Article

Green Economy Indicators and Determinants in South Sulawesi Province

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Abstract.
The aim of this study was to measure indicators and determinants of the level of green economic development in South Sulawesi Province based on driving factors, status, impact or influence, and models of the green economy regionally. This measurement was carried out to evaluate and develop the green economy using a quantitative approach to the DPSIR conceptual model with the multicriteria decision-making analysis method (MCDMA), which is widely used to assess the diversity of socio-economic phenomena. This makes it possible to rank regions and progress in green economic development in South Sulawesi Province. The results of the study found that all regions in South Sulawesi Province experienced progress in terms of green economic growth, but from several indicators, there were still regions that experienced a slowdown in several sectors.

Keywords: green economy indicators, MCDMA, DPSIR

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1. Introduction

Climate change is one of the things that is currently of concern to the world. The impact of climate change is increasingly being felt and causing several countries in other parts of the world to experience quite extreme heat waves, droughts, landslides, changing rainfall, melting ice at the poles due to global warming causing rising sea levels that can cause flooding and several natural disasters caused by climate change. This happens because the economic development model is still conventional and highly dependent on fossil fuels which of course produce large amounts of greenhouse gas (GHG) emissions, industrial waste, air pollution and production activities that cause ecological imbalance due to excessive exploitation of resources. If this situation is not handled quickly and appropriately, it will endanger humans in the future.

To increase development and economic growth but still be able to preserve the environment, a new paradigm, idea or concept is needed to overcome this. One thing that can be done is sustainable development that adopts the concept of a green

economy. The United Nations Environment Program (UNEP) in 2012 put forward the concept of a green economy as a method to overcome environmental, social and economic problems in development for a country.

*Green Economy*is a way to achieve sustainable development that is socially just, encouraging economic growth and at the same time maintaining environmental quality. Green Economy is built on a dynamic system approach that allows simultaneous measurement of the impact of a policy intervention on social, economic and environmental (Global Green Growth Institute, 2015). This is also in line with the concept of sustainable development popularized by John Elkington in 1994 regarding the Triple Bottom Line (TBL) Concept which is outlined in his book entitled Cannibals with Forks. This theory is considered relevant because it explains the sustainable development scheme that pays attention to aspects that are dimensions in this study, namely Social, Economic and Environmental.

To further develop and maintain green economic development in a region, it is necessary to measure current economic development and the impacts or influences caused by green economic development[1]. The transition to a green economy requires a theoretical and methodological basis and an evaluation indicator system [2]. Indicators are needed to determine the level of transformation towards the established development goals.So thatIt is important to correctly formulate the objectives of green transformation, determine the level and schedule for achieving them, formulate appropriate steps and indicators, and seek data to evaluate the development strategies and policies implemented.

Therefore, it is necessary to conduct measurements by determining the right indicators according to the characteristics of the region in an area because it will affect the quality and depth of the green economy assessment. The selection of indicators in measuring the green economy is a key word in the evaluation of its implementation empirically. This measurement includes an assessment of the current state of the environment from internal and external pressures caused by human activities and government policies designed to encourage green economic development Green economic indicators are a series of indicators that provide a good picture of human life in terms of social, economic and environmental aspects, which show the correlation between the three, thus providing a representative picture of the fundamental aspects of the greening process[3].

There are several studies that examine the green economy using the indicator assessment method, one of which is a study conducted by Dual Citizen Inc. which produced the Global Green Economy Index (GGEI) consisting of 32 indicators with 4 main dimensions, namely (1). Leadership and climate change, (2). Sector efficiency, (3). Markets and investment and (4). Environment and natural capital. This study found that a framework such as the GGEI was needed to better understand the green economy from various aspects (Dual Citizen Inch, 2014). The United Nations Environment Program (UNEP) made an initial proposal regarding green economy indicators for an integrated assessment of policies and methods in the green development process on a national and global scale. To evaluate development policies, UNEP consists of 39 specific indicators with an emphasis on 3 main dimensions, namely (1). Identification of environmental problems and objectives, (2). Policy intervention indicators, (3). Quality of life and social justice (UNEP, 2012).The Organisation for Economic Co-operation and Development (OECD) has also developed its own set of indicators including 26 core indicators, each of which may have additional components, complementary or substitute indicators with dimensions consisting of (1). socio-economic, (2). environment and resource productivity, (3). natural asset base, (4). environmental quality and economic opportunities and (5). policy responses (OECD, 2011).

