

Sustainable Development and Green Economy: a Proposal of Index for Azerbaijan

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Abstract— The concept of the green economy, regarded as a key strategy for sustainable development, is considered a way to reconcile the conflicts between ecological challenges and economic goals. Therefore, measuring and evaluating countries' activities related to the green economy is of great importance for shaping future policies. However, since the green economy encompasses economic, social, and environmental dimensions, there is a need for an alternative measurement framework that can represent these dimensions comprehensively.

The purpose of this study is to measure and evaluate Azerbaijan's green economy performance. To achieve this, a Green Economy Index covering the years 1990-2023 has been calculated based on numerical data for 21 variables believed to represent the three distinct aspects of the green economy. According to the index values obtained, it can be concluded that Azerbaijan's green economy performance has improved during the specified period. This improvement is largely due to positive developments in economic, social, as well as environmental indicators. Although there has been some positive progress in environmental performance, especially in recent years, the impact of environmental indicators on overall green economy metrics has been relatively limited.

Keywords—Sustainable Development, Green Economy, Green Growth, Green Economy Index, Ecology

I. INTRODUCTION

The relationship between economic development and the environment has been a topic of discussion within the framework of growth and development theories since the 1970s. In the early years, researchers acknowledged the limitations of natural resources and argued that economic growth was also inherently limited [6]. Accordingly, the report "The Limits to Growth" prepared by the Club of Rome in 1972 emphasized the importance of considering the interdependence between the economy and the natural environment in development policies. According to this report, if current trends in global population growth, industrialization, environmental pollution, food production, and natural resource consumption persist, the global economy will reach its growth limits within approximately a century. The anticipated consequence of this scenario would be a sudden and uncontrollable decline in the world population and industrial production [15].

However, technological advancements, the discovery of new natural resource deposits, and the utilization of previously economically unviable reserves have begun to eliminate the limits to growth and development. Over time, the concept of development has evolved to incorporate the idea of intergenerational equity, giving rise to the concept of sustainable development. Intergenerational equity refers to ensuring that each generation enjoys the same level of well-being and opportunities as others. Achieving this requires the preservation of the environment and the rational use of natural resources through a sustainable approach [6]. In the modern era, the world is increasingly affected by threats arising from

environmental factors such as global warming and climate change. These threats profoundly impact social and economic life worldwide. Undoubtedly, one of the necessary measures is to reduce greenhouse gas emissions on a global scale. However, countries remain hesitant in this regard due to concerns about potential negative impacts on economic growth, making it difficult to establish a strong global consensus. While these concerns may seem valid in the short term, they are considered unfounded in the long run.

As Başoğlu and Akyazı [6] point out, while production levels may decrease in the short term when environmental balance is prioritized, sustainable growth becomes achievable in the long term as environmental conditions improve. This can lead to increased societal welfare through an enhanced quality of life. Furthermore, neglecting environmental balance is argued to potentially reduce a country's long-term growth potential.

Gross Domestic Product (GDP) is the most commonly used indicator for determining the economic development levels of countries. However, issues such as income inequality, environmental pollution, ecological imbalance, and the adverse effects of global warming have enriched the content, dimensions, and objectives of the concept of economic development in recent years. Consequently, this concept has evolved into a multidimensional structure that includes social and environmental factors in addition to economic ones. The necessity of considering these new factors in measuring economic development has brought Beyond GDP discussions to the forefront.

Within this framework, numerous new metrics prioritizing environmental and social issues in measuring economic activity have been developed. These metrics can be grouped into three categories [9].

- Indices aimed at adjusting GDP (e.g., Genuine Progress Indicator, Green GDP, Adjusted Net Savings)
- Indices that do not use GDP (e.g., Gross National Happiness, Ecological Footprint, Subjective Well-being, Happy Planet Index, Social Progress Index)
- Composite indices incorporating GDP (e.g., Human Development Index, Sustainable Development Index)

One of the new concepts emerging within this discussion is the green economy. The green economy is a multidimensional concept that encompasses economic, social, and environmental dimensions. It is considered to have the potential to reduce existing economic concerns related to environmental protection, while also enabling social and economic development through the preservation of the environment. In this context, it is crucial to develop low-carbon technologies and implement green investments that will drive a green industrial revolution. Measuring countries' activities in the field of green economy is of significant

importance for more accurate evaluations and providing direction to policymakers in the process of shaping policies.

