REPORT

Three main dimensions reflected by national SDG performance

Xutong Wu,[1] Bojie Fu,[1,2,*] Shuai Wang,[1] Yanxu Liu,[1] Ying Yao,[1] Yingjie Li,[3] Zhenci Xu,[4] and Jianguo Liu[5]

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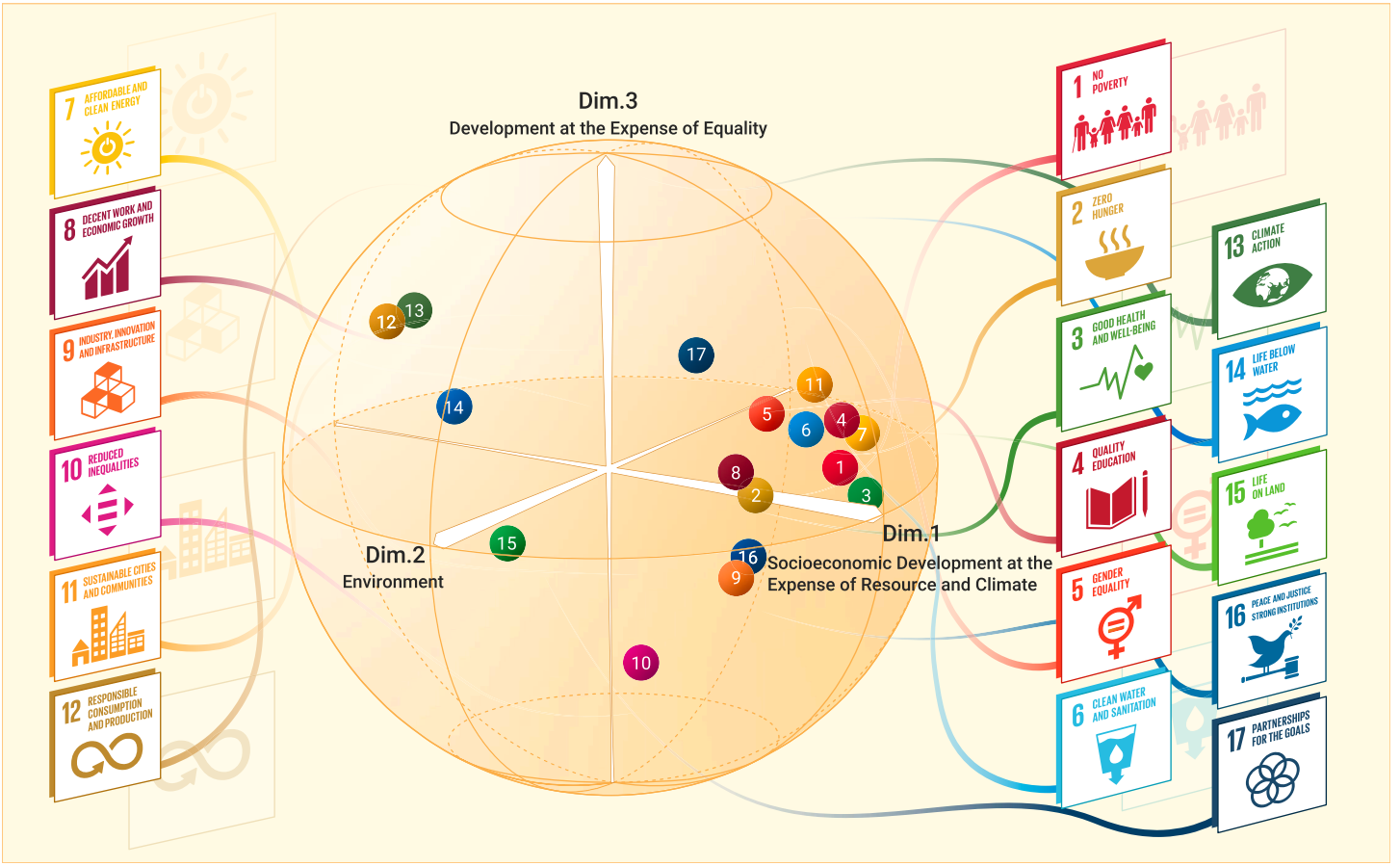
GRAPHICAL ABSTRACT



PUBLIC SUMMARY

- Three dimensions capture ~70% of the variability of national SDG performance.
- Economy is the main driver of the spatial variations of these dimensions.
- Systematic conflicts exist between economic growth and resource and climate goals.
- Sustainable transformation of the current development paradigm is urgently needed.

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Unraveling the complexity of the 17 interacting sustainable development goals (SDGs) is crucial for their achievement. Empirically revealing the dimensions of the SDGs helps generalize the dominant features of SDGs and better understand their drivers. Here, using a database of 166 countries' progress toward achieving each individual SDG, we found that about 70% of the variability of national SDG performance can be captured by three dimensions: socioeconomic development at the expense of resource and climate, the environment, and development at the expense of equality. Moreover, these dimensions are mainly affected by the economy; as gross domestic product (GDP) per capita increases, the first dimension increases monotonically, the environment dimension decreases and then increases, and the inequality dimension increases and then decreases. Our findings indicate a dim prospect of eventually achieving all SDGs because of the conflicts between economic growth and resource and climate goals under the current development paradigm, highlighting the importance of sustainable transformation.

INTRODUCTION

As human activities have become the leading force within the Earth system, we have entered the Anthropocene,[1–3] a new geological epoch accompanied by ecological and environmental problems that threaten human survival and sustainable development. To tackle the most pressing problems humanity faces, such as climate change, biodiversity loss, land degradation, poverty, and inequality, the United Nations (UN) adopted the 2030 Agenda for Sustainable Development in 2015, offering a shared blueprint for joint sustainable actions for all countries.[4] At the heart of the agenda are the 17 ambitious sustainable development goals (SDGs), which cover 169 targets and 231 unique indicators and point out critically important areas for peace and prosperity for people and the planet now and into the future.[4] Regrettably, the world is currently off course for achieving the 17 SDGs by 2030, and urgent action is required to address the cascading and interlinked crises dominated by pandemic, climate change, and conflicts.[5,6] Because the 17 SDGs are integrated, indivisible, and interact in complex ways,[7] it is crucial to approach the design and implementation of relevant policies and measures from a holistic and systematic perspective.[8]

The complexity in achieving the 17 SDGs has been unraveled to some degree by classification of SDGs based on their interlinkages.[9] The UN addresses the three pillars of sustainable development: economic, social, and environmental. Such thought is also reflected in the SDG "wedding cake" conceptualization presented by the Stockholm Resilience Center,[10,11] which shows that economies (SDGs 8–10 and 12) are embedded in societies (SDGs 1–5, 7, 11, and 16), societies are embedded in the biosphere (SDGs 6 and 13–15), and achievement of sustainability requires partnerships (SDG 17). From the perspective of achieving maximum benefit with minimum input through appropriate governance measures, the 17 SDGs can be clustered into three categories: essential needs (SDGs 2, 6, 7, 14, and 15), objectives (SDGs 1, 3–5, 8, 10, and 16), and governance (SDGs 9, 11–13, and 17).[9] Although these classifications have been widely used in SDG studies,[12–15] the combinations of different SDGs are relatively conceptual and based on expert knowledge and have therefore only been treated as predefined categories without quantitative information.

The empirical and quantitative understanding of the interlinkages and integrated nature of the SDGs is a key focus in SDG research.[16] Dimensionality reduction methods, such as principal-component analysis (PCA) and multiple-factor analysis (MFA), provide effective tools for extracting the dominant features from high-dimensional data while retaining trends and patterns, making the data more easily accessible for analysis.[17] Previous studies have utilized these methods to measure the performance of individual goals and overall sustainability using SDG indicator data.[18–20] They have also been employed to identify the principal indicators and simplify the SDG indicator system.[21,22] Furthermore, these methods have been used to analyze the correlations between SDG indicators, identify the primary components represented by the indicators,[16] quantify the synergies and trade-offs between different predefined SDG categories,[15] and analyze the axes of global progress within these categories.[23] However, these studies primarily focused on measuring SDG performance and SDG interactions and were typically conducted at the indicator level, leaving the main dimensions reflected by goal-level performance largely unexplored. Empirically revealing the dimensions of the SDGs can provide a more comprehensive and broader understanding of their interlinkages,[7] enable quantitative generalization of the dominant characteristics of the SDGs, and facilitate a clearer analysis of their drivers.

