MEASURING PERFORMANCE FOR SUSTAINABLE DEVELOPMENT GOALS: A REVIEW FROM SOCIAL, ECONOMIC, AND ENVIRONMENTAL PERSPECTIVES UNDER SCIENTIFIC DIPLOMACY

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Abstract

Sustainable Development Goals (SDGs), put forward by the United Nations (UN), emerged intending to create a more sustainable world in terms of social, economic, and environmental (SEE) aspects. Measurements and reporting containing various indices determine the SEE position of countries in achieving the Global Goals. This study examines the adequacy, consistency, weaknesses, and strengths of the SDG Index (the SDGI) introduced by the Sustainable Solutions Network and used to measure the SDGs and other global indices. In this context, more than thirty indices in the SEE fields used to measure the SDGs were investigated, and the indices containing current data from recent years were evaluated. In addition, SEE weights, performances, and relationships among SDG indicators and indices were discussed. Among more than 30 indices, only 4 indices with the SEE dimension were used. In order to be fair and equal, only indices with the SEE dimension were selected for comparison, and the SDGI and 4 index indicators were compared in detail. As a result of the SDGI and index comparison, it seems that SDG also carries out more detailed examinations despite the limitations in SEE dimensions. In addition, it is important to acknowledge the contribution of science diplomacy to the achievements of the SDGs and the relationship between them. This includes recognizing the framework that the SDGs offer for the practice of science diplomacy. Achieving the SDGs of countries is closely related to science diplomacy because the challenges in achieving the SDGs can come through science diplomacy. The dynamic relationship between them is based on science diplomacy, proving on a scientific basis the contribution that the achievement of the SDGs will make to countries. Contributions to this end have also been presented here.

Keywords

Sustainable Development, Sustainable Development Goals, SDG Index, Global Indices, SDG Performance, Science Diplomacy

Introduction

As societies grow, their demands progressively escalate. In order to keep up with the developing world, people have started to engage in social pursuits for different needs. About 50 years ago, the Organization for Economic Cooperation and Development (OECD) aimed at sustainable development to achieve economic growth and increased living standards (Swain, 2018). The concept of sustainability was introduced in 1987 with "Our Common Future" (WCED, 1987), also known as the Brundtland Report, published by the World Commission on Enviroment and Development (WCED). Subsequently, the concept of sustainability has changed meaning repeatedly (Kuhlman & Farrington, 2010; WCED, 1987). In the Brundtland Report, sustainable development was defined as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Swain, 2018; WCED, 1987). Thereafter, in the extensive discussion and use of the concept of sustainable development, three dimensions of sustainable development are generally accepted as social, economic, and environmental (SEE) (Harris, 2000).

The literature examines the dimensions of development and determines their goals in various ways. Sustainable economic development aims to reduce absolute poverty by providing lasting and secure livelihoods that minimize resource depletion, environmental and cultural degradation, and social instability (Barbier, 1987; Harris, 2000). While sustainable environmental development aims to make the ecosystem adapt easily to new conditions, sustainable social development aims to protect the diversity of the Earth, connect with communities, and preserve cultural richness (Baines & Morgan, 2004; Harris, 2000; Sutton, 2004; Tıraş, 2012).

The Millennium Development Goals were implemented during the Millennium Development Goals Summit in 2010, to promote sustainable development. It consists of 8 goals to achieve development by 2015 on issues such as eliminating poverty and hunger, completing primary education, gender equality, reducing child mortality, maternal health, combating communicable diseases, environmental sustainability, and global partnerships (United Nations Development Programme [UNDP] Türkiye, n.d.). Besides the achievements of the Millennium Development Goals, it has been noted that the goal of ending poverty is not sufficient to ensure sustainable development (Sachs, 2012). Thus, the first steps of the Sustainable Development Goals (SDGs) were taken at the 2012 UN Conference on Sustainable Development in Rio de Janeiro, Brazil, in order to set broader and more detailed goals. Consequently, social development, economic development, and environmental sustainability, which are three main objectives in response to global issues, have formed the main pillars of the SDGs. There are different opinions in the literature about whether the determined goals and the indicators are of equal importance in SEE terms and whether they interact with each other. Sustainable development can be examined from different perspectives under SEE dimensions (Paoli & Addeo, 2019). When the SDGs are assessed in a unidimensional way, their weight is ordered from most to least as social, environmental, and economic. Ignoring the interrelationships of the SDGs can make it difficult to achieve the SDGs and slow down sustainable development. In order to focus on the connections between the thematic

areas, when the 16 SDGs, except SDG 17, "Partnership for the Goals", are examined as a whole, it is seen that they are interconnected. The objectives that exhibit the strongest correlation with others are mostly found within the economic dimension, followed by objectives within the social and environmental dimensions. As a result of the consideration of these connections, it has been understood that SDG does not belong to only one dimension but that a goal covers more than one dimension (Le Blanc, 2015). The existence of these connections reveals whether there are inconsistencies within the index. As well, positive or negative developments may cause an accelerated improvement or deterioration in connections. It indicates inconsistency if a country's SDG 1 "No Poverty" score with 10 connections is very high, while all other SDGs have lower scores. Considering that SDG 1 should be one of the main goals, it is particularly associated with SDGs 2, 3, 4, 5, 6, 8, 10, 13, 16, and 17 and is equally important as SDG 10, "Reduced Inequalities" (Nyasimi & Peake, 2015). Poverty is the basis of life. Unless poverty is improved, it is difficult to develop other social and environmental activities. Therefore, SDG1 is the goal with the most connections. When considering the SDG Index (SDGI) scores, it is uncommon to find another accomplished sustainable development goal other than SDG 1 in some countries. Based on this idea, there may be dilemmas about whether the index indicators developed for the SDGs make the measurements for the goals.