II. PROBLEM STATEMENT

The concept of sustainable development was more broadly presented in the Our Common Future report, known as the Brundtland Report, published in 1987 by the UN's World Commission on Environment and Development [27]. In this report, sustainable development was defined as the process of meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. The key goals identified within this approach are as follows [5]:

- Stimulating economic growth,
- Improving the quality of growth,
- Ensuring the provision of basic needs such as employment, food, energy, water, and public health,
- Ensuring a sustainable population level,
- Protecting and developing the natural resource base,
- Integrating the environment and economy in decision-making.

The sustainable development approach presented in the Brundtland Report is largely seen as a call for policies that promote economic growth and aim for maximum growth. This approach provides new perspectives on economic development, emphasizing that quality is as important as quantity [20].

The 1992 United Nations Conference on Environment and Development in Rio de Janeiro recognized sustainable development as a common goal for humanity. The conference emphasized that humans are at the center of sustainable development, and living a healthy, productive life in harmony with nature is a right for everyone. Today's development can only lead to long-term successful outcomes if ecological balance is preserved.

A. Green Economy and Green Growth

The concepts of green economy and green growth are new terms frequently used in the context of sustainable development in recent years. The term "green economy" was first used in the report The Green Economy Project (1989, UK). However, since the report did not contain specific ideas about the green economy, it was largely seen as an attempt to introduce the concept [14].

The foundations of the green economy and green growth concepts were established at the 2005 Conference of Environment and Development Ministers in Seoul. During this conference, it was proposed to further develop the concept of sustainable development in more specific directions and to choose the path of green growth [13]. Later, at the 2012 Rio+20 Conference on Sustainable Development, it was confirmed that green growth is a strategic approach for sustainable development [23].

B. The Concept of Green Growth

Green growth is a concept that promotes economic growth by enhancing human well-being while conserving natural resources and the environment [18]. It emphasizes not only the efficient use of natural resources but also the management of the environment to prevent ecological disasters [26]. Green growth is also an environmentally sustainable model that ensures economic progress, increases social development, and reduces emissions [10].

C. The Concept of Green Economy

Green economy is an approach aimed at significantly reducing ecological problems and environmental risks while enhancing human well-being and social equity. According to

the United Nations Environment Programme [22], the main goals of the green economy are as follows:

The main goals of green economy, according to the United Nations Environment Programme [22], are as follows:

- Reducing carbon emissions,
- Decreasing waste and pollution,
- Preserving biodiversity and preventing ecosystem losses,
- Increasing energy and resource efficiency,
- Promoting human well-being and social equity.

Within this approach, investments from both the public and private sectors ensure increased income and employment, and ecological resources are used more efficiently [7]. According to Schlör et al., green economy is an innovative process that ensures sustainable socio-economic development. Therefore, green economy is an institutional response to socio-economic and ecological challenges in a globalized world. While there may not be full agreement on the definitions, there is a consensus on what the concepts of green economy and green growth represent. These concepts are often used interchangeably with or as a part of sustainable development [3].

Green economy has various aspects in economic, social, and ecological terms [8]. Within these dimensions, the main objectives of green economy can be summarized as increasing resource use efficiency, promoting social equity and fair income distribution, and preserving ecological sustainability [8]. Achieving these goals requires progress in employment, income, and health, reduction of carbon emissions, inclusion of stakeholders in processes and economic activities, and fair income distribution. To achieve these goals, the following methods should be followed [1]:

- Economic growth (Focusing on sectors and regions with the highest potential to support well-being),
- Sustainable management of natural resources (Increasing the efficiency of natural resources per capita and using over-exploited, depleted resources sustainably),
- Resilience (Adapting to climate change, diversification, risk management, creating responsible organizations, competitiveness, and attracting investment).

In the context of the explanations provided above, the green economy can be represented through Figure 1.

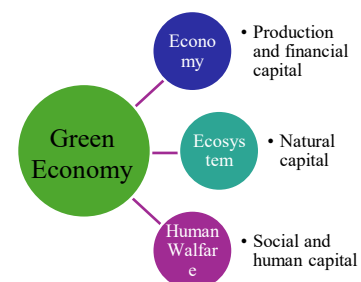


Fig. 1. Green Economy

Source: EEA (2013, p.5)

Therefore, the economic dimension covers production and financial capital; the human welfare dimension encompasses social and human capital; and the ecological dimension includes natural capital.