The European Environment Agency (EEA) also published Green Economy Indicators in 2012. It included 225 indicators into the following five groups: (1) driver indicators: 50 indicators related to socio-economic development, including transport, tourism, energy consumption; (2) pressure indicators: 71 indicators related to with greenhouse gas emissions and other air, water and land pollutants; (3) condition indicators: 33 indicators that describe the state of the environment; (4) impact indicators: 46 indicators that describe environmental changes and their impacts on ecosystems, the economy and human health; (5) response indicators: 25 indicators that describe how politicians and society react to environmental issues (EEA, 2012). Green economy indicators were also created by Bożena Ryszewska, which contain 21 indicators grouped into seven dimensions as follows: (1). Ecosystems, biodiversity and natural capital; (2). Emissions, pollution and waste; (3). Resource consumption; (4). Poverty and social inequality; (5) Economy; (6) Environmental policies and strategies; (7). The green economy sector, its specifics, strengths and weaknesses need to be considered. Likewise, research from Nurkarim which measures the green economy index with 3 dimensions with 13 indicators using the remote sensing method as a data source to measure agricultural data to the smallest unit [4].

In Indonesia, the determination of the green economy index is issued by the National Development Planning Agency (Bappenas) using a simple methodology of normalized scores consisting of 15 indicators with 3 dimensions, namely social, economic and environmental. Green economy policy interventions are also stated in the National Long-Term Development Plan (RPJPN) 2025-2045 andfor the regional scale is stated in the Regional Regulation of South Sulawesi Province Number 7 of 2024 concerning the Regional Long-Term Development Plan (RPJPD) for 2025-2045. In supporting the National Low Carbon Development Policy (PRK), the South Sulawesi Provincial Government has also stipulated Governor Regulation Number 11 of 2020 concerning Amendments to the South Sulawesi Governor Regulation Number 59 of 2012 concerning the Regional Action Plan for Reducing Greenhouse Gas Emissions in South Sulawesi Province.

The green economy indicator framework allows for differences between countries and regions according to their social, economic and environmental conditions [4]. Differences in dimensions and indicator frameworks from several studies are a natural thing to be able to describe a green economy that is accurate and representative according to the region and characteristics of an area.

In this study, the determination of green economy indicators is based on the dimensions and indicators that have been determined by Bappenas, namely 3 pillars of social, economic and environmental, but in some indicators there are modifications that are adjusted to empirical conditions and data available in the field. The procedure for selecting indicators in measuring the green economy index includes an assessment of environmental conditions and the pressures exerted by human activities on the environment and policies taken by the government. So on this basis, the determination of green economy indicators in this study modifies policy indicators that are adjusted to the regional scale. This research framework uses a design from the European Environment Agency (EEA), namely using the DPSIR model which is grouped into five categories, namely: driving factors (D), pressure (P), status (S), impact (I) and response (R where these categories are then reviewed from the Indonesian green economy indicators issued by Bappenas.

The purpose of this study is to measure the indicators and determinants of the level of green economic development in South Sulawesi Province based on the driving factors, status, impact or influence and model of the green economy. To measure the current status of green economic development, this study compiles a green economic development index system based on drivers, pressures, status, impact, model

2. Materials and Methods

This research is in line with the concept of sustainable development popularized by John Elkington in 1994 regarding the Triple Bottom Line (TBL) Concept outlined in his book entitled Cannibals with Forks. This theory is considered relevant to this research because it explains the sustainable development scheme that must consider three main aspects which are dimensions in this research, namely: 1). Social (Community welfare, human rights, equality and social justice); 2). Economic (sustainable economic growth without damaging the environment and social welfare); 3). Environmental (Ecology, reducing environmental impacts and conservation of natural resources) (Figure 1).

Figure 1: Green economy development system framework sorce john elkington, 1994.

Sustainable development and green economy are interrelated. So it is undeniable that green economy is part of sustainable development and vice versa because the pillars in sustainable development are also part of the green economy itself, namely economy, social and environment and the three pillars cannot stand alone because they are interrelated (Figure 2).