SDGs have been designed to cover all countries in the world, and in order to reach the 2030 targets, countries must be successful in the SEE dimensions. The SDGs do not distribute the weights of SEE indicators equally. In the 2017 SDG indicator distribution, the order of weight is social, economic, environmental, and governance dimensions, with the lowest weight (Diaz-Sarachaga et al., 2018). The SDGs and SDGI assign dimensions in a similar order of importance to countries. While developed countries focus on the environmental dimension, developing countries focus on social and economic dimensions for economic development (Swain, 2018).

The SDGI and sub-indices used in the measurement of SDGs were developed by the UN Sustainable Development Solutions Network (SDSN) and the Bertelsmann Foundation using data from 149 of the 193 UN member states in 2016 (Sachs et al., 2016). While the SDGs consist of 249 indicators, the SDGI consists of 125 indicators (Sachs et al., 2024). The decrease in the number of indicators used to measure the SDGs stems from the unmeasurable nature of some indicators or the ability to estimate multiple indicators in the SDGI using similar measurements. In short, these indicators are either consolidated into a single indicator or gathered under a single indicator. From a holistic perspective, gathering data for indicators that have an economic dimension is simpler than collecting data for social and environmental indicators because economic data is numerical.

Although the evaluation has been done at the country level in the annual Sustainable Development Report since 2016, some sub-indices are based on regional measurements. In order to calculate some indicators, such as SDG 10 in the SDGI, it is necessary to collect regional data, which is a measure of the actions of the responsible countries. However, the SDGI has turned out to be insufficient for regional measurements (Sachs et al., 2024). The difficulties in collecting and measuring indicator data that have a global impact, other than the indicators created on a country basis, cause a decrease in accuracy and

consistency in measurements (Moyer & Steve, 2020). On the other hand, the activities carried out by countries may affect the achievement of the SDGs of other countries. For example, environmental issues such as emissions from commercial activities, reduction of biodiversity, and groundwater affect not only the responsible countries but also the remaining countries (Schmidt-Traub et al., 2017).

Many indices, such as the SDGI, analyze on a country or regional basis. Currently, where globalization has become crucial, it is not enough to evaluate the responsibilities, efforts, and results of the countries' activities only within their borders. Although country borders are a concrete concept in terrestrial terms, they are abstract in diplomatic terms. However, difficulties arise because countries' responsibilities towards each other are complex. Although the SDGI and all other indices make country-wide evaluations, their purpose and results are due to a global challenge. In this case, science diplomacy helps solve existing difficulties. For example, climate change, ozone layer depletion, and global biodiversity are some of the global issues and the main targets of the SDGs, especially SDG 13, SDG 14, and SDG 15. Science diplomacy is required in the solution and functioning of issues such as collecting, sharing, and interpreting necessary scientific data and taking action on a global scale (Kökyay et al., 2023). Climate migrations caused by climate change may increase tensions between countries (Cole, 2015; Fuentes et al., 2023). There may be cross-country difficulties that may arise with energy transitions as a result of changing energy policies of countries with climate change and sustainable development (Fuentes et al., 2023; Koubi, 2019; Nordås & Gleditsch, 2015). In such international issues, taking political decisions and formulating public policies in which scientific evidence, technology, and innovation are considered, achieves a more perfect success with science diplomacy (Echeverria et al., 2020). Science diplomacy is when governments work together on science to solve issues and get along, which is crucial for achieving these objectives (Shrestha et al., 2022). Science diplomacy consists of three main dimensions: science in diplomacy, diplomacy for science, and science for diplomacy (Gluckman et al., 2017). The SDGs are interconnected with all of the science policy dimensions, since specific activities may be devised for each dimension. Considering this, a visual depiction of governmental initiatives to accomplish the SDGs (Echeverría et al., 2020). Science diplomacy is the use of scientific counsel to shape judgments in foreign policy, and it aims to promote and enable international collaboration in scientific endeavors (Kaltofen & Acuto, 2018). These elements jointly contribute to the advancement of the SDGs by promoting the sharing of information, encouraging innovation, and enabling partnerships across borders. Science diplomacy includes several important factors that help achieve the SDGs. Science in Diplomacy compiles and shares SDG-related scientific findings with policymakers to help them make informed choices. Researchers and networks may collaborate on SDG issues using this capability (Echeverría et al., 2020). Diplomacy for Science promotes SDG solution creation via researcher, professor, and student exchange programs. It also involves creating cooperative spaces, networks, and meetings to debate and exchange research projects, expertise, and help for Sustainable Development Goals projects (Echeverría et al., 2020). Science for Diplomacy helps researchers and specialists move to enhance national and international sustainable development initiatives. Science for Sustainable Development works with governments