III. THE MAIN PART

The concept of Gross Domestic Product (GDP) is criticized for not taking into account the negative impacts of economic activities on the environment and natural resources. Therefore, in the process of transitioning to a green economy,

new measurement methods are required that will promote environmental priorities, due to the need to reconsider development and income distribution indicators. A number of economic sustainability indicators are available to measure the impacts of economic activities on social welfare and the environment. These indicators can be listed as follows [27]:

- **Environmental Sustainability Index**
- **Environmental Performance Index**
- **Environmental Vulnerability Index**
- **Index of Sustainable and Economic Welfare**
- **Green Net National Product**

The common feature of the indices listed above is their recognition that the GDP, used to measure economic performance, is insufficient to address today's environmental problems, and that a more effective digital variable is needed to aggregate human welfare and environmental factors under one value. However, these indices are either focused on environmental or economic issues. Therefore, it is difficult to say that there are adequate criteria covering all dimensions of green economy.

The organization "Dual Citizen" has been calculating the Global Green Economy Index (GGEI) for countries around the world every two years since 2010 and sharing it with the public. This index includes 20 different variables in the fields of climate change, sector efficiency, investments, and the environment. The index presented covers various dimensions of the green economy, but data for periods prior to 2010 is unavailable.

Nahman, A., Mahumani, B.K and Lange W.J calculated a green economy index based on 26 indicators from economic, social, and ecological perspectives for 196 countries [16]. Similarly, Kararach, G., Nhamo, G., Mubila, M., Nhamo, S. Nhamachena, C. and Babu, S created a green growth index with 48 variables in 5 categories for 22 African countries. However, these studies only provide index scores for a single year and do not allow tracking the performance of countries over time [16].

The difficulty and cost of regularly collecting data each year leads to many data being inaccurate or collected in intermittent periods. This prevents tracking progress in a given period [16]. Therefore, due to the lack of regular data to track performance development for a specific period in a country, many variables should be excluded from the index. In such cases, creating an index with a small number of regularly collected variables could be a solution. For instance, Teixeira, J.R, Pinheiro, D.S. and Vilasboas created an index to evaluate the social and environmental performance of the U.S. and China's economies from 2002 to 2012, using four different variables: CO2 emissions per capita, access to drinking water, public health, human development index, and the share of renewable energy in total energy consumption [16].

Vilasboas, A.E. and Teixeira, J.R. created a green economy index for Brazil covering the period from 2001 to 2014. The researchers used variables such as income per capita, carbon dioxide emissions, and renewable energy supply as components of the index [16]. Similarly, Velame, I.S. and Teixeira, J.R. calculated a green economy index for 20 Latin American countries to show their green economy and sustainable development performance for the period 2006-2013. In the creation of this index, variables representing the social, economic, and ecological dimensions

of green economy, such as the Gini coefficient, GDP per capita, and fossil fuel consumption, were used [16].

Schlör, H., Venghaus, S. and Hake, J.F. included 46 variables in their green economy innovation index for Germany, which consists of three sub-indices for the food, energy, and water sectors, as well as a general index derived from their arithmetic mean [16].

A. RESEARCH

The public and policymakers need reliable and well-synthesized information to make optimal decisions on a particular issue. However, the presence of numerous variables related to the topic can lead to challenges in determining which variable(s) should be considered. Therefore, indexes are necessary to aggregate digital data on multiple variables into a single value. The process of index calculation generally involves four stages: selection, transformation, weighting, and evaluation of the variables [17].

B. SELECTION OF VARIABLES

In order to assess the development of green economy, the index calculated should include variables that reflect the interaction between the environment and the economy at the macro level. In this context, three potential groups of indicators would be suitable for selection. First, it would be important to consider indicators related to key sectors relevant to green economy, such as investment, employment, and production levels. For example, the share of renewable energy in total energy consumption could be an indicator in this regard. Second, measuring economic growth and the environmental damage caused is crucial. Relevant variables in this context include energy intensity, resource and material usage, and waste generation in certain sectors. Third, general indicators related to economic development and welfare, such as poverty reduction and natural resource consumption, should be considered. In this respect, it is necessary to focus on developing traditional measures like GDP that directly account for environmental degradation and resource depletion [12].