2.1. Structure

The green economic development system is complex because it is influenced by various factors including social, economic, energy, environmental and technological [1]. Green economic development is then assessed in five categories, namely: dri ving factors (D), pressure (P), status (S), impact (I) and response (R) to measure the interaction of indicators. emphasizing the causal relationship between human socio-economic activities and environmental change. This DPSIR Conceptual Model comes from the PSR conceptual model issued by the European Environment Agency (EEA) in 1999.
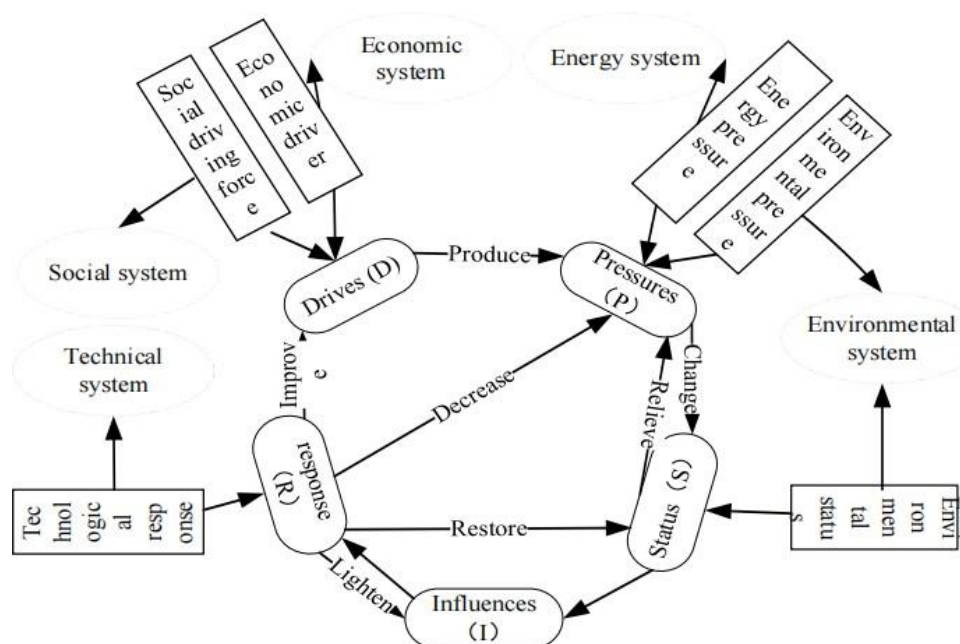
Figure 2: Green Economy Development System Framework Source: Min Wang et al, 2019.

2.2. Methods

This research musing the DPSR conceptual model first proposed by the EEA in 1991 to measure green economic development in a region. This study uses a quantitative approach with the Multi-Criteria Decision Making Analysis (MCDMA) analysis technique to assess the level of green economy in the South Sulawesi region and its changes during the period 2015-2021. MCDMA is a decision- making process related to solving problems with complex complexity and difficult to measure with certainty. MCDMA is based on the structure of the problem, considering all aspects (priority scales) that have an influence [5]. Therefore, this analysis technique is very suitable for use in this study to

measure the index level and make decisions from the complexity of the many indicators in the green economy index.

2.3. Data source

The index data for this study was obtained by using literature studies from the Ministry of National Development Planning / National Development Planning Agency (Bappenas), the National Statistics Agency, the South Sulawesi Province Book in figures for 2024, the 2025-2045 RPJPD Document for South Sulawesi Province, the 2025-2045 RPJPD KLHS Report for South Sulawesi Province and from several documents, articles and international journals indexed by Scopus.

3. Results and Discussion

The implementation of the green economy in Indonesia began in 2013 through the collaboration of Bappenas with the Global Green Growth Institute (GGGI). Indonesia established Law Number 16 of 2016 which ratified the main material of the Paris Agreement and committed to determining national contributions. In 2020, Indonesia submitted a climate plan in the Nationally Determined Contributions (NDCs) climate action to reduce CO^2 emissions by 29% by 2030. Then in 2021 the Indonesian Government established Presidential Regulation (Pepres) Number 98 of 2021 concerning the Implementation of Carbon Economic Values for the Achievement of Nationally Determined Contribution Targets and Control of Greenhouse Gas Emissions in National Development.