on cooperative agendas to monitor and track sustainable development (Echeverría et al., 2020). This component requires coordination with international organizations to assess needs, obtain resources, and promote sustainable development. The integrated efforts show how scientific diplomacy and the SDGs promote a sustainable and equitable future (Ahmed et al., 2021; Fuentes et al., 2023). Extensive research has consistently shown a strong synergy between scientific policy and the SDGs. Science diplomacy facilitates international collaboration on scientific research, hence expediting the achievement of the SDGs. Science diplomacy plays a crucial role in bridging the divide between developing and developed countries, facilitating equitable development, and addressing the global disparities highlighted by the SDGs (Kaltofen & Acuto, 2018). It improves research and innovation by promoting cross-border partnerships, benefiting the economy, society, and environment (Gluckman, 2022). Scientific insights from international collaboration enhance policy design and execution, making policies more effective and sustainable. It helps governments solve difficult global issues by sharing information and expertise (Fedoroff, 2009). Harmonizing practices supports global norms and ensures nations work together to achieve development and sustainability objectives. Science diplomacy's integrative and collaborative approach promotes human growth, prosperity, sustainability, and inclusive wealth by fostering international collaboration, information exchange, and policy formulation (Fedoroff, 2009; Thompson, 2018). All these encouraging situations are aimed at increasing the tendency for SDGI scores to be higher.

The SDGI is based on factual data. The data collected for each SDGI indicator, which has 125 indicators applied to over 193 countries, is supposed to be updated. It ignores the advancements made by nations toward their 2030 targets because it is based on the latest data (Paoli & Addeo, 2019). In addition, there are difficulties in collecting accurate and complete data for the SDGI. The countries examined with the SDGI become measurable if they provide at least 80% of the necessary data (Sachs et al., 2024). Countries that fall below the 80% data supply threshold are generally underdeveloped and/or developing (Campagnolo et al., 2016; Swain, 2018). Specific methods for filling in data gaps have an impact on the accuracy of the findings (Sachs et al., 2024; Swain, 2018). For example, filling in the missing data of countries with less than 20% data deficiency reduces reliability. Therefore, it is more appropriate not to include countries with more than 20% missing data in the scoring, as it will not accurately represent the position of the countries on the path to sustainable development. Finally, one of the processes that contradicts the mission of the SDGI is its application to countries with a population of more than 1 million (Sachs et al., 2024). It is argued that countries with low population density should be included in the SDGI, which is accepted on a global scale (Diaz-Sarachaga et al., 2018).

In addition to the SDGI, there are various indices that examine the social, economic, and environmental dimensions developed by countries and organizations. In addition, some global indices are also used in sub-indices of the global SDGI, such as the Human Development Index (HDI), Sustainable Nitrogen Management Index (SNMI), and Corruption Perception Index (CPI). Considering the economic dimension, it is considered not to be sufficient to measure the welfare of a country based on the GNP. Assessing the

welfare of a country with its SEE dimensions gives more consistent and accurate results. For example, HDI focuses on a country's quality of life, education, and GNP with their social and economic dimensions (UNDP, n.d.; UNDP, 2020a). In the SDGI and Indicator Table General Report published in 2016, 149 countries were ranked according to their index score, and the countries ranked according to HDI were compared, and the correlation between them was examined (Sachs et al., 2016). It has been mentioned that countries with no correlation between them lack environmental dimensions. There is no comparison with the environmental indices that are not used in the SDGI in the environmental dimensions. HDI proves that SDG measurements are consistent and accurate. However, there are cases where the HDI is insufficient. The UN Environment's Inclusive Wealth Index (IWI) measures economic sustainability and national welfare (United Nations Environment Programme [UNEP], 2018). It provides more accurate and consistent results compared to HDI and per capita GDP. Although the HDI is the most common index, it is seen that it does not adequately evaluate human development and welfare. Social dimensions that are necessary for human development, such as poverty, income distribution, gender equality, housing, accessibility to public services, and human rights, are also not sufficient (Beslerová & Dzuričková, 2014). Indices such as the Gender Development Index (GDI), Gender Inequality Index (GII), Inequality Adjusted Human Development Index (IAHDI), Planetary Pressures Adapted Human Development Index (PPAHDI), and Multidimensional Poverty Index (MPI) created by the development of the HDI prove that the HDI is inadequate. Environmental Performance Index (EPI) indicators, which measure the environmental dimension of countries, are entirely related to the environment and nature, but there is a relationship between the EPI score and the countries' per capita GNP and inequalities. EPI scores show high performance in countries with high per capita GDP and low inequalities (Morse, 2018). The Social Progress Index (SPI), which is one of the indices representing the social and environmental pillars of sustainable development, examines the meeting of basic needs, the welfare level of the country, rights, and education. However, the adequacy of indicators belonging to categories such as "inclusiveness" that address inequalities on the way to index goals is a matter of debate (Stern et al., 2020).

In this study, the weak and strong points of the SDGI and the indicators of 4 global indices aiming to ensure and promote sustainable development were examined in terms of SEE dimensions, and the country communities were compared according to the index scores. First of all, the SEE dimensions of SDG and SDGI, their weights, and their relationship with each other were given, taking into account the criticisms in the literature. Afterward, the strengths and weaknesses of the indicators of the SDGI, their success, and their consistency in reaching their goals were analyzed. In addition, the strengths and weaknesses of 4 globally accepted indices serving the same purpose and dimensions, except for the sub-indices of the SDGI, were examined and compared with the SDGI. In addition, the scoring and indicators of the Sustainable Development Goals Index were examined and compared in all dimensions, as well as the scoring and indicators of other indices, to see whether there was consistency between each other. Furthermore, the findings were discussed and interpreted from the perspective of science diplomacy.