C. NORMALIZATION

Since the values of variables generally have different scales and units, these values need to be normalized. Normalization is essentially a mathematical transformation that arranges raw values with different scales and units into a common scale. Thus, all values are scaled to a specified range (0-1, 0-10, 0-100, etc.), preventing one variable from dominating others when the final index value is calculated. Although various normalization methods exist in the literature, the max-min normalization method used in the World Bank's Human Development Index has been chosen for this work. In this method, raw data is normalized within the framework of the following equations [16]:

If the raw values of a variable are desirable to be high (e.g., income per capita), the normalization is done as follows:

$$Xi' = \frac{Xi - \min(x)}{\max(x) - \min(x)} \quad (1)$$

If high raw values are not desirable (e.g., the ratio of government debt to GDP), the normalization is done as follows:

$$Xi' = \frac{\max(x) - Xi}{\max(x) - \min(x)} \quad (2)$$

Equation (1) and (2), X_i' represents the normalized value, X_i is the raw value of the variable, and $\max(x)$ and $\min(x)$ are the maximum and minimum values of the variable, respectively. Thus, all numerical values of the variables are brought into a defined range. If the normalized values are closer to the lower end of the range, it indicates poor performance, while values closer to the upper end of the range indicate good performance. Since the range used in this case is 0-1, a normalized value of 0 represents the worst condition, and 1 represents the best condition.

Weighting is the process of evaluating the relative importance of the various components within an index. In an index, it is possible to assign different weights according to the significance of each variable. This helps to assess the role of each variable in the index more accurately and in a balanced manner.

D. OBTAINING AZERBAIJAN'S GREEN ECONOMY INDEX

In this study, Azerbaijan's green economy index was calculated for the period 1990-2023. The most important limitation of the study is the lack of data. The lack of regular data for many variables caused the study to be limited to the period in question. For example, although the Gini coefficient in Azerbaijan has been calculated for some years.

In order to create the index, a total of 21 variables, which are thought to represent economic, social and environmental dimensions in the context of the relevant literature, were used and the data were obtained from the World Bank (WB) databases. Information and sources of the variables are presented in Table 1.

DIME NSION	VARIABLE
ECONOMIC	Net National Income (current, US Dollar)
	Net National Income per Capita (Current, US Dollar)
	Net National Income Growth Rate (Annual, %)
	GDP by Purchasing Power Parity (Current US Dollar)
	Gross fixed capital formation (current US\$)
	Gross fixed capital formation (% of GDP)
SOCIAL	Agriculture, forestry, and fishing, value added (current US\$)
	Life expectancy at birth, total (years)
	Mortality rate, infant (per 1,000 live births)
	Government expenditure (GE) on education, total (% of GE)
	School enrollment, primary (% net)
	Poverty rate (% of population)
ENVIROMENTAL	Access to electricity (% of population)
	Electricity production from renewable sources, excluding hydroelectric (% of total)
	Renewable energy consumption (% of total final energy consumption)
	Fossil fuel energy consumption (% of total)
	Adjusted savings: natural resources depletion (% of GNI)
	Energy intensity level of primary energy (MJ/\$2017 PPP GDP)
	Total greenhouse gas emissions excluding LULUCF (Mt CO2e)
	Forest area (% of land area)
	Arable land (% of land area)

Table 1. Economic, Social and Environmental Variables Included in the Green Economy Index.

In the index creation process, first the raw data of all variables were normalized with the max-min method and each variable was brought to a 0-1 scale. Then, economic, social and environmental sub-indices were calculated by taking the arithmetic average of the normalized values of the variables in each group. Finally, the scores for the green economy index were obtained by taking the arithmetic average of the sub-indexes obtained. The graphs below show

the normalized economic, social and environmental variables of Azerbaijan between 1990 and 2023 taken from the World Bank data.