To fill this knowledge gap, this study addresses three major questions. First, what are the main dimensions reflected by the 17 SDGs? Second, how do these dimensions vary among different countries? Third, what factors influence these variations? To answer these questions, we used PCA to analyze 166 countries' SDG data (Figure S1) from the Sustainable Development Report 2020,[24] a widely recognized and utilized global dataset that provides scores for each of the 17 goals,[25,26] to reveal the main dimensions reflected by national SDG performance. We further analyzed the spatial variation of these dimensions and employed random forest analysis to explore the main drivers behind their variations. Our findings will simplify the inherent complexity of the 17 interacting SDGs and provide insights for broader governance of sustainable development.

RESULTS

Three main dimensions reflected by the 17 SDGs

The key dimensions reflected by the 17 country-level SDG scores were identified by PCA (see material and methods for more details). The first three principal components of variation explain 69.1% of the spatial variation of national SDG performance (Figures 1A and S2). Dimension 1 (Dim1) explains 52.5% of the variance and reflects socioeconomic development at the expense of resource and climate. SDGs 1 (no poverty), 2 (zero hunger), 3 (good health and well-being), 4 (quality education), 5 (gender equality), 6 (clean water and sanitation), 7 (affordable and clean energy), 8 (decent work and economic growth), 9 (industry, innovation, and infrastructure), 11 (sustainable cities and communities), and 16 (peace, justice, and strong institutions) positively contribute to the first dimension (Figure 1), indicating the synergies among these SDGs. However, SDGs 12 (responsible consumption and production) and 13 (climate action) contribute with negative loadings, reflecting the systematic conflicts between these two SDGs and the SDGs mentioned above. Dim2 explains 9.4% of the variance and is dominated by the environment because SDGs 14 (life below water) and 15 (life on land) positively contribute to it. Dim3 explains 7.2% of the variance and refers to development at the expense of equality. SDG 10 (reduced inequalities) contributes most to Dim3 with negative loadings.

Spatial variation of the three identified dimensions

The three identified dimensions show significant spatial differences across geographic regions (Figure 2). The dimension of socioeconomic development at the expense of resource and climate shows the highest values in European and North American countries as well as in Australia and New Zealand and the lowest values in countries in sub-Saharan Africa. East and Southeast Asian countries rank the second highest in this dimension, while the values of other regions are similar. In the environment dimension, European and North American countries have the highest values; sub-Saharan African countries also show

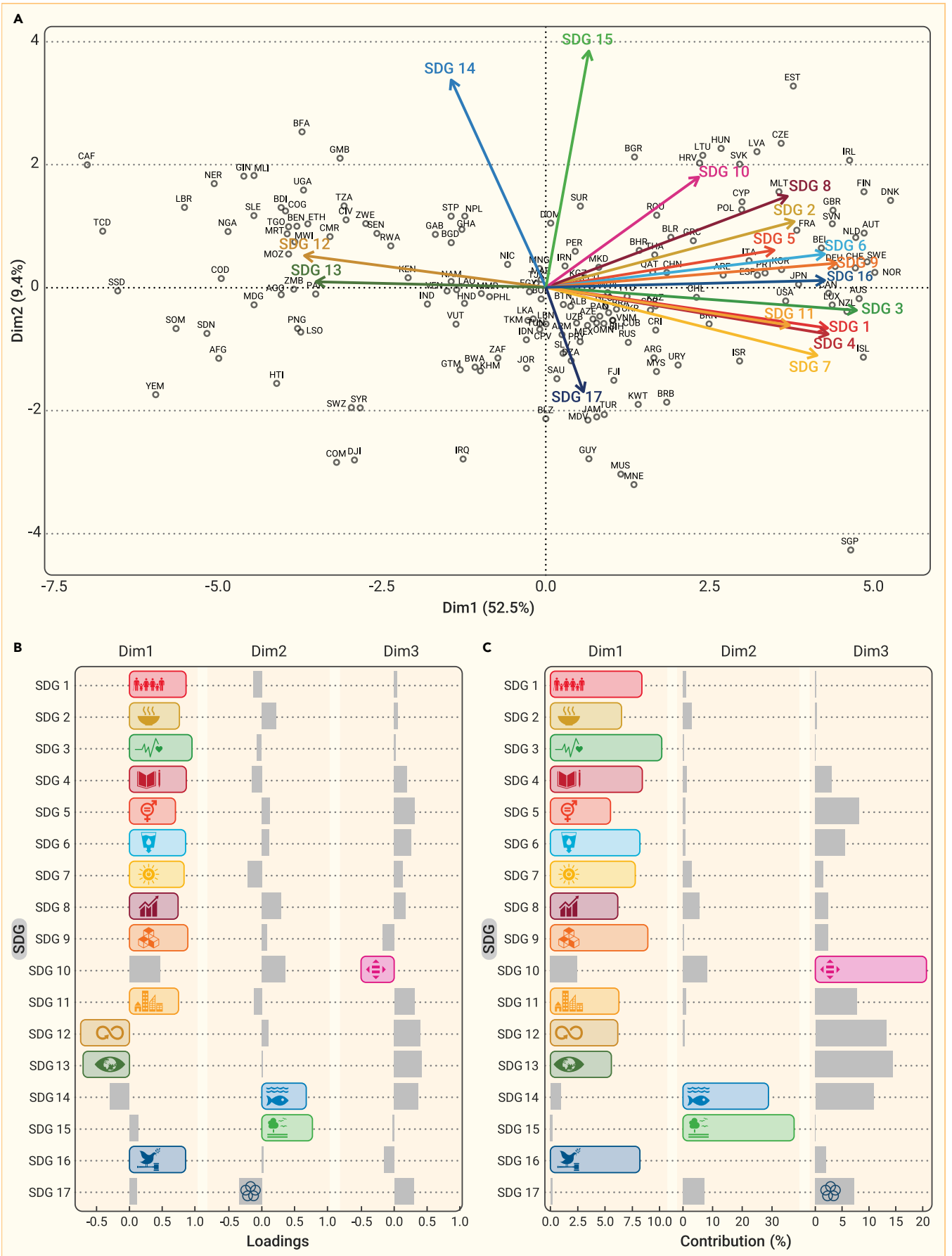


Figure 1. Main dimensions reflected by country-level performance on the 17 SDGs (A) Biplot of the principal-component analysis (PCA) results. The full names and PC values of the countries are shown in Table S1. (B) Loading of each SDG to each dimension. (C) Contribution of each SDG to each dimension. Non-gray bars indicate SDGs with significant loadings (i.e., with an absolute value greater than 0.5).