Methodology

In the study, a literature review was conducted on the SDGI and the indices that deal with the social, economic, and environmental factors of the countries used globally. When searching for relevant information, keywords such as "SDGI", "SDGI Indicators", "Indices for Sustainable Development", and "Measurement of Sustainable Development Goals" were applied. A total of 32 global indices serving the SEE fields used for sustainable development measurement were identified, and a deeper search was attempted for these 32 indices. Out of these indices, the 4 most up-to-date indices that encompass the social, economic, and environmental dimensions were selected for the analysis: i. Legatum Prosperity Index (LPI), ii. Inclusive Wealth Index (IWI), iii. Sustainable Society Index (SSI), iv. Planetary Pressure Adjusted Human Development Index (PPAHDI) (Table 1). The 4 indices and SDGI indicators are divided into social, economic, and environmental dimensions, and the 4 indices are matched with the targets of the SDGs (Figure 1). LPI, SSI, IWI, and PPAHDI were also investigated on an indicator basis and interpreted in general terms. Following the comparison between SDGI and 4 indices, the contribution of science diplomacy to the SDGs, SDGI and 4 indices was questioned and weaknesses were revealed in this framework.

17 out of 32 indices obtained from the literature were not included in the study due to a lack of updated reports, being included in the SDGI or missing data. The Corruption Perception Index, the Water Scarcity Index, the Press Freedom Index, the Financial Privacy Index, the Universal Health Coverage Service Index, the OECD Better Life Index, and the Sustainable Nitrogen Management Index were examined, but they were not included in the regional comparison since they are sub-indices of the SDGI. Since the last application of the Happy Planet Index was in 2016, the current reports of the Human Welfare Index, the Local Human Development Index, the Adapted Net Savings Index, the Human Sustainable Development Index, the Sustainable Economic Welfare Index, the Ecosystem Welfare Index, and the Human Welfare Index were not included in the study. Also, MPI was not included in the study because of missing data. The SDGI has social-economic-environmental dimensions and in order to make the comparison fair and equal, only 4 indices with social-economic-environmental dimensions out of the remaining 15 indices (i. Human Development Index, ii. Legatum Prosperity Index (LPI), iii. Environmental Performance Index, iv. Social Progress Index, v. World Happiness Index (WHI), vi. Index of Economic Freedom (IEF), vii. Gender Development Index, viii. Gender Inequality Index, ix. Ecological Footprint (EF), x. Human Development Index Adjusted to Planetary Pressures, xi. Inclusive Wealth Index, xii. Inequality Adjusted Human Development Index xiii. Energy Transition Index (ETI) xiv. Sustainable Society Index (SSI), xv. Living Planet Index (LPI*)) were used in the study.

Results

SDGI and Global Indices

SDGs and SDGI

The SDGI, created to measure whether countries have achieved the SDGs or not, consists of 17 goals and 125 indicators. 98 of the 125 indicators are global indicators. In addition, there are 27 indices available for OECD countries. Although the indicator numbers of the 17 goals are different from each other, each objective has equal weight. For example, 2017 SDGI indicators include 51% social, 30% economic, 14% environmental, and 5% governance dimensions (Diaz-Sarachaga et al., 2018). Therefore, the weight given to the social and economic dimensions in the indicators pushed the environmental dimension, which is very important on a global scale, to rank below other dimensions (Diaz-Sarachaga et al., 2018). Based on the assessments, as developing countries focus on enhancing their economies, they tend to develop social and economic dimensions rather than environmental ones (Swain, 2018). Therefore, goals with an economic dimension address both low-income and middle-income countries, while goals with an environmental dimension generally address developed countries. There are four critical limitations in the measurement of SDGs, which are defined as global goals. The first limitation of the SDGI, which aims to achieve global goals, is that it is applied only to countries with a population of more than 1 million (Sachs et al., 2024). Ignoring countries with a population of less than 1 million contradicts the ideology of the SDGs. Therefore, the SDGI should be applied to all countries for global sustainable development, regardless of population (Diaz-Sarachaga et al., 2018). The second limitation is that there is a chronological order to the data collected for the formation of the Sustainable Development Report. SDGI collects the most up-to-date data for the years close to the year in which the measurement was made (Sachs et al., 2016). However, not all of the data used for the SDGI is for 2024. For example, the data reference year corresponding to the first indicator of SDG1 is 2024, while the data reference year corresponding to the first indicator of SDG2 is 2021. Such differences in reference years may lead to inconsistencies (Sachs et al., 2024). In order to achieve the 2030 Agenda appropriately, development or regression trends can be observed in some indicators (Sachs et al., 2024). Therefore, the SDGI shows countries' current status instead of their progress on the path to achieving sustainable development (Paoli & Addeo, 2019). The third limitation is about gathering data from 193 countries. Approximately two-thirds of the data are collected from international organizations, and the rest is collected from household surveys such as the Gallup World Poll, civil society organizations, Geographic Information System (GIS), etc. (Sachs et al., 2024). In a word, the SDGI cannot be applied globally due to a lack of data. The SDGI requires that at least 80% of the data collected from each country be complete for the measurements to be consistent. Thereby, some countries are not included in the SDGI Report in annual measurements. For example, the 2024 SDGI was applied to 193 countries; however, 26 countries such as Libya, Eritrea, Monaco, and San Marino were not included in the scoring due to a lack of data (Sachs et al., 2024). Countries that are not included in the SDG Report on account of missing data are generally low-income and middle-income countries, and they lack hard data collection