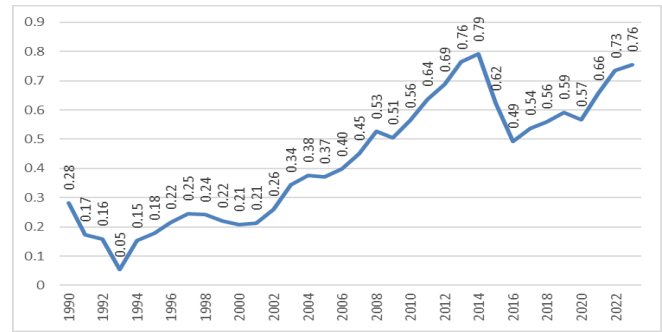


Fig. 2. Normalized economic index of Azerbaijan for 1990-2023

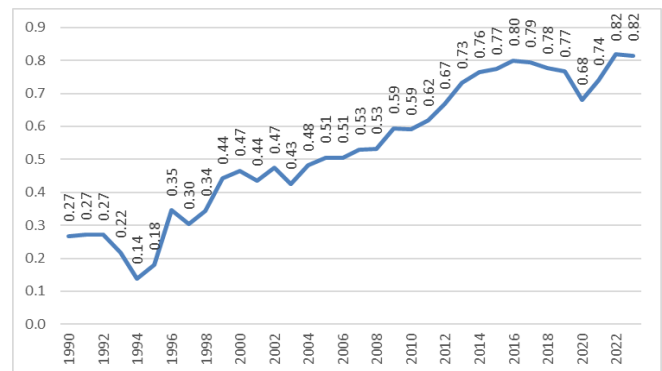


Fig. 3. Normalized social index of Azerbaijan for 1990-2023

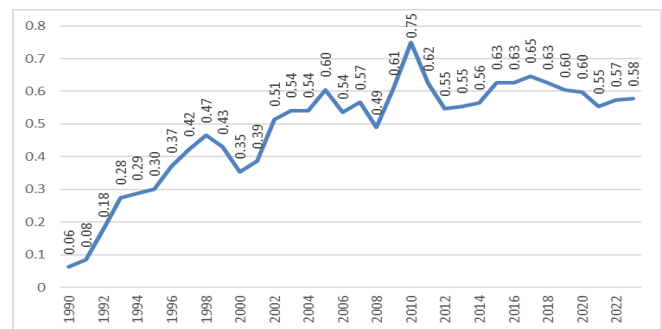


Fig. 4. Normalized enviromental index of Azerbaijan for 1990-2023

As depicted in figures, Azerbaijan's economic performance decreased in 1990-1993, it showed a long-term growth in 1993-2013 and the oil price slump of 2014 caused a drastic economic slowdown with all economic indicators and economic performance has declined but with the increasing oil prices in the following years, after 2016, it again followed a growth rate. Azerbaijan's social indicators also showed a decline between 1990-1994, fluctuations were observed in 1994-2003, and although it showed a decrease in 2019-20 due to the Covid pandemic, it was at a growth rate in the following years. But talking about a trend for environmental performance it is not possible. Azerbaijan's environmental performance increased until 1998, 1998-2008 it fluctuated during the period, showed a large increase in 2008-2010, and had a decreasing trend in the post-2010 period compared to the previous period. But in general, we can see that environmental performance is also increasing in the long term.

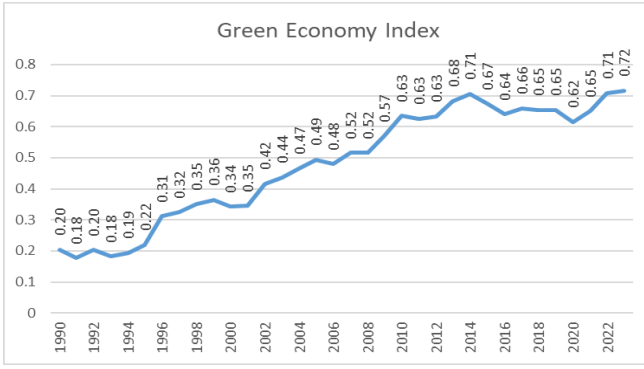


Fig. 5. Green economy index of Azerbaijan for 1990-2023

The development of Azerbaijan's green economy index for the 1990-2023 period is presented in Figure 5. We can say that Azerbaijan's green economy performance is generally on an upward trend. Although this upward trend became more pronounced in the 1990-2014 period, it followed a stable course in the 2014-2020 period and has been on an upward trend in the following years.

IV. CONCLUSION

In this study evaluating the green economy performance of Azerbaijan, first of all, a green economy index consisting of 21 variables belonging to economic, social and environmental dimensions was created. According to the index scores obtained, it can be said that the green economy performance of Azerbaijan has increased in the period under consideration. This increase was mainly driven by the progress in the economic and social dimensions. On the other hand, it is not possible to say that it has shown an adequate performance in the environmental dimension. This is because the environmental performance index has shown a more fluctuating course than the others in the period under consideration.

In addition to progress in economic and social variables, implementing social policies to increase equitable income distribution and reduce poverty, and increasing investments in health, education and infrastructure that contribute to the development of human capital can improve the social index and hence the country's green economy performance.

In particular, positive developments in environmental variables will further improve the performance of the green economy. In this context, the development of green technologies that will also contribute to the economy, the creation of green jobs, the efficient use of natural resources and energy, the rehabilitation of agricultural land and increasing productivity can improve both economic and environmental performance. In this context, developing incentives for wind and solar energy investments and accelerating natural gas exploration efforts will contribute to Azerbaijan's current account balance and economic growth by reducing energy dependency, and will also contribute positively to environmental performance by preventing environmental pollution. However, in making these investments, it is also important to determine the correct location of the establishment and to choose the methods that will cause the least damage to the environment. It is also important to develop and expand recycling practices, which are widely practiced in many countries.

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