

SUSTAINABLE DEVELOPMENT AND GREEN ECONOMY: A PROPOSAL OF INDEX FOR AZERBAIJAN

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Summary. This study evaluates Azerbaijan's progress toward a green economy that integrates economic growth, social well-being, and environmental protection. Since conventional indicators such as GDP fail to reflect environmental and social dimensions, a composite Green Economy Index is developed for a more comprehensive assessment. Using national data from 1990 to 2023, the index is constructed from 21 economic, social, and environmental indicators obtained from the World Bank. Indicators are normalized using the min-max method and aggregated into dimension-specific sub-indices, which are then averaged to obtain the overall index. The results show a general upward trend in Azerbaijan's green economy performance over the study period. Progress is mainly driven by economic and social improvements, including higher income levels, better access to electricity, education, and health services. Environmental performance improves over the long term but remains volatile and contributes less consistently. The findings underline the need to strengthen environmental policies, expand renewable energy investment, and improve resource efficiency. The index provides a practical tool for monitoring green economy performance and supporting sustainable policy design.

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Introduction

The relationship between economic development and environmental sustainability has been widely discussed since the 1970s. The Limits to Growth emphasized that continuous population growth, industrialization, pollution, and resource consumption could eventually constrain economic development, highlighting the need to consider the interdependence between economic activity and the natural environment (Meadows et al., 1972). This perspective contributed to the development of sustainability-oriented approaches based on the rational use of natural resources and intergenerational equity (Diniz & Bermann, 2012).

Growing concerns about climate change, environmental degradation, and resource depletion have further demonstrated that conventional economic growth cannot be evaluated independently of environmental and social conditions. Although environmental protection measures may impose short-term economic costs, maintaining ecological balance can support sustainable long-term growth and social welfare (Akyazı & Başoğlu, 2015).

These developments have also intensified the Beyond GDP debate. GDP remains a fundamental measure of economic performance but does not adequately capture income inequality, environmental degradation, resource depletion, or broader social well-being. Consequently, alternative measures have emerged, including GDP-adjusted indicators, non-GDP indices, and composite indices integrating economic, social, and environmental dimensions (Özsoy & Tosunoğlu, 2017).

Within this framework, the green economy has emerged as a multidimensional approach integrating economic development, social well-being, and environmental protection. Its measurement is particularly

important for assessing national progress and supporting policies related to low-carbon development, green investment, resource efficiency, and sustainable economic growth.

Problem statement

Sustainable development was formally defined in the Brundtland Report as development that meets present needs without compromising the ability of future generations to meet their own needs. The approach integrates economic growth, basic human needs, natural-resource protection, and environmental considerations into development policy, emphasizing the quality as well as the quantity of growth (Brundtland, 1987; Soussan, 1992). This principle was further reinforced at the 1992 Rio Conference, where sustainable development was recognized as a common global objective.

Within this framework, green growth and green economy have emerged as approaches that integrate economic progress with environmental sustainability and human well-being. The foundations of green growth were strengthened through international initiatives, including the 2005 Seoul Conference and the Rio+20 process, which recognized green growth as an important pathway toward sustainable development (Kararach et al., 2018; UNESCAP, 2012). Green growth emphasizes economic development alongside efficient resource use, environmental protection, and lower emissions (OECD, 2011; Yalçın, 2016; GGGI, 2012).

The green economy similarly aims to improve human well-being and social equity while reducing environmental risks. Its principal objectives include reducing carbon emissions, waste and pollution, preserving biodiversity, increasing energy and resource efficiency, and promoting social welfare (UNEP, 2011). Public and private investment can support these objectives by generating employment and income while improving resource efficiency (Diyar et al., 2014). Although definitions vary, green economy and green growth are generally regarded as closely related components of sustainable development (Bowen, 2012).

From economic, social, and environmental perspectives, green economy performance therefore depends on **resource efficiency, social equity, ecological sustainability, resilience, and responsible management of natural resources** (EEA Report, 2013; Bass, 2013). These interrelated dimensions are summarized in Figure 1.