(Campagnolo et al., 2016; Swain, 2018). Thus, the SDGI includes informal data for some indicators, the results of the surveys conducted by the institutions, and numerical estimations and models' outputs to eliminate the missing data (Sachs et al., 2024; Swain, 2018). Filling in missing data with different methods may cause inconsistencies in the measurements. While numerical estimations find values close to accurate results, there may be deviations in the estimates due to uncontrollable factors. In this case, the SDGI results may show some inconsistencies regarding the sustainable development processes of countries. There are some issues with the time management of the ongoing processes in the background of data collection for the SDGI of the countries. The processes of adding the collected data to the database and verifying them may take longer, which affects the evaluation phase (Sürdürülebilir Kalkınma için Küresel Amaçlar, 2019). The fourth limitation is that SDG scores from different years cannot be compared. The SDGI indicators undergo annual revisions; some indicators are removed, and new indicators are added. Therefore, it is not possible to make a comparison with the overall score (Sachs et al., 2024). However, comparisons can be made on an indicator basis.

The Sustainable Development Goals are based on three basic dimensions: i. social dimension: SDGs 1, 3, 4, 5, 11, and 16, ii. economic dimension: SDGs 8, 9, 10, and 17, and iii. environmental dimension: SDGs 2, 7, 12, 13, and 15 (Paoli & Addeo, 2019). SDG 6 "Clean Water and Sanitation" and SDG 14 "Life Below Water" were not included in this study because of insufficient data. Examining the targets and indicators of each goal, it appears that the interactions between them indicate a multi-faceted structure (Kroll et al., 2019; Paoli & Addeo, 2019). The order from the most interacting dimension to the least interacting dimension among the three dimensions is as follows: social, economic, and environmental (Le Blanc, 2015). The most connected to other goals are SDG 12 "Responsible Consumption and Production", SDG 10, SDG 1, and SDG 8 "Decent Work and Economic Growth" respectively. Examining the most connected goals, they seem related to the economic dimension and directly target economic growth. Among the least connected goals are SDG 7 "Affordable and Clean Energy," SDG 9 "Industry, Innovation and Infrastructure", and SDG 14. Assessing these connections, it was understood that SDGs do not belong to only one dimension, but indicators serve multiple dimensions (Le Blanc, 2015). For example, while SDG 13 "Climate Action" covers the environmental dimension, directly related to SDGs 2, 3, 6, 8, 9, 11, 14, and 15 and indirectly to SDGs 1, 10, 16, and does not achieve the climate action goals, each SDG associated with has negative impact from this case (Nyasimi & Peake, 2015). SDG 7 supports SDG 13. SDG 12 is associated with improving water quality by reducing the proportion of untreated water and chemical emissions (SDG 6.3), water scarcity (SDG 6.4), resource use in production and consumption, and decoupling economic growth from environmental impact (SDG 8.4) (Le Blanc, 2015). The relationship between SDGs and SDGs' targets is based on synergies and trade-offs. Looking at SDG 1 and SDG 12, which have the highest number of connections, SDG 1 has a synergistic relationship with the goals associated with, on the other hand, there are trade-offs between SDG 12 and the goals associated with it (Kroll et al., 2019). According to the World Happiness Report, looking at the relationship between 17 goals and well-being, SDG 12 and SDG 13 indicate trade-offs via a negative correlation with well-being in each region. Notably, the excessive waste production in developing

countries explains the inverse relationship with welfare (De Neve & Sachs, 2020). To reduce this negative correlation, or, in other words, to increase welfare, it is necessary to reduce the effects of waste and climate change.

The strong relationships between SDGs are similar in the data outputs obtained with the indicators in the SDGI. The SDGI, which consists of 125 indicators, is a global measurement, but the global measurements of some indicators are insufficient. Although the SDGI is applied on a country basis, other countries also have shares in SEE outputs. However, the fact that some indicators of the SDGI have regional characteristics and are not included in the evaluation process poses an issue in scoring. SDG 10 aims to eliminate inequalities both globally and nationally, and data and evaluation criteria are insufficient to measure inequalities experienced globally not country-based and cause inconsistencies in scoring (Moyer & Steve, 2020; Sachs et al., 2024). Comparing indicators of SDGs and SDGI indicators within the scope of SDG 10, the economic dimension of inequalities seems to be in the SDGI. However, the indicators of SDG 10 also measure the social dimension. It is necessary to generalize this issue to all indicators of the SDGI. The SDGI, which is used to measure global SDGs, should also have global indicators. For example, the environmental impacts of a product throughout its life cycle should not be evaluated on a country-wide basis. Although measurements are made on a country basis, there are examples where limited measurements are not sufficient and the effects are global. The fact that only the country where the measurement is made is responsible for the production and consumption of this product causes the accuracy of the outputs to be questioned. For example, the reduction of biodiversity is not only the responsibility of a country, but rather a global issue. Actually, the fact that the LPI* does not assess on a country basis proves this situation. Climate change is globally causing a decrease in biodiversity. Attributing this issue to only one country is like a reward for the remaining countries. In addition, multiple countries have contributed to the increase in trade-related emissions and the reduction of groundwater, and the indicators fall short of making this assessment (Schmidt-Traub et al., 2017). This situation is generally included under SDG 12. There are serious deficiencies in the SDGI, which measures SEE dimensions, because other countries also have responsibilities, but are ignored. Furthermore, by measuring the impacts of the accountable countries with indicators, country rankings may change.