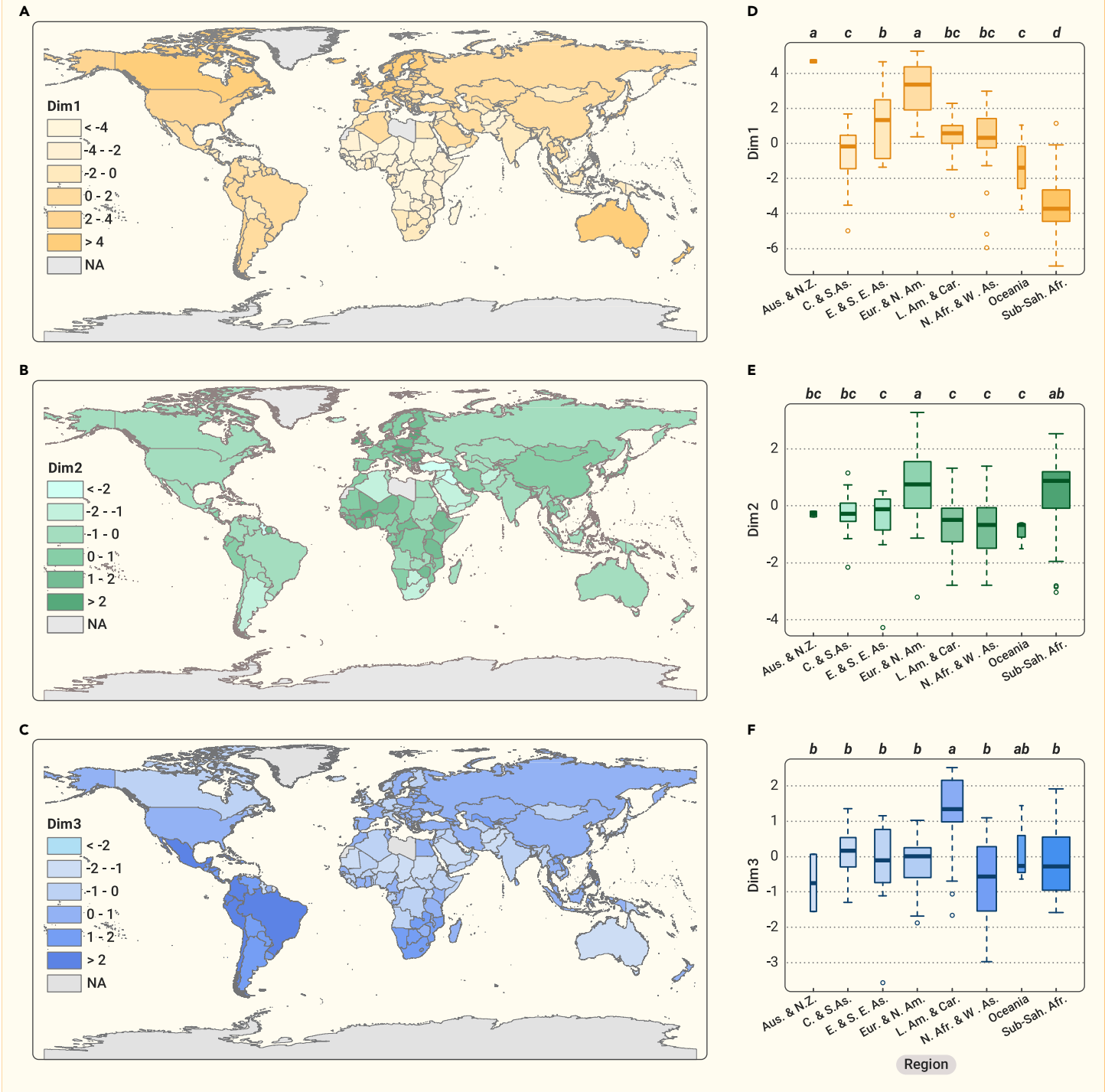


Figure 2. Spatial variation of the dimensions (A–C) The spatial variation of Dim1, Dim2, and Dim3. (D–F) Comparison of different regions for Dim1, Dim2, and Dim3. Regions with different letters at the top of boxplots differ significantly ($p < 0.001$). Countries included in each region are shown in Table S1.

values that are significantly higher than countries in East and Southeast Asia, Latin America and the Caribbean, North Africa and West Asia, and Oceania. Latin American and the Caribbean countries have the highest values in the dimension of development at the expense of equality, while there are non-significant differences among the other regions.

Potential influencing factors of the three identified dimensions

The influence and relative importance of multiple socioeconomic and environmental factors on the spatial variability of the three dimensions were explored by random forest analysis (Figures 3 and S3–S5; see material and methods for more details). The selected variables explain 86.2%, 24.9%, and 46.6% of the variability of Dim1, Dim2, and Dim3, respectively (Figure 3). All of the dimensions are mainly explained by gross domestic product (GDP) per capita, but its influence varies for the different dimensions. As GDP per capita increases, the socioeconomic development dimension (Dim1) increases monotonically, the environment dimension (Dim2) shows an overall trend of decreasing and then increasing, and the inequality dimension (Dim3) shows the opposite trend of increasing and then decreasing. Some environmental factors, such as temperature and precipitation, are also among the top three predictors, but there is little difference between their importance and that of the other factors.

DISCUSSION

This study identified the three main dimensions reflected by the performance of 166 countries in the 17 SDGs: socioeconomic development at the expense of