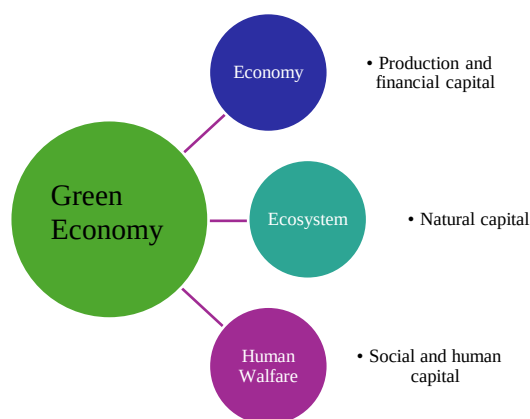


Fig. 1. Green Economy

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.

Materials and methods

GDP does not fully account for the environmental and social consequences of economic activity; therefore, alternative measures such as the Environmental Sustainability Index, Environmental Performance Index, Environmental Vulnerability Index, Index of Sustainable Economic Welfare, and Green Net National Product have been developed. However, these measures often emphasize particular economic or environmental dimensions rather than providing a comprehensive assessment of the green economy.

Several composite approaches have subsequently been proposed. The Global Green Economy Index (GGEI), calculated by Dual Citizen since 2010, incorporates 20 variables related to climate change, sector efficiency, investment, and the environment. Nahman et al. (2016) developed a green economy index based on 26 economic, social, and ecological indicators for 196 countries, while Kararach et al. (2018) constructed

a green growth index using 48 variables in five categories for 22 African countries. However, limited historical data restrict the use of these indices for long-term performance analysis.

Other studies have applied smaller indicator sets to improve temporal comparability. Teixeira et al. (2015) assessed the socioeconomic and environmental performance of the United States and China using selected indicators, including CO₂ emissions, access to drinking water, public health, human development, and renewable energy. Similar approaches have been applied to Brazil and Latin American countries using indicators such as income per capita, CO₂ emissions, renewable energy, the Gini coefficient, GDP per capita, and fossil-fuel consumption (Vilasboas & Teixeira, 2017; Velame & Teixeira, 2017). Schlör et al. (2017) developed a Green Economy Innovation Index for Germany using 46 variables and sub-indices covering the food, energy, and water sectors.

Research

Composite indices provide a practical means of aggregating multiple variables into a single measure for decision-making and policy evaluation. Their construction generally involves four stages: variable selection, transformation, weighting, and evaluation (OECD, 2002).

For assessing green economy development, variables should represent the interaction between economic activity, social welfare, and environmental conditions. Accordingly, indicator selection should consider three main areas: (1) green-economy-related investment, employment, and production, including renewable energy; (2) economic growth and associated environmental pressures, including energy intensity, resource use, and waste generation; and (3) broader development and welfare indicators, including poverty reduction and natural-resource consumption. Such indicators allow conventional economic measures to be assessed together with environmental degradation and resource depletion (Jones, 2011).

Discussion

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 (Nahman et al., 2016):

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), Xi' represents the normalized value, Xi 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.

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.

Table 1

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

DIMENSION	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) Agriculture, forestry, and fishing, value added (current US\$)
SOCIAL	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) Access to electricity (% of population)
ENVIRONMENTAL	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 CO ₂ e) Forest area (% of land area) Arable land (% of land area)

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.