Global Indices

Four indices, which are applied globally and have social, economic, and environmental dimensions similar to SDG, differ in indicator value intervals (Table 1). Score intervals were categorized as 0-1, 1-10, and 0-100 in the study**.** Although it has 3 dimensions in 4 indices, their weights are different based on the dimensions. The LPI and SSI are more focused on the social dimension, the IWI is more focused on the social-environmental dimension, and the PPAHDI is more focused on the economic dimension.

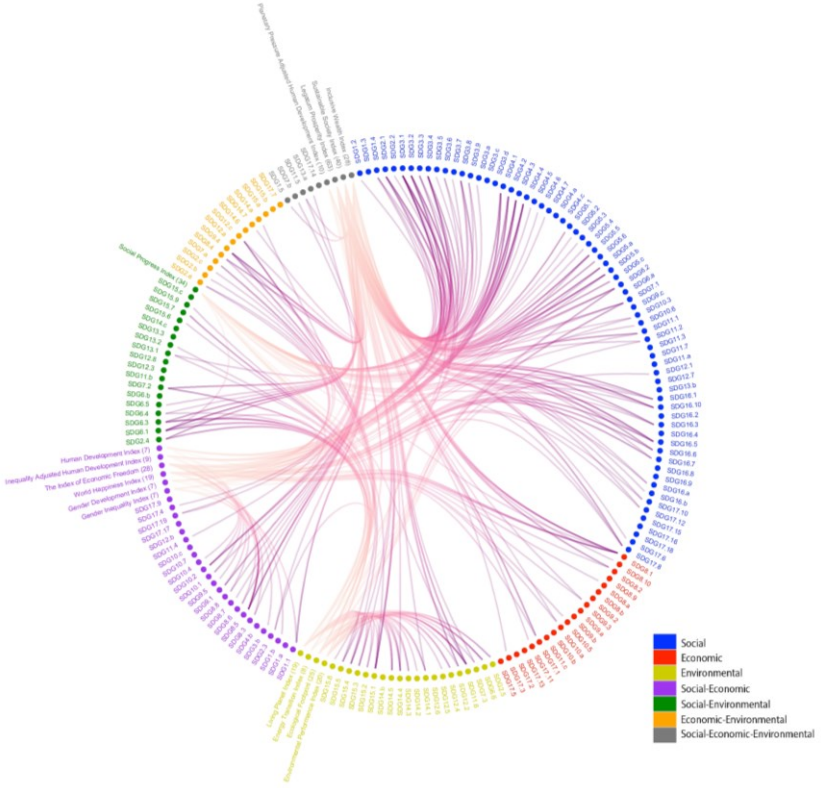
Table 1
Four Global Indices Examined in the Study and Their Definitions

Indices	Description	Score Interval
Legatum Prosperity Index (LPI)	LPI measures country prosperity with the dimension of SEE. Measuring Area: i. Inclusive Societies (i.e., Safety & Security, Personal Freedom, Governance, Social Capital), ii. Open Economies (i.e., Investment Environment, Enterprise Conditions, Market Access and Infrastructure, Economic Quality), iii. Empowered People (i.e., Living Conditions, Health, Education, Natural Environment) (Legatum Institute, 2023).	0-100
Sustainable Society Index (SSI)	SSI compares countries by analyzing countries' advancement and policies for sustainability. It analyzes three dimensions (i.e., Human Well-being, Environmental Well-being, and Economic Well-being) with 21 indicators (TH Köln, n.d.; van de Kerk & Manuel, 2012).	1-10
Planetary Pressure Adjusted Human Development Index (PPAHDI)	PPAHDI is an experimental index that adjusts the HDI for planetary pressures in the Anthropocene Epoch. Sub-indices: i. Production-based CO_2 Emissions per Capita, ii. Material Footprint per Capita, iii. HDI (UNDP, 2020b).	0-1
Inclusive Wealth Index (IWI)	IWI measures countries' economic sustainability and welfare. It focuses on in terms of the capital of manufactured, human, and natural (UNEP, 2018). The IWI supports countries to establish a policy by appraising the economic value of each system within national boundaries (UNEP, 2018).	--

A Critical Review of Globally Applied Indices With Three Dimensions

In the study, global indices were examined in social-economic-environmental dimensions. Components measured by 4 indices with different weights of social-economic-environmental dimensions and their indicators were matched with the targets of the SDGs, and 4 indices and the targets of the SDGs with equivalent dimensions were grouped (Figure 1). Indices with the same dimensions and the targets of the SDGs were classified. 68 of the targets of the SDGs have a social dimension. The targets of the SDGs have 24 social-economic, 20 economic, 20 environmental, 18 socio-environmental, 14 economic-environmental, and 5 social-economic-environmental dimensions. 118 of the 169 targets of the SDGs were matched with the indicators of global indices. The matched targets of the SDGs have 49 social, 18 environmental, 17 social-economic, 11 social-environmental, 10 economic, 8 economic-environmental, and 3 social-economic-environmental dimensions. The LPI, which has 3 dimensions, correlates with 63 targets of the SDGs and is one of the indices with the most connections.