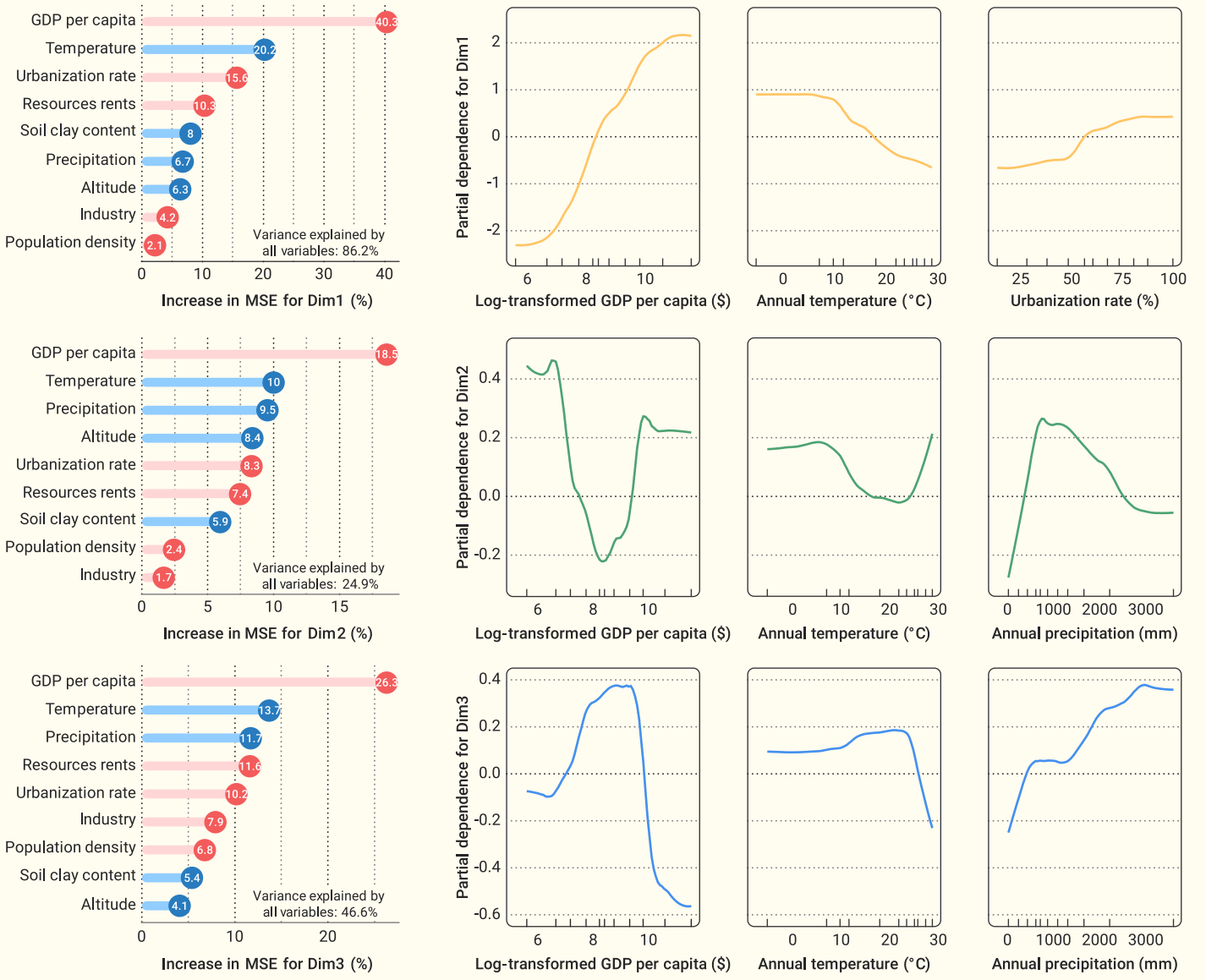
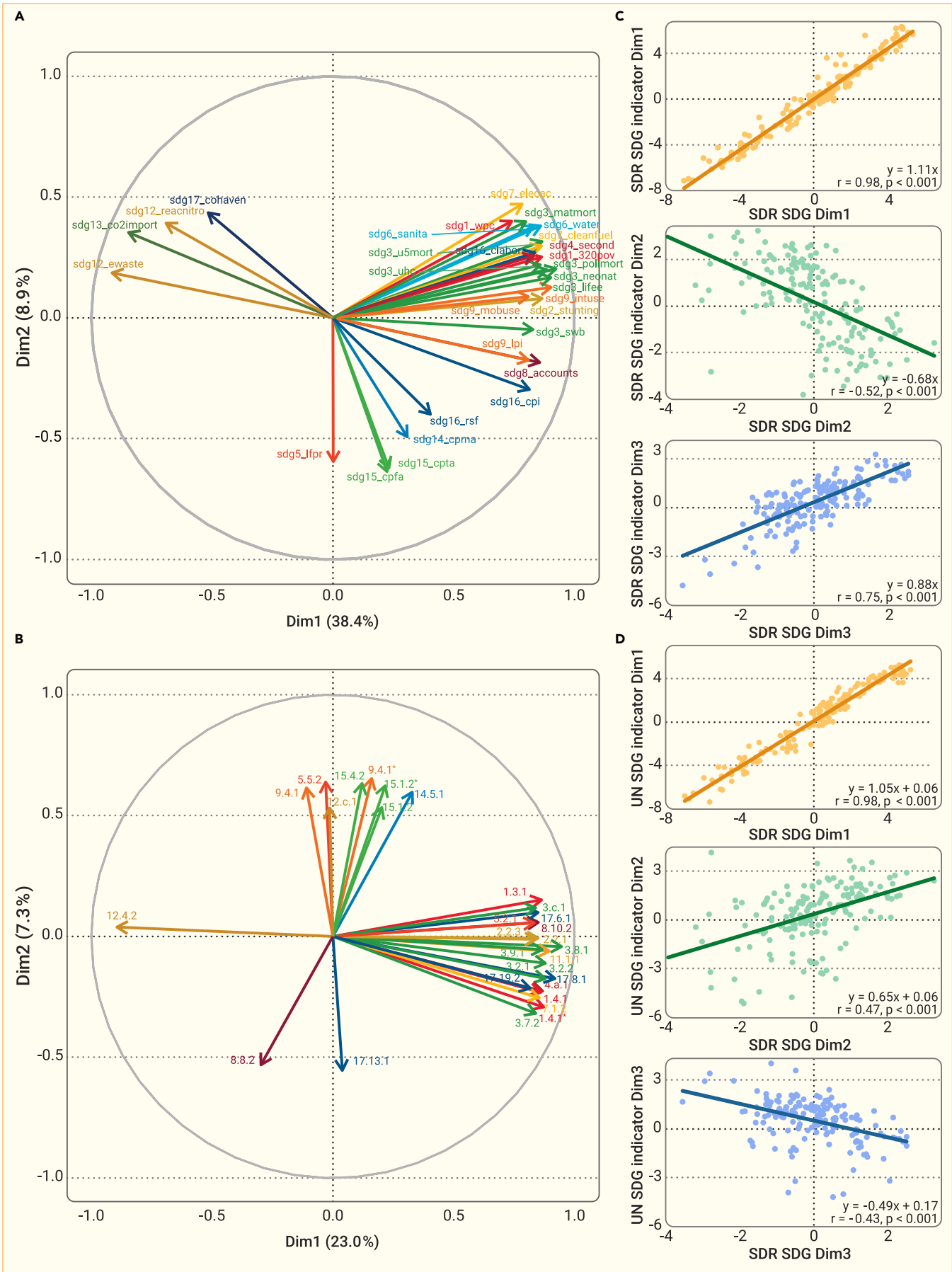


Figure 3. Importance of socioeconomic and environmental variables and partial dependence plots of the three most important variables for each dimension The increase proportions of mean squared error (MSE) are shown as numbers in circles. Red circles represent socioeconomic variables, and blue ones represent environmental variables. Tick marks on the x axis represent the distribution of each variable.

resource and climate, the environment, and development at the expense of equality. Variations of these dimensions are mainly explained by the economy, as represented by GDP per capita. By unraveling the complexity of the 17 interacting SDGs, this study provides a clear and simple way to characterize sustainable development performance and explore the underlying mechanisms. It also lays the foundation for sustainable governance and transformation based on this new understanding.

The three dimensions were identified using SDG data from the Sustainable Development Report 2020;[24] however, the selection of indicators and measuring methods may lead to different evaluations of SDG performance and then different findings.[27] To validate the reliability of our findings, we conducted MFA at the indicator level using two datasets: the SDG indicator dataset from the Sustainable Development Report 2020 (Tables S2) and an additional dataset from the UN SDG Global Database (Tables S3). Unlike PCA, MFA takes into account the varying number of indicators associated with each SDG. The first three dimensions explain 53.1% (Dim1_SDR, 38.4%; Dim2_SDR, 8.9%; Dim3_SDR, 5.7%) and 35.0% (Dim1_UN, 23.0%; Dim2_UN, 7.3%; Dim3_UN, 4.7%) of the variance, respectively (Figures 4A and 4B). Consistent with the dimensions identified at the goal level, the socioeconomic SDGs and SDGs 14 and 15 contribute the most to Dim1 and Dim2 in both datasets, respectively (Figures S6 and S7). Although the contribution of SDG 10 to Dim3 at the indicator level is not as prominent as at the goal level, its indicators still rank among the top 10 contributors for Dim3 in both datasets (Figures S8 and S9). For Dim1, indicators related to the socioeconomic SDGs show a strong positive contribution, while indicators sdg12_ewaste and sdg13_co2import negatively contribute to Dim1_SDR, and indicator 12.4.2 (hazardous waste generated per capita) for responsible consumption and production negatively contributes to Dim1_UN (Figures 4A, 4B, S8, and S9). Dim2 at the indicator level still primarily reflects the environment dimension because several environmental indicators strongly contribute to Dim2_SDR and Dim2_UN. Despite differences in indicators and rescaling methods used, all three dimensions at the indicator level are significantly ($p < 0.001$) correlated with their corresponding dimensions at the goal level (Figures 4C and 4D). These analyses demonstrate the robustness of our findings and support the interpretations of the identified dimensions.

Identification of the dimensions and analysis of their influencing factors based on comparisons among global countries cover the entire development spectrum because one country generally follows the development path of others.[28] By linking the spatial variations of the identified dimensions to the per-capita GDP of different countries, our findings can reveal the influence of the current economic development paradigm on sustainable development. The monotonic increase of



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Dim1 with per-capita GDP indicates that most socioeconomic SDGs and economic growth can be pursued in parallel.[29] Nevertheless, SDGs 12 and 13 exhibit negative contributions to Dim1, indicating that the observed monotonic increase also signifies adverse associations between the current economic development paradigm and responsible consumption and production as well as climate action. Previous studies have shown that economic growth on the current path will generate more human welfare (e.g., better health and nutritional status, higher quality education, and cleaner water provision) but will also cause larger material and environmental footprints and higher greenhouse gas emissions,[30–32] which is consistent with the relationships between economic growth and the first dimension. The trends of the environment (decreasing and then increasing) and inequality (increasing and then decreasing) dimensions, along with per-capita GDP, are consistent with the environmental Kuznets curve[33] and the Kuznets curve[34,35] theories, respectively. According to these theories, during early development of an economy, the focus is on economic growth, not environmental protection, and the benefits of growth tend to accrue primarily for the wealthy, leading to increasing environmental degradation and income inequality. As development continues, people begin to value the environment more, and investment in environmental protection measures and technologies increases, the middle class grows, and social welfare programs expand, leading to a reduction in environmental degradation and income inequality.[33–35] It is crucial to acknowledge that our analyses are derived from cross-sectional data. Further research and analysis of temporal data will provide a more comprehensive understanding of the aforementioned relationships and their dynamics over time.