In South Sulawesi Province, the implementation of a green economy is also stated in the development planning process, namely in the Regional Regulation of South Sulawesi Province Number 7 of 2024 concerning the Long-Term Regional Development Plan for 2025-2045, the Medium-Term Development Plan (RPJMD), Regulation of the Governor of South Sulawesi Number 17 of 2024 concerning the Work Plan of the Regional Government of South Sulawesi Province for 2025, KLHS RPJPD of South Sulawesi Province for 2025-2045 and KLHS RPJMD of the Regional Government of South Sulawesi Province for 2025-2029. In supporting the National Low Carbon Development Policy (PRK), the South Sulawesi Provincial Government has also stipulated Governor Regulation Number 11 of 2020 concerning Amendments to the Regulation of the Governor of South Sulawesi

Number 59 of 2012 concerning the Regional Action Plan for Reducing Greenhouse Gas Emissions in South Sulawesi Province.

Regionally, the green economy index value on the island of Sulawesi shows quite good development in terms of green economy transformation. However, there is quite a significant disparity in several provinces, for example between the provinces of West Sulawesi and North Sulawesi. [6] This shows that the policy or implementation of green economy development is not evenly distributed, there needs to be cross-regional coordination in Sulawesi that can support and encourage equitable green economy development by developing local potential. The following are the regional green economy index values in several provinces in Indonesia, especially provinces on the island of Sulawesi, which can be seen in the graph 1 below:

At the regional level, the achievement of the Green Economy Index (GEI) of South
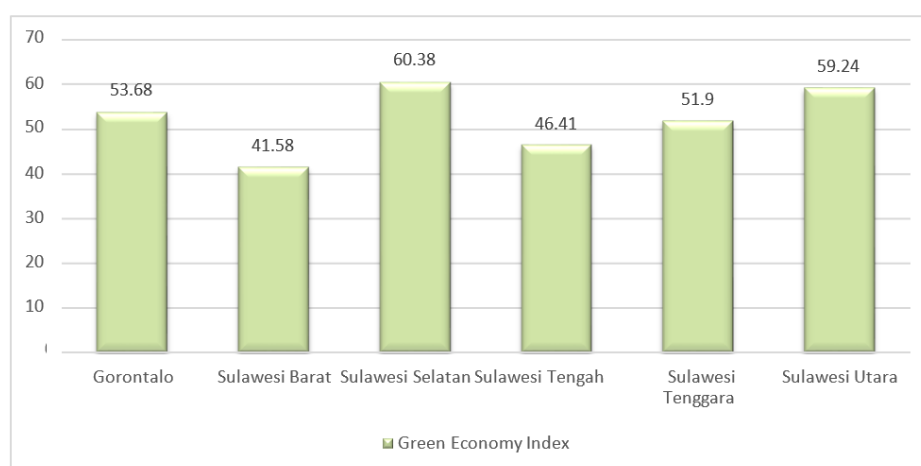

Figure 3: Green Economy Index Regionally.

Sulawesi Province is quite good because it has the highest GEI value compared to equivalent provinces, but its progress is still lower than that of North Sulawesi, Southeast Sulawesi and Central Sulawesi Provinces, but its progress is still better than that of West Sulawesi. At the national level in 2015-2018, the GEI achievement of South Sulawesi was still above the achievement of Indonesia's GEI, then decreased and in 2021 it again experienced a significant increase because it was above the national achievement.

3.1. Green Economy Index in South Sulawesi Province

This study assesses the Green Economy Index (GEI) issued by the Ministry of National Development Planning / National Development Planning Agency (Bappenas) which

consists of 15 indicators covering three dimensions, namely economic, social and environmental based on driving factors, pressures, status, impacts and models (DPSIR). The GEI of South Sulawesi Province can be seen from the green economy index as shown in the graph 2 below:
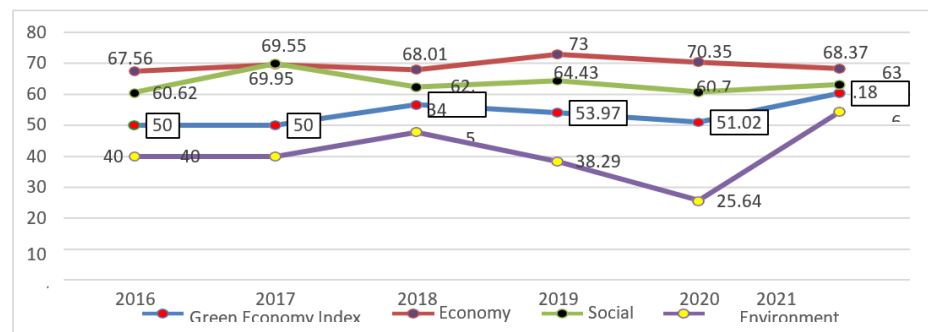

Figure 4: Green Economy Index of South Sulawesi Province Source: PPN/Bappenas, GEI Indonesia.