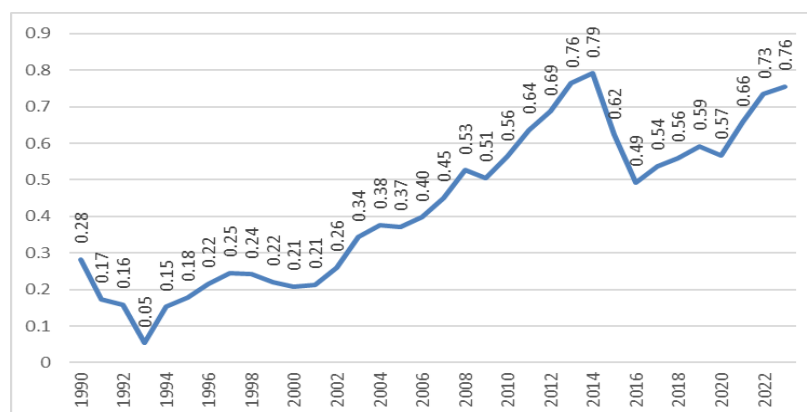


Fig. 2. Normalized economic index of Azerbaijan for 1990-2023

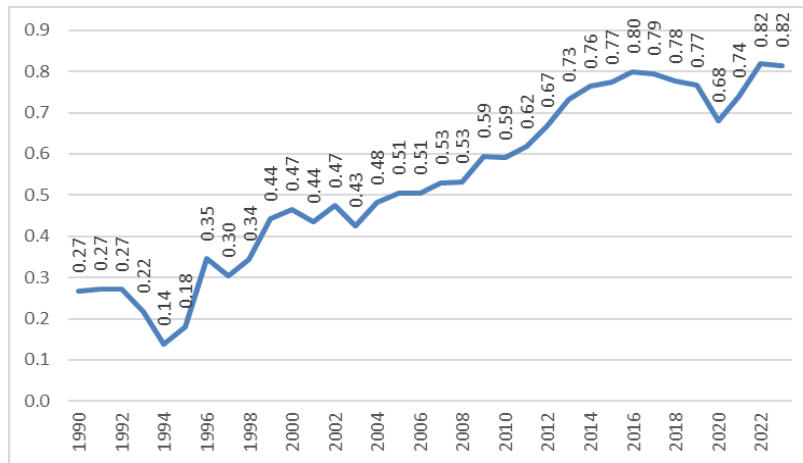


Fig. 3. Normalized social index of Azerbaijan for 1990-2023

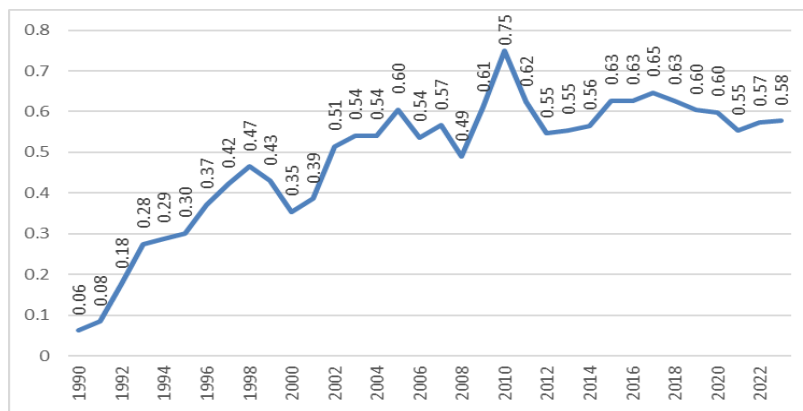


Fig. 4. Normalized environmental index of Azerbaijan for 1990-2023

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.

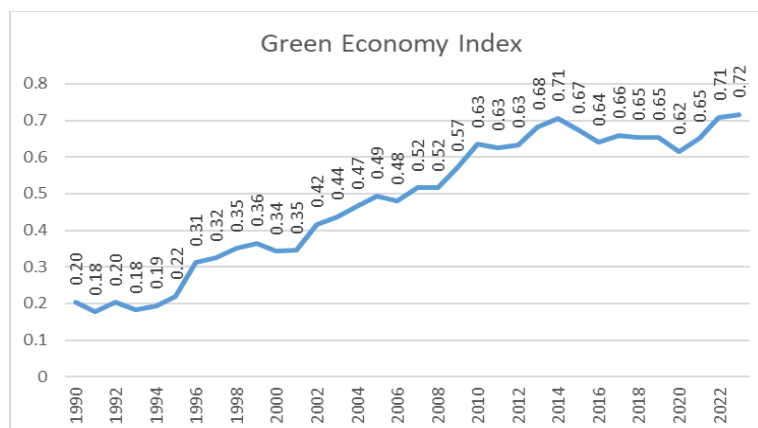


Fig. 5. Green economy index of Azerbaijan for 1990-2023

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.

Conclusions

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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УСТОЙЧИВОЕ РАЗВИТИЕ И ЗЕЛЁНАЯ ЭКОНОМИКА: РАЗРАБОТКА ИНТЕГРАЛЬНОГО ИНДЕКСА ДЛЯ АЗЕРБАЙДЖАНА

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Резюме. В исследовании оценивается прогресс Азербайджана в направлении перехода к зелёной экономике, объединяющей экономический рост, социальное благополучие и охрану окружающей среды. Поскольку традиционные показатели, такие как валовой внутренний продукт (ВВП), не отражают экологические и социальные аспекты, для более комплексной оценки разработан составной Индекс зелёной экономики. На основе национальных данных за 1990–2023 годы индекс сформирован из 21 экономического, социального и экологического показателя, полученного из базы данных Всемирного банка. Показатели нормализованы методом минимакса и агрегированы в субиндексы по отдельным направлениям, после чего путём вычисления их среднего значения получен общий индекс. Результаты свидетельствуют об общей тенденции роста показателей зелёной экономики Азербайджана в течение исследуемого периода. Прогресс обусловлен главным образом улучшениями в экономической и социальной сферах, включая повышение уровня доходов, расширение доступа к электроэнергии, образованию и медицинским услугам. Экологические показатели улучшаются в долгосрочной перспективе, однако сохраняют нестабильный характер и вносят менее устойчивый вклад в общий прогресс. Полученные результаты подчёркивают необходимость усиления экологической политики, расширения инвестиций в возобновляемую энергетику и повышения эффективности использования ресурсов. Разработанный индекс представляет собой практический инструмент для мониторинга показателей зелёной экономики и поддержки формирования политики устойчивого развития.

Ключевые слова: зелёная экономика, устойчивое развитие, индекс зелёной экономики, Азербайджан, экологическая результативность

DAYANIQLI İNKİŞAF VƏ YAŞIL İQTİSADİYYAT: AZƏRBAYCAN ÜÇÜN İNDEKS TƏKLİFİ

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Xülasə. Tədqiqatda Azərbaycanın iqtisadi artımı, sosial rifahı və ətraf mühitin mühafizəsini özündə birləşdirən yaşıl iqtisadiyyata keçid istiqamətində irəliləyişi qiymətləndirilir. Ümumi daxili məhsul (ÜDM) kimi ənənəvi göstəricilər ekoloji və sosial aspektləri əks etdirmədiyindən daha əhatəli qiymətləndirmə üçün kompozit Yaşıl İqtisadiyyat İndeksi hazırlanmışdır. Dünya Bankından əldə edilmiş 1990–2023-cü illərə aid milli məlumatlardan istifadə edilməklə indeks 21 iqtisadi, sosial və ekoloji göstərici əsasında formalaşdırılmışdır. Göstəricilər min–maks metodu ilə normallaşdırılmış və ayrı-ayrı istiqamətlər üzrə subindekslərdə birləşdirilmiş, daha sonra onların orta qiyməti hesablanaraq ümumi indeks əldə edilmişdir. Nəticələr tədqiqat dövründə Azərbaycanın yaşıl iqtisadiyyat

göstəricilərində ümumi artım meylinin müşahidə olunduğunu göstərir. İrəliləyiş əsasən gəlir səviyyəsinin yüksəlməsi, elektrik enerjisinə, təhsilə və səhiyyə xidmətlərinə çıxış imkanlarının yaxşılaşması da daxil olmaqla iqtisadi və sosial sahələrdəki müsbət dəyişikliklərlə şərtlənir. Ekoloji göstəricilər uzunmüddətli dövrdə yaxşılaşsa da, dəyişkən olaraq qalır və ümumi irəliləyişə daha az sabit töhfə verir. Əldə edilən nəticələr ekoloji siyasətin gücləndirilməsi, bərpa olunan enerji mənbələrinə investisiyaların genişləndirilməsi və resurslardan istifadə səmərəliliyinin artırılması zərurətini vurğulayır. İndeks yaşıl iqtisadiyyatın inkişaf göstəricilərinin monitorinqi və dayanıqlı siyasətin formalaşdırılmasının dəstəklənməsi üçün praktiki vasitə təqdim edir.

Açar sözlər: *yaşıl iqtisadiyyat, dayanıqlı inkişaf, yaşıl iqtisadiyyat indeksi, Azərbaycan, ekoloji nəticəlilik*