Our findings show that the current economic development paradigm is expected to eventually achieve most socioeconomic SDGs (SDGs 1–9, 11, and 16) and ensure the ultimate realization of environmental and social equality goals despite the initial deterioration. Unfortunately, the irreconcilable conflicts between economic growth and resource and climate goals (SDGs 12 and 13) make the prospect of achieving all 17 SDGs dim. Sustainable transformation of the existing development paradigm is urgently needed to resolve these systematic conflicts as well as avoid environmental degradation and social inequalities throughout the development process.[36–38] Such transformation calls for intensified and effective collaborations between governments, public organizations, the private sector, and civil society, highlighting the importance of SDG17 (partnerships for the goals).[37,39–41] The concepts of circularity and decoupling without lowering human well-being, which can change patterns of consumption and production, are at the core of such transformation.[39] Circularity promotes reuse and recycling of materials[40] and can be applied in the design and management of resource flows in cities,[42] management of livestock and food loss or waste in agriculture and food systems,[43] and reuse and extension of service life through repair, remanufacture, upgrades, and retrofits in industrial ecosystems.[40] Decoupling requires decarbonization that sustainably reduces and compensates for greenhouse gas emissions,[39] dissociation of net release of pollutants from human well-being,[44] and decoupling of land, freshwater, and non-renewable resource use from socioeconomic progress.[45] Achievement of circularity and decoupling relies on the advancement of new technologies, forms of governance, and business models.[39,40] The fourth industrial revolution and the underlying digital transformation, known as Industry 4.0, holds the potential to enhance corporate profitability, optimize resource utilization, reduce emissions, facilitate the transition to zero-carbon energy systems, monitor and protect ecosystems, promote circular economy and decoupling, and play other crucial roles in supporting the SDGs.[39,46–48] Adoption of innovative business models that connect an organization's purpose and strategy, while aligning with the SDGs and encompassing digital transformation, can simultaneously deliver performance and ensure transformation, creating enduring value for key stakeholders and achieving remarkable results.[49]

It should be noted that the present study has some limitations. Although the comparisons of PCA results based on Sustainable Development Report SDG data and MFA results based on two SDG indicator datasets demonstrated the reliability of the identified dimensions, these analyses used a limited number of indicators (<130) because of data availability. For SDG 14, the Sustainable Development Report 2020 provides scores for only 126 non-landlocked countries. We chose to retain this SDG and impute the scores for the remaining countries (see material and methods for more details) because our primary objective is to comprehend the complex interconnections among all SDGs. However, this process might influence the precise assessment of SDG 14's contributions to various dimensions on a global scale, emphasizing the importance of identifying more metrics in the future to evaluate the impact of landlocked countries on oceans.[24] Our understanding of the dimensions of SDGs may evolve as more SDG indicators and temporal data become available. For clarity, only three PCs that minimize redundancy and loss of information were used, leading to SDG 17 (partnerships for the goals) being excluded in the identified dimensions, but SDG 17 contributed more than half to the fourth PC (data not shown). The relative independence of SDG 17 has also been found in other studies.[10,25] This study only considered domestic factors as influencing factors of the dimensions, although cross-border telecoupling factors such as trade and tourism also affect SDGs.[50–52] Future research should examine impacts of telecoupling factors, such as technology transfer, investment, water transfer, waste transfer, knowledge transfer, human migration, disease spread, and information dissemination.[53]

In conclusion, this study provides an empirical understanding of the complexity of the 17 interacting SDGs by identifying the three main dimensions reflected by national SDG performance. Economic growth is the main driver of variation, and although the current economic development paradigm is expected to eventually achieve most SDGs, it cannot achieve all of them because of the conflicts between economic growth and resource and climate goals, highlighting the importance of sustainable transformation.

MATERIAL AND METHODS

National SDG data

The performance of 166 countries on the 17 SDGs was obtained from the Sustainable Development Report 2020,[24] published by the Sustainable Development Solutions Network and the Bertelsmann Stiftung. It is a well-recognized and widely used global dataset at the whole-goal level.[25,26] In the report, each country's progress toward achieving each individual SDG is described with a score, which represents a percentage of optimal performance. Although a report was published annually from 2017 to 2022, SDG scores cannot be compared among the different years because of changes in the indicators and refinements of the methodology.[24] Given that the Sustainable Development Report 2020 has the greatest number of countries, we chose it for use in this study. A total of 115 indicators (85 global indicators and 30 indicators added specially for Organization for Economic Co-operation and Development [OECD] countries) were used to generate comparable scores in this report. Extreme values were censored from the distribution of each indicator, and the data were then rescaled from 0–100 to ensure comparability across all indicators. The scores for each goal were calculated as the arithmetic mean of the corresponding indicators. The raw indicator data underwent extensive and rigorous data validation processes, mainly from the World Bank, Food and Agriculture Organization, World Health Organization, UN Children's Fund, OECD, and other international organizations.

To ensure the robustness of the identified dimensions based on the 17 SDG scores, we conducted validation at the indicator level using the SDG indicator dataset from the Sustainable Development Report 2020 and an additional dataset from the UN SDG Global Database. This validation aimed to assess the impact of different measurement methods and indicator selections on our main findings. The UN SDG Global Database provides data on more than 210 SDG indicators for a total of 261 countries and areas between 1960 and 2022 (accessed in October 2022). The database is generated based on the official global indicator framework for SDGs from the Inter-Agency and Expert Group on SDG Indicators, which includes 231 unique indicators. For some indicators, the dataset provides sub-indicators disaggregated by sex, age, rural/urban area, etc. However, we only used aggregated (i.e., both sexes, all ages, and all areas) values for these indicators to ensure that all SDG indicators in the analysis had the same weight. Because of data limitations, complete indicator time series are unavailable for all time steps and countries. To ensure consistency in terms of the research period and to include as many indicators as possible, we selected available data for the period 2015–2020 and used the value from the nearest year to 2020 for each indicator to conduct a cross-sectional analysis. Only indicators that cover more than 70% of the UN member states and member states that have data for more than 70% of the indicators remained, resulting in a total of 125 indicators and 181 countries included in this study.

Figure 4. Comparisons between the dimensions identified by the Sustainable Development Report (SDR) SDG data and the dimensions identified by SDR SDG indicator data and UN official SDG indicator data (A) Biplot of the multiple-factor analysis (MFA) results using SDR SDG indicator data. (B) Biplot of the MFA results using UN official SDG indicator data. Only the top 20 and 10 contributing indicators for Dim 1 and Dim 2 are shown, respectively. (C) Relationships between the identified dimensions using SDR SDG and indicator data. (D) Relationships between the identified dimensions using SDR SDG and official indicator data. Details of each indicator are shown in Tables S2 and S3.

Identification of main dimensions of national SDG data

PCA has been used to identify the fundamental axes of plant form and function,[54] the dimensions of the terrestrial biosphere state,[55] and the key axes of terrestrial ecosystem function[56] and to better understand the driving mechanisms of their variabilities.[56] We performed PCA on the goal-level SDG data using the PCA function in the FactoMineR package[57] in R to identify the main dimensions. Each variable was centered on its mean and scaled by its variance. The ade4 package[58] in R was used to determine the number of significant components retained. This package allows us to test the significance of PCA dimensionality and has been used in other studies about plant traits[54] and ecosystem functions.[56] The method is based on computation of the RV coefficient. The number of retained components to minimize redundancy and loss of information was three. We extracted the explained variance of each PC and the SDG loadings (which indicate the contribution of each SDG to each PC) from the PCA results. The significance of the PCA loadings was tested by the threshold method. If the absolute value of the loading was larger than 0.5,[59] then it was considered significant.