Figure 1
The Targets of the SDGs Match with Global Indices. The Targets of SDGs and Globally Applied Indices were Classified in Social, Economic, Environmental, Social-Economic, Social-Environmental, Economic-Environmental, and Social-Economic-Environmental Dimensions



The PPAHDI, which was integrated with the HDI was developed because of the insufficient side of the environmental dimension via SDG 9.4, SDG 8.4 and SDG 12.2 (UNDP, 2020b). The PPAHDI measures sustainable development of the countries by using production-based CO_2 emission per capita, material footprint per capita, and 3 indices of the HDI. However, the LPI has shown a positive correlation with these factors, and it has been searching for an answer to similar questions (Legatum Institute, 2023). The LPI more clearly reveals the current situation of the countries on the path to provide welfare. Additionally, the LPI added an environmental dimension to measurements in 2016 by asserting that the environment is one of the key dimensions for welfare and economic profitableness (Legatum Institute, 2023). SSI is also one of the 3-dimensional indices. SSI with 21 indicators calculates welfare and sustainable development, observes the difference between them, and compares it to GNI (Kowalski & Veit, 2020).

Another index that measures the welfare of a country is the IWI. It asserts that the total capital of a country determines its welfare level. The IWI emphasizes natural resources such as forest, agricultural land, and wetland for sustainable development and appraises natural resources as having financial value. According to the IWI 2018, while the global

economy developed, 127 out of 140 countries experienced declines in their natural capital (UNEP, 2018). This means that forests, agricultural land, rivers and estuaries, the atmosphere and oceans, that is, natural capital, could not be protected by 127 countries. Population and its growth rate are the keystones that need to be paid attention to achieve the SDG. Solutions about how a country is sustainable by adding population emerge with the IWI (UNEP, 2018). Countries may achieve the 2030 target with the intended path to provide sustainable development, but the SDGs cannot measure whether social, economic, and environmental dimensions are sustainable in the long term or not. The IWI has been using data since 1990 in addition to up-to-date data. Thus, the IWI presents the opportunity to see and compare the progress of countries (UNEP, 2018). The increase in inclusive wealth, which is one of the IWI's categories, signifies that the SDGs will be sustainable (UNEP, 2018).

When examining the rankings of these indices, it is evident that they generally show similar results. Countries with high scores in these indices are typically developed European countries (Legatum Institute, 2023; UNDP, n.d.; UNEP, 2018; van de Kerk & Manuel, 2012). Considering the first 10 country rankings of LPI, they also seem to place in the top of the rankings for other indices. One common characteristic of these countries is their high GDP. This pattern holds the same, with some exceptions. For example, Denmark is considered a high quality of life, investments in education and innovation, strong economy, and social justice and equality. Thanks to these, it ranked first out of 167 countries in the overall LPI ranking (Legatum Institute, 2023). Similarly, Denmark maintained its top positions with very high scores in other indices such as PPAHDI and SSI (UNDP, n.d.; van de Kerk & Manuel, 2012). The similarity and the countries' level are not the same at the bottom of the rankings due to missing data. Besides, as a generalization, it can be said that, if a country's score is placed at the bottom of the LPI rankings, it could be similar to the other index rankings. To give an example, Afghanistan, placed in the last 10 rankings of the LPI, has one of the lowest scores of the PPAHDI, SSI notably for economic dimensions, one of the lowest scores of the IWI (Legatum Institute, 2023; UNDP, n.d.; UNEP, 2018; van de Kerk & Manuel, 2012).

Discussion and Conclusions

The concept of sustainable development, which came to the fore with the Brundtland Report in 1987, has become the focus of global societies. Various indices have been introduced to measure countries' sustainable development. The SDGs and global indices aiming at sustainable development have been classified in three main dimensions and by grouping these dimensions in seven different ways. In addition, it is stated that the SDGs and SDGI have a governance dimension (Diaz-Sarachaga et al., 2018). However, there are difficulties in separating social and governance dimensions from each other. Therefore, instead of examining the governance dimension as the fourth dimension, the inclusion of governance in the social dimension has facilitated the research.

Even countries with the best SDGI scores have not achieved success in all 17 SDGs. While the scores for some targets of the SDGs are lower, some are higher. In the global SDGI, in which 193 countries participated, only SDG 2 was not successful in any country. There

are countries that show a tendency towards success, but there are shortcomings. Because there are basic problems that can negatively affect other vital and social activities such as undernourishment, obesity, unsustainable agriculture, and unsustainable diets (Sachs et al., 2024). The fact that it is a problem for all countries and that SDG 2 is not successful while all other targets of the SDGs are improving may perhaps require different solution implementations. At this point, science diplomacy can accelerate the unity of countries and solve this issue. Because it is seen in 193 countries that the problems of undernourishment, obesity, unsustainable agriculture, and unsustainable diets can no longer be addressed as a country-based issue but as a global issue. By combining existing country-wide policies with science diplomacy, international policies can be created. Thanks to these international policies, countries may have the authority to take necessary actions in situations where each other is found inadequate. If political protocols are created from the beginning, thanks to science diplomacy, the process always progresses faster, in other words, solutions can be reached faster (Fuentes et al., 2023; Özkaragöz Doğan et al., 2020).