From the data above, it can be seen that the green economy index value of South Sulawesi in 2021 was at 60.38 points. This value is the result of the accumulation of the economic dimension value of 68.37 points, the social dimension of 63.18 points and the environmental dimension of 54.47 points. Climate change has quite an impact on the achievement of the green economy index of South Sulawesi where the indicators forming the environmental dimension have the lowest achievement compared to other dimensions. This is due to the high rate of land conversion in the last decade, which shows a trend of pressure on quite large forest areas. On this basis, the land cover indicator is included in the P factor, namely pressure, in the DPSIR conceptual model.

The South Sulawesi green economy index uses 15 indicators in accordance with those issued by the Ministry of National Development Planning/Bappenas in the Green Economy Index which includes three main dimensions, namely social, economic and environmental. The social pillar consists of four indicators, namely unemployment rate, poverty rate, life expectancy and average length of schooling. The economic pillar consists of six indicators, namely emission intensity, energy intensity, GRDP/capita, Agricultural Productivity, Industrial Sector Labor Productivity and Service Sector Labor Productivity. The Environmental Dimension consists of land cover, renewable energy mix, surface water quality, air quality, percentage of GHG emission reduction. This can be seen from the Table 1 below:

TABLE 1: Green Economy Index Score of South Sulawesi Province in 2015 and 2021.

Dimensions	Indicator	Year 2015	Year 2021
Environment	Land Cover	33.88	36.27
	Renewable Energy	24.41	14.44
	Mix	76.25	91.25
	Surface Water Quality (BOD)	85.42	82.27
	Air Quality (NO^2)	2.83	4.00
Economy	GHG Emission Reduction Percentage	98.87	99.10
	GHG Emission Intensity	72.88	88.57
	Final Energy Intensity	33.34	42.73
	GRDP/Capita	49.94	52.91
	Agricultural Productivity	88.72	79.60
	Industrial Sector Labor Productivity	41.20	47.32
Social	Labor Productivity in the Service	56.40	64.60
	Sector Average Years of Schooling	72.44	76.63
	Life	27.77	32.46
	Expectancy	75.42	77.33
	Poverty Level	**53.14**	**60.38**
	Open Unemployment Rate		
	Green Economy Index		

Description: 0-25 Bad/Red category; 26-50 medium/yellow category; 51-75 good/green category; 76- 100 very good/blue category. Source: KLHS RPJPD South Sulawesi Province

From the Table 1 above, it can be seen that the green economy index value of South Sulawesi Province has increased every year from 53.14 in 2015 to 55.89 in 2021. However, the index score values in the indicators are still included in the bad/red category, namely the Renewable Energy Mix Indicator and the Greenhouse Gas Emission Reduction Percentage Indicator, even though the government has issued several policies and regulations related to reducing greenhouse gases. Likewise, indicators such as land cover, GRDP/perkanpita, agricultural productivity, labor and poverty rates are still in the moderate or yellow category. Factors that affect the percentage of GHG emission reduction in South Sulawesi Province in the red numbers include the use of fossil fuels, both from private vehicles and from the production process. Although the government's efforts towards green development are still very much by issuing regulations and rules regarding renewable energy and regulations regarding NEK and providing incentives and low taxes for the use of electric vehicles, there are still many people who have not been able to leave this habit. Likewise, the renewable energy mix figure is still in the red numbers. This is certainly influenced by the global economy which affects the price of energy commodities, energy generators that are still limited. Therefore, it is necessary to develop environmentally friendly renewable energy such as solar, wind and hydraulic power. However, the problem then faced is the high budget needed to change from conventional energy to renewable energy so that cooperation with other parties is needed to overcome these capital constraints. Transformation of systems and mindsets towards green development. Comprehensive collaboration and integration between the