Because of data limitations, there are missing scores for SDGs 1, 4, 10, and 14 for 12, 2, 17, and 40 countries, respectively (Figure S1). They were imputed with the imputePCA function in the missMDA package[60] in R, which imputes the missing entries of mixed data using the regularized iterative PCA algorithm. The algorithm first imputes the missing values with initial values (the means of each variable), then performs PCA on the completed dataset, imputes the missing values with the reconstruction formulae, and iterates until convergence.[60] To assess the reliability of our findings based on the imputed SDG scores, we conducted a separate PCA using only 108 countries that have complete data without any missing SDG scores. The three dimensions identified using the non-imputed national SDG performance exhibit similar characteristics to those identified using the imputed scores (Figure S10), and the corresponding dimensions show a high level of consistency (with correlation coefficients exceeding 0.9 for all three pairs, Figure S11).

At the indicator level, the main dimensions of SDG data were identified using MFA, an extension of PCA that is well suited for analyzing tables with observations or individuals across different groups of quantitative variables.[61] The MFA analyses were performed using the MFA function in the FactoMineR package[57] in R. Missing values were imputed using the imputeMFA function in the missMDA package[60] in R, which employs an approach similar to the imputePCA function, with the exception of utilizing the regularized iterative MFA algorithm. In the MFA analysis, the values of SDG indicators were multiplied by 1 when an increase was desirable and −1 when a decrease was needed to achieve the SDG.

Influencing factors analyses

Several socioeconomic and environmental variables were selected to analyze the potential influencing factors of the identified PCs of national SDG data. The socioeconomic data for each country were obtained from the world development indicators of the World Bank, which contain GDP per capita and gross national income, the ratios of value added of different industries (i.e., agriculture, forestry, and fishing; industry; and services) to GDP, the ratio of total natural resources rents to GDP, population density, and urbanization rate in 2020. The environmental variables include average precipitation, temperature, altitude, and soil clay content for each country, calculated based on the Climatic Research Unit gridded Time Series (CRU TS 4.04), the Global 30 Arc-Second Elevation Dataset (GTOPO30), and the Regridded Harmonized World Soil Database v.1.2, respectively. We calculated the variance inflation factor (VIF) of each variable and excluded variables with a VIF greater than 5 to avoid multicollinearity. Only GDP per capita, the ratio of value added of industry to GDP, the ratio of total natural resource rents to GDP, urbanization rate, population density, precipitation, temperature, altitude, and soil clay content remained after this exclusion process.

To identify the variables contributing most to the PCs' variabilities, we conducted a random forest analysis. The importance of the variables was measured by the increased proportion of mean squared error; a higher value means a more important variable. The partial dependencies of variables were used to assess the relationships between the socioeconomic and environmental variables and the PCs and computed by the pdp package[62] in R. The results can reflect the effects of individual variables on the PCs without the other variables' influence. To reduce the risk of interpreting the partial dependence plot outside the data's range (extrapolation risk), the partial dependencies were calculated restricted to the values within the convex hull of their training values.[56]

DATA AND CODE AVAILABILITY

All of the data used in this paper can be obtained from the Sustainable Development Report (https://www.sustainabledevelopment.report/), the SDG Global Database of the UN (https://unstats.un.org/sdgs/dataportal), the World Bank World Development Indicators (https://databank.worldbank.org/reports.aspx?source=world-development-indicators), the Climatic Research Unit gridded Time Series (https://crudata.uea.ac.uk/cru/data/hrg/), the Global 30 Arc-Second Elevation Dataset (https://webmap.ornl.gov/ogc/dataset.jsp?ds_id=10003), and the Regridded Harmonized World Soil Database v.1.2 (https://daac.ornl.gov/SOILS/guides/HWSD.html). All computer code used in conducting the analyses summarized in this paper is available from the corresponding author upon reasonable request.

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AUTHOR CONTRIBUTIONS

B.F. and X.W. designed the research. X.W. and Y.Y. performed the data analysis. All authors contributed to interpretation and writing.

DECLARATION OF INTERESTS

The authors declare no competing interests.

SUPPLEMENTAL INFORMATION

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Supplemental Information

Three main dimensions reflected by national SDG performance

Xutong Wu, Bojie Fu, Shuai Wang, Yanxu Liu, Ying Yao, Yingjie Li, Zhenci Xu, and Jianguo Liu

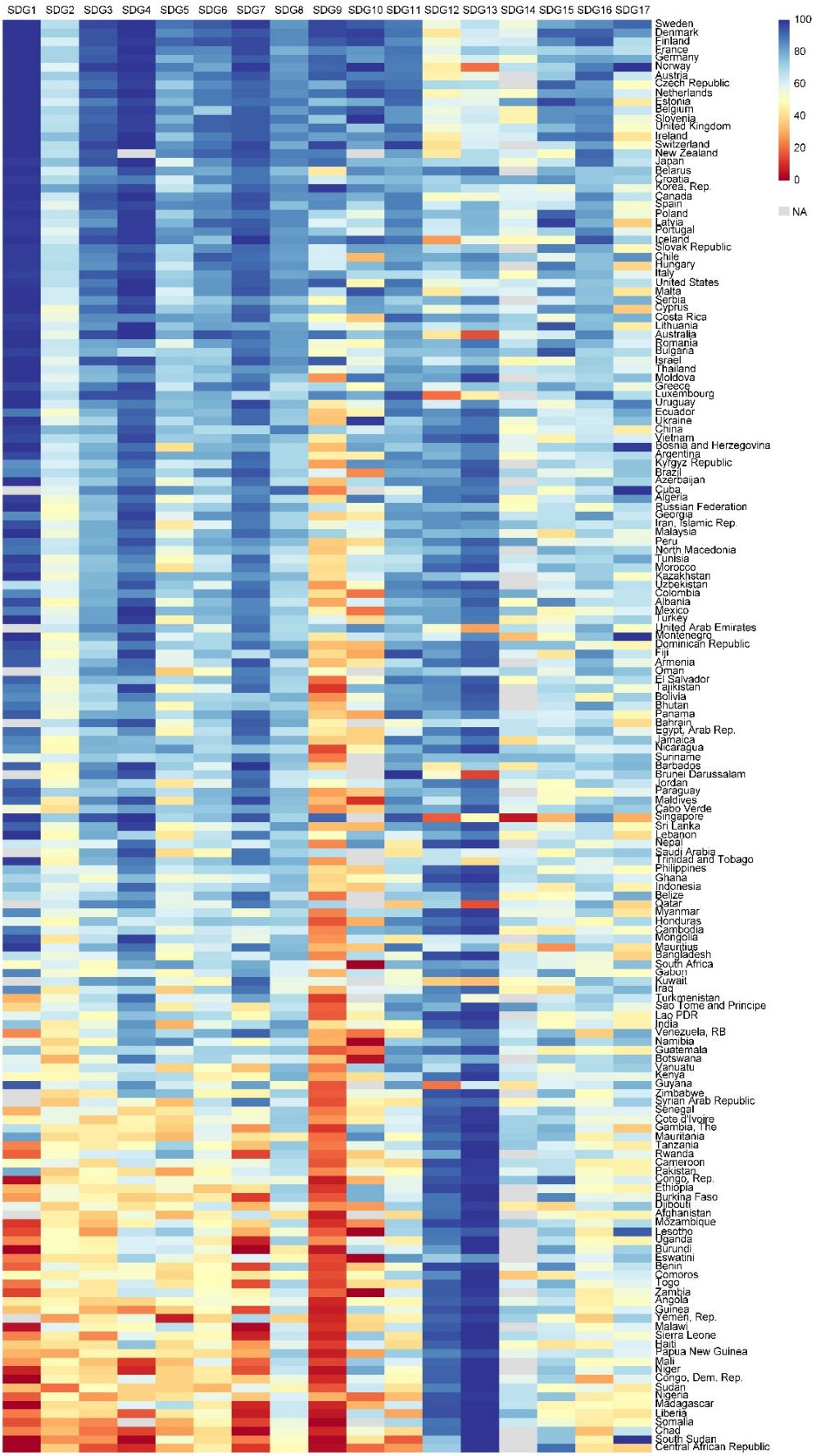

Fig. S1 SDG performances of 166 countries from the Sustainable Development Report 2020.