Examining the effects of science diplomacy in terms of all indices, they are getting different contributions. For the PPAHDI, science diplomacy supports governments to minimize their environmental footprint via coordinating research on environmental sustainability (Thompson, 2018; UNDP, n.d.). The LPI evaluates prosperity in many domains, including economic quality, government, education, health, safety, and the natural environment. Science diplomacy encourages economic development and a strong business environment by supporting collaborative studies. By enabling policymaking with evidence, the improvement of social trust and government practices could become easier (Legatum Institute, 2023; Thompson, 2018). For SSI, science diplomacy facilitates the exchange of the most effective methods and innovative concepts in the field of sustainability, promoting progress in renewable energy, sustainable agriculture, and conservation initiatives. It also facilitates the coordination of international norms and regulations, ensuring that nations collaborate towards shared sustainability objectives (Thompson, 2018; van de Kerk & Manuel, 2012). Considering the IWI, examples of impacts include promoting the growth of human resources via educational and training programs, as well as the protection and improvement of natural resources through environmental research and conservation initiatives (Thompson, 2018; UNEP, 2018).

Since the SDGs and targets are linked to each other, it is evident that the SDGs have multiple dimensions (Le Blanc, 2015). As shown in Figure 1, the targets of the SDGs were matched with global indices. This match revealed a global index that matched the targets of the SDGs across various dimensions. For example, SDG 2 is a goal that has an environmental dimension (Paoli & Addeo, 2019). However, the targets of SDG 2.a, 2.b, and 2.c measure economic and environmental dimensions. The target of SDG 12.b has a social and economic dimension, although SDG 12 is a goal with an environmental dimension (Paoli & Addeo, 2019). Regardless of the actual dimensions of the indices, other dimensions of the index are used as a means to achieve the goal. This case has shown that social, economic, and environmental dimensions serve and need each other in order to define sustainability.

When the SDGI was compared with the PPAHDI, LPI, IWI, and SSI, it was observed that these indices, which aim at sustainable development, have followed different paths. It is noteworthy that 63 targets are serving common goals between the LPI and the SDGs. The PPAHDI was connected to 10 targets of the SDGs. The LPI is the index with the highest links to the SDGs with its 3 dimensions. However, it would not be correct to say that the two indices are equivalent to each other because in both indices, some targets and indicators are dealt with in more detail than in the other. For example, 5 indicators that have the component of terrorism in the "safety and security" category in the LPI were used, but the SDGI does not include indicators about terrorism (Legatum Institute, 2023; Sachs et al., 2024). Furthermore, while the LPI measures the social dimension, it gives more attention to citizens' thoughts via the Gallup World Poll than the SDGI. When examining environmental dimensions, the SDGI has made more detailed examinations with indicators than the LPI. For example, the LPI did not mention indicators in the field of agriculture. Agriculture is a goal that needs to be assessed for countries. Therefore, the LPI remained weak in terms of the environmental dimension (Legatum Institute, 2023).

From a theoretical perspective, there is a lack of data on all indices, including the SDGs. It is the countries' responsibility to ensure that data is available, rather than institutions and organizations that have made measurements. Data obtained from index measurements have been investigated across the region and country in the literature. However, examining the components of the environmental dimension, such as biodiversity, greenhouse gas emissions, and natural resources country-wide, has been a matter of opinion. Environmental impacts considered in the indices occur due to social activities. These activities have not occurred within the borders of the countries, but the environmental success of some countries has been adversely affected because other countries have negative impacts on the environment (Schmidt-Traub et al., 2017). Biodiversity is a community that includes all living things and various ecosystems in different living quarters. Although countries are responsible for the factors that threaten life, the consequences are experienced on a regional scale. Thus, calculations are not made on a country basis. The issue of not including the interaction of environmental impacts with other countries is underlying the environmental dimension indicators of the SDG Index (Schmidt-Traub et al., 2017). From the perspective of science diplomacy, international unity and action are required. It is important for countries to share their data in order to obtain numerical data to determine to what extent the existing problem harms the environment, and to create policies together and solve them quickly, for non-border problems such as biodiversity and carbon emissions.

The three primary pillars of sustainable development are social, economic, and environmental development. All 3 development components are interdependent and in constant interaction. Economic power, a clean and sustainable environment are required for social welfare. Society and natural resources have important roles in economic development. Economic power and the support of social structures are necessary for a sustainable environment. Considering 3 basic development dimensions as a whole can only validate an index. Consistent and accurate reports and indicators can be obtained when these 3 dimensions are handled equally and fairly while conducting regional

studies. The SDGs support science diplomacy efforts through guidance, contributing to mutual development within a globally recognized framework with high impact. In return, science diplomacy can be considered as a fourth but comprehensive dimension. It is the support dimension to make countries more professional, faster and more global in terms of SEE. Global improvements may be seen when science diplomacy progresses while creating SDG targets. Notably, since the environmental dimension has more interaction between countries, not only one country but all countries should be examined in the measurements with science diplomacy.

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