community, government and private sector as well as non-governmental organizations are needed to work together and gradually start changing habits from conventional methods that can damage the environment to more environmentally friendly methods. The following is a diagram of indicators that form the green economy index in South Sulawesi Province:
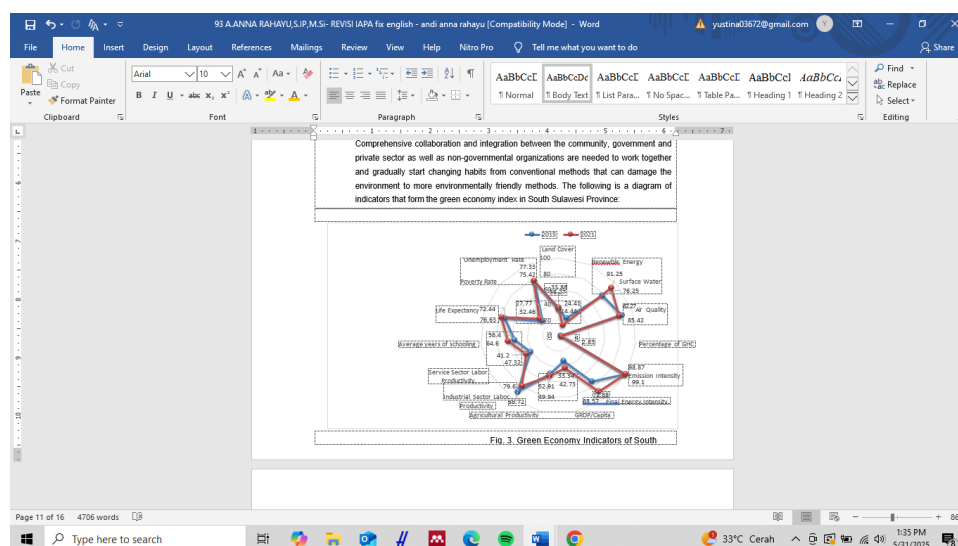

Figure 5: Green economy indicators of south Sulawesi province.

From the diagram (fig 3) above, it can be seen that there has been a development in the green economy from 2015 to 2021. This can be seen from the increase in indicators in several dimensions. Of the 15 green economy indicators set by Bappenas, there are 3 indicators that have decreased, namely the renewable energy mix indicator from 24.41 to 14.44, then the air quality indicator from 85.42 to 82.27 and the third is the industrial sector labor productivity indicator from 88.72 to 79.60. This is caused by one of the factors, namely climate change so that air quality decreases and the lack of innovation regarding renewable energy which can have implications for air quality and labor productivity in the industrial sector. From this data, the three indicators are taken as impact and pressure factors in the DPSIR model.

3.2. Development of Green Economy Indicators based on DPSIR

The green economy indicator development system is based on the DPSR conceptual model proposed by the European Environment Agency (EEA) in 1999 using 5 dimensions, namely economic, social, energy, environment and technology. However, in this study the DPSIR model used refers to the dimensions issued by John Elinkton in the

Triple Bottom Line (TBL) theory and is based on the Pillars adopted by Bappenas, namely Social, economic and environmental. The construction of the DPSIR model criteria in this study only uses the DPSIR criteria layers, namely Drivers, Pressures, State, Influences and Response. Therefore, 15 indicators are divided intodriver (D), pressure (P), status (S), impact (I) and response (R) which can be seen in the diagram Figure 4 below:
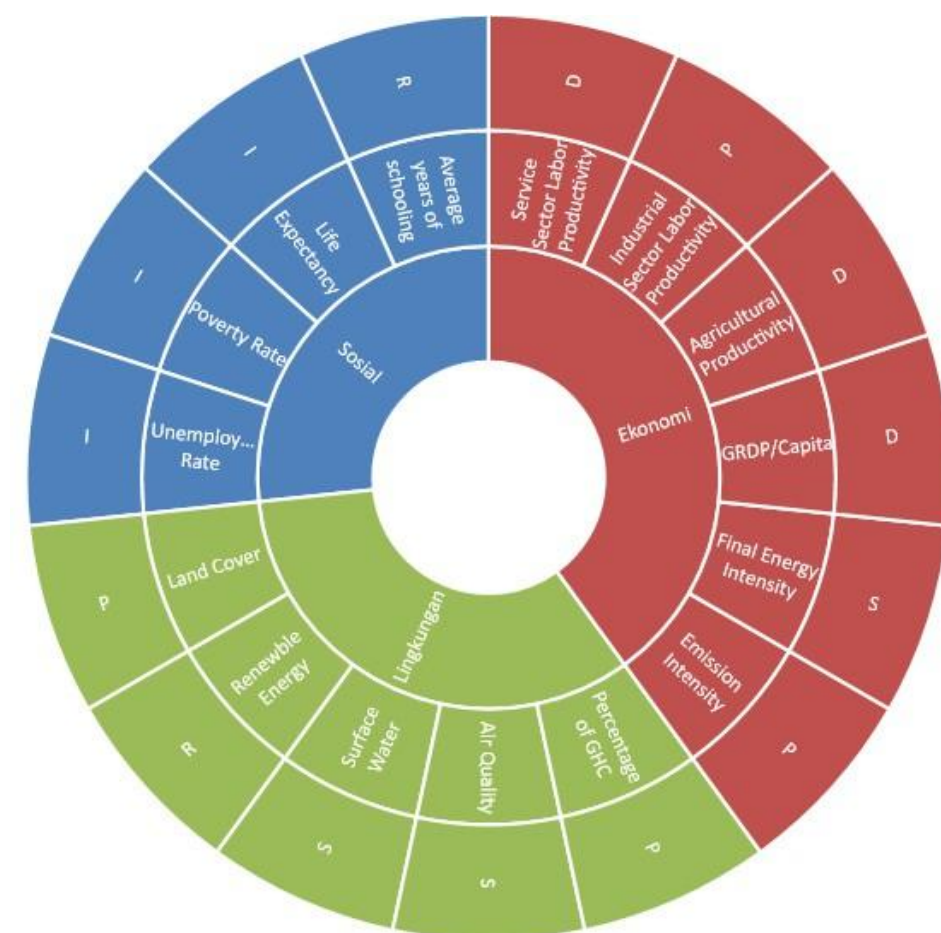