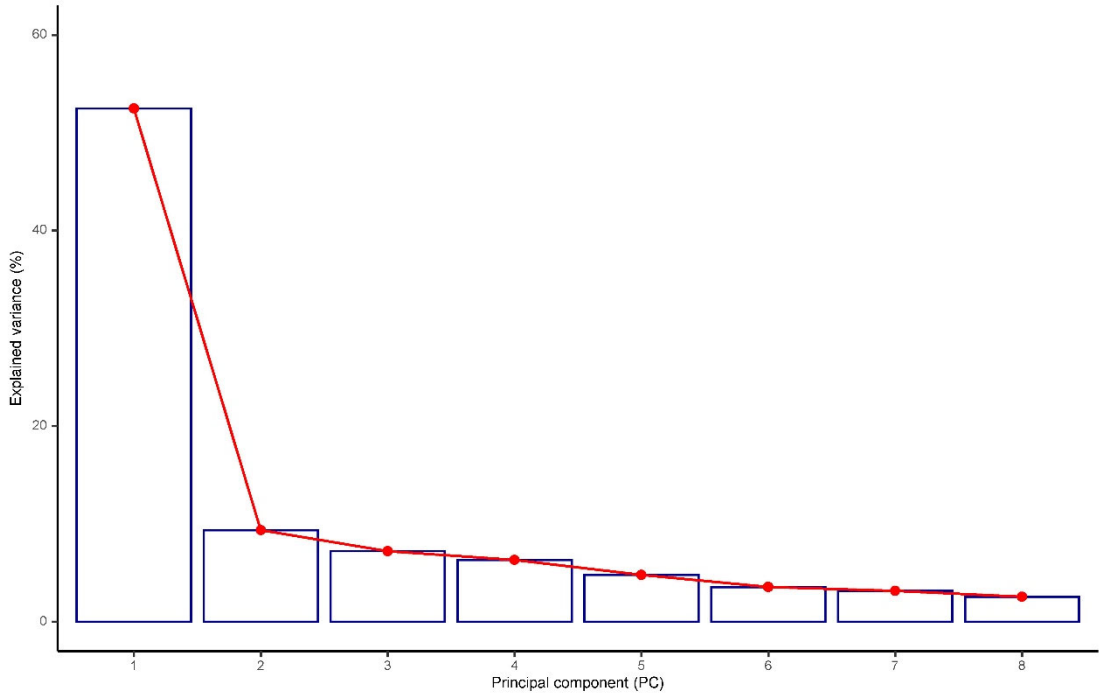

Fig. S2 Explained variance for each principal component.

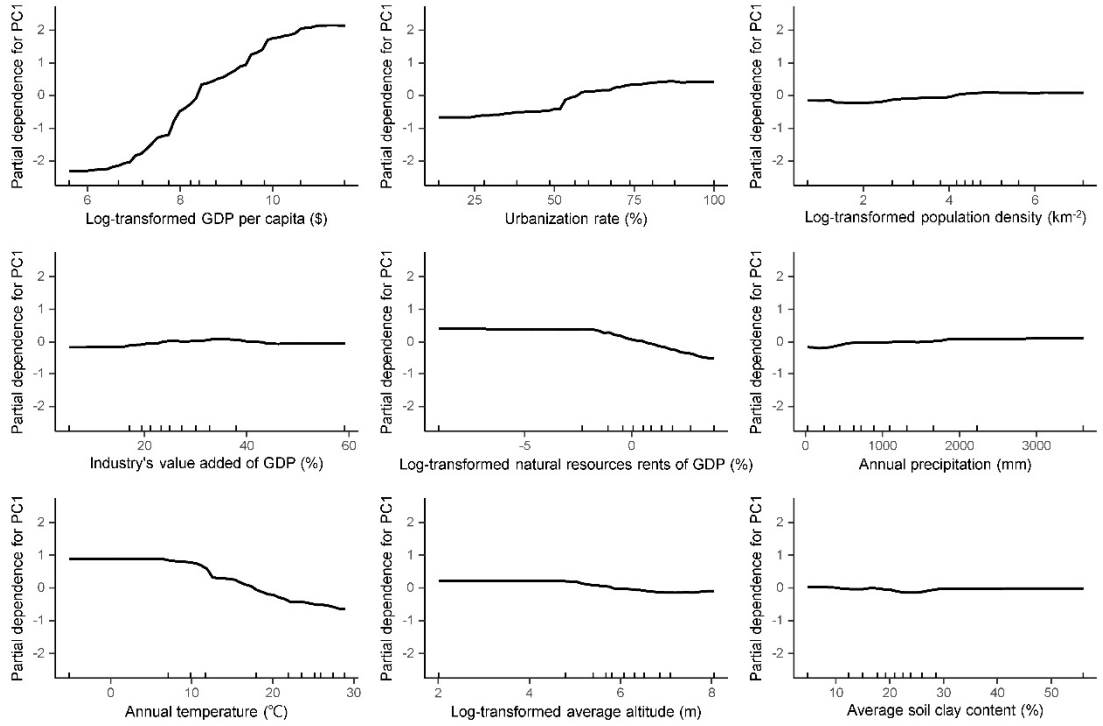

Fig. S3 Partial dependence plots of the predictors for PC1. The slopes of the partial dependence plots indicate the sensitivity of PC1 to the specific predictor. Tick marks in the x-axis represent the minimum, maximum, and deciles of the variable distribution.

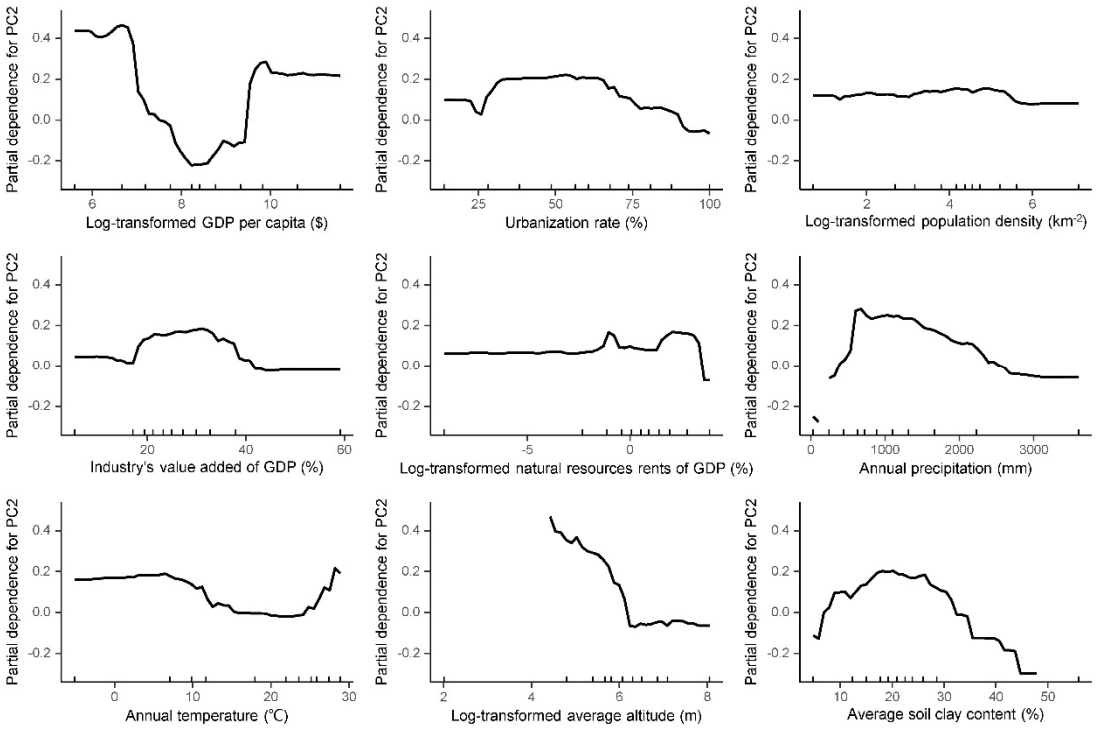

Fig. S4 Partial dependence plots of the predictors for PC2. The slopes of the partial dependence plot indicate the sensitivity of PC2 to the specific predictor. Tick marks in the x-axis represent the minimum, maximum, and deciles of the variable distribution.

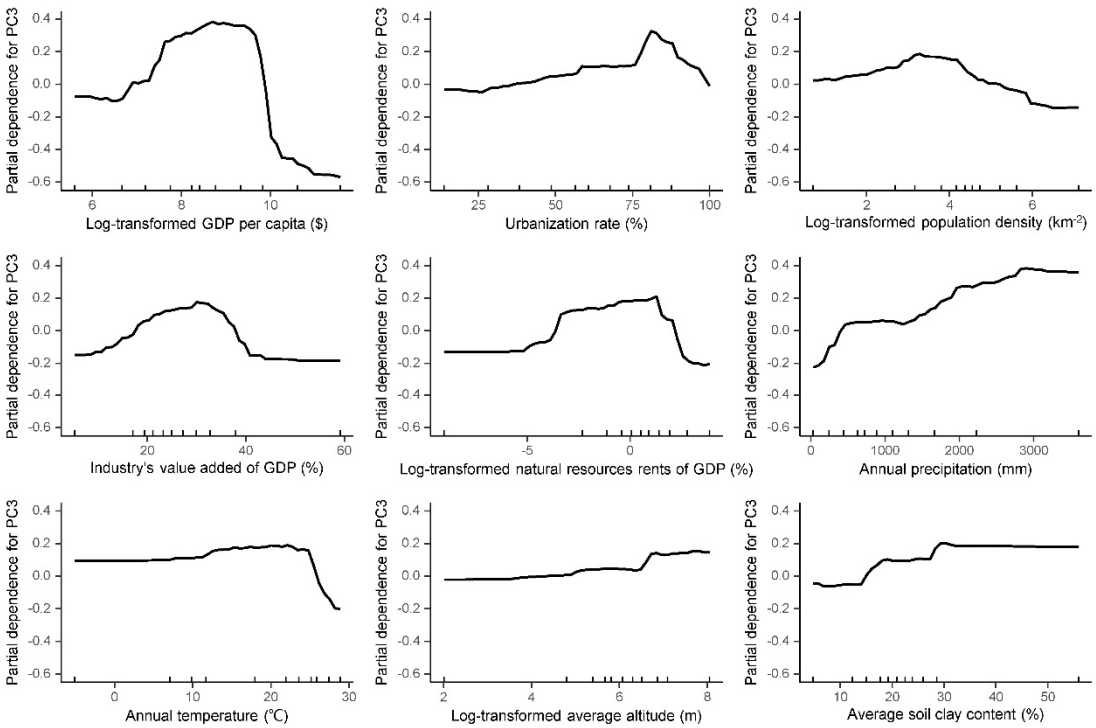

Fig. S5 Partial dependence plots of the predictors for PC3. The slopes of the partial dependence plot indicate the sensitivity of PC3 to the specific predictor. Tick marks in the x-axis represent the minimum, maximum, and deciles of the variable distribution.

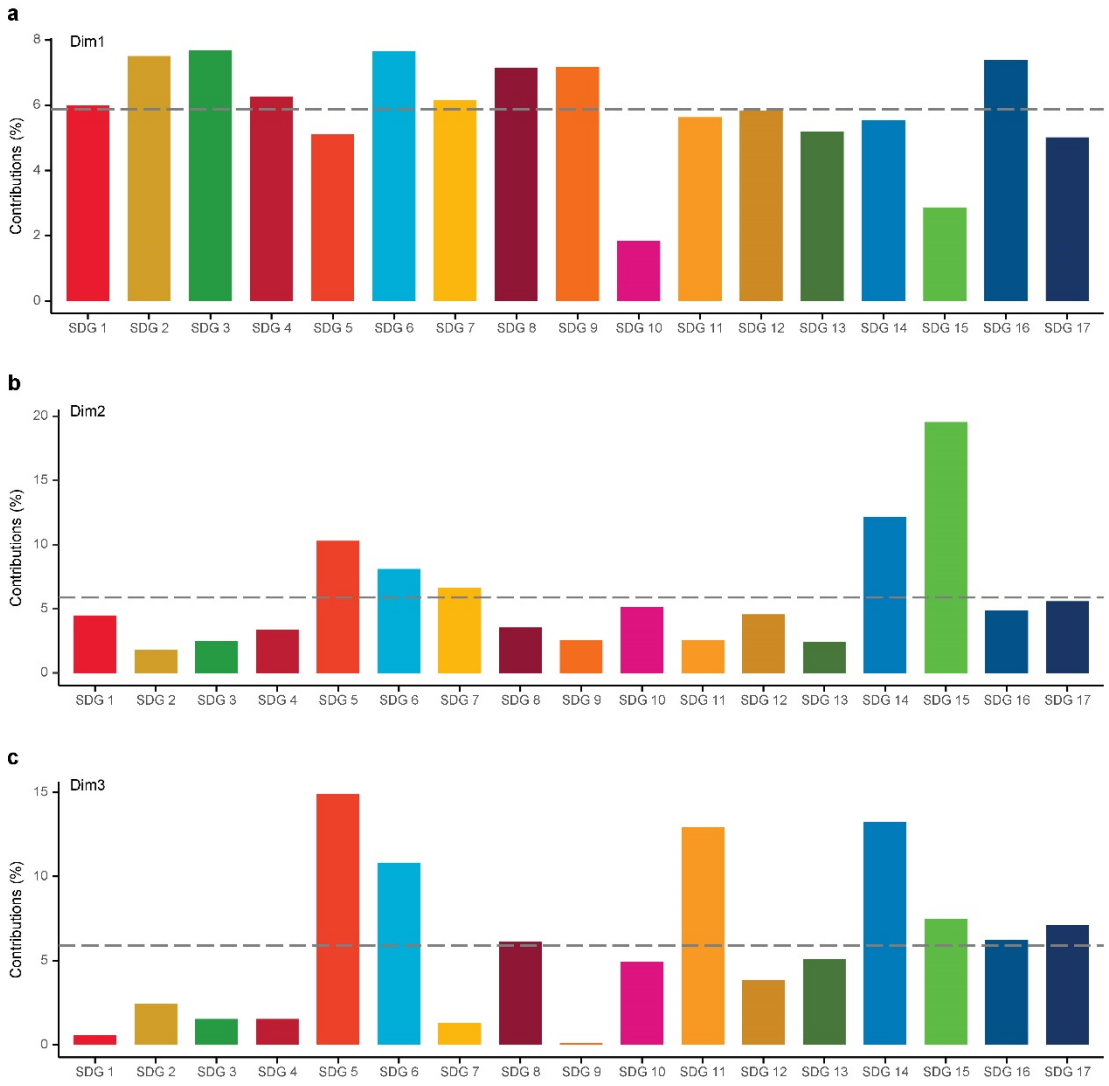

Fig. S6 Contributions of each SDG to the three dimensions identified by SDR SDG indicator data. Gray dashed line represents the average contribution of all SDGs.