Figure 6: Green economy index based on DPSIR.

The selection of driver or driving indicators (D) is chosen based on socio-economic activities that can have a good impact on the environment and welfare. In this study, the Drivers (D) indicators are GRDP/capita, Agricultural Productivity, Service Sector Labor Productivity. The pressure indicator (P) is chosen based on the pressure that can cause the green economy index value to decrease, such as: GHG emission intensity, Percentage of GHG Emission Reduction, Land Cover and industrial sector labor productivity. The pressure indicator is also chosen based on data from the GEI value that has decreased over several decades. The status indicator (S) is chosen to show the actual condition of the environment and resources such as: final energy intensity, water quality, air quality. The impact indicator (I) is chosen because of the social, economic

and health consequences of changes in socio-economic and environmental conditions (green economy) such as: Life expectancy and poverty levels. The Response indicator is chosen based on policies and programs or interventions carried out to reduce pressure and impact and improve status. As in the findings above, the renewable energy indicator is a pressure factor with a significant decrease from 24.41 points to 14.44 points in 2021.

That figure is still in the red category, which is bad. so indirectly this also affects the R factor, namely the government's response by issuing policies to intervene in overcoming environmental change by making regulations contained in regional regulations, but in its implementation it is still considered lacking, so commitment, strategy and cross-sector collaboration are needed and active participation from all levels of society and government in dealing with this. From the selection of indicators with the DPSIR model, it was found that the dynamics of environmental change affect the achievement of the South Sulawesi green economy index because its achievement is the lowest and affects every dimension.

This condition is caused by the high conversion of land and forest functions for the agricultural, plantation, mining, and residential sectors due to the increasing human population so that basic needs and production processes are increasing. Likewise, the need for housing so that it takes land that should function as a water catchment area. Spatial allocation should be adjusted to the balance and preservation of the area so as not to cause vulnerability and land degradation that can cause various natural disasters. The extension of the production of superior regional commodities needs to pay attention to the sustainability of economic development by considering local wisdom and the characteristics of each region as a driver of the green economy with downstream sectors that consider social, economic and environmental sustainability.

4. Conclusion

South Sulawesi Province is a region whose development is supported by good natural resources from the agricultural, plantation, fisheries and mining mineral sectors, so a high commitment is needed in realizing sustainable green economic growth, namely increasing economic growth for the welfare of the community without damaging the environment. This study compiles a regional green economy index using three dimensions, namely economic, social and environmental in accordance with the theory of John Elinkton and selected indicators from the Ministry of PPN/Bappenas using the DPSIR model. Analysis of the green economy index value each year has been proven to be able

to determine the distance between the current status and the ideal condition so that it is possible to clarify future development trends. With the identification of several driving factors, pressures, responses and impacts from various aspects, especially from social, economic and environmental aspects, we can identify obstacles in green economic development and take steps to overcome them for sustainable development. [3]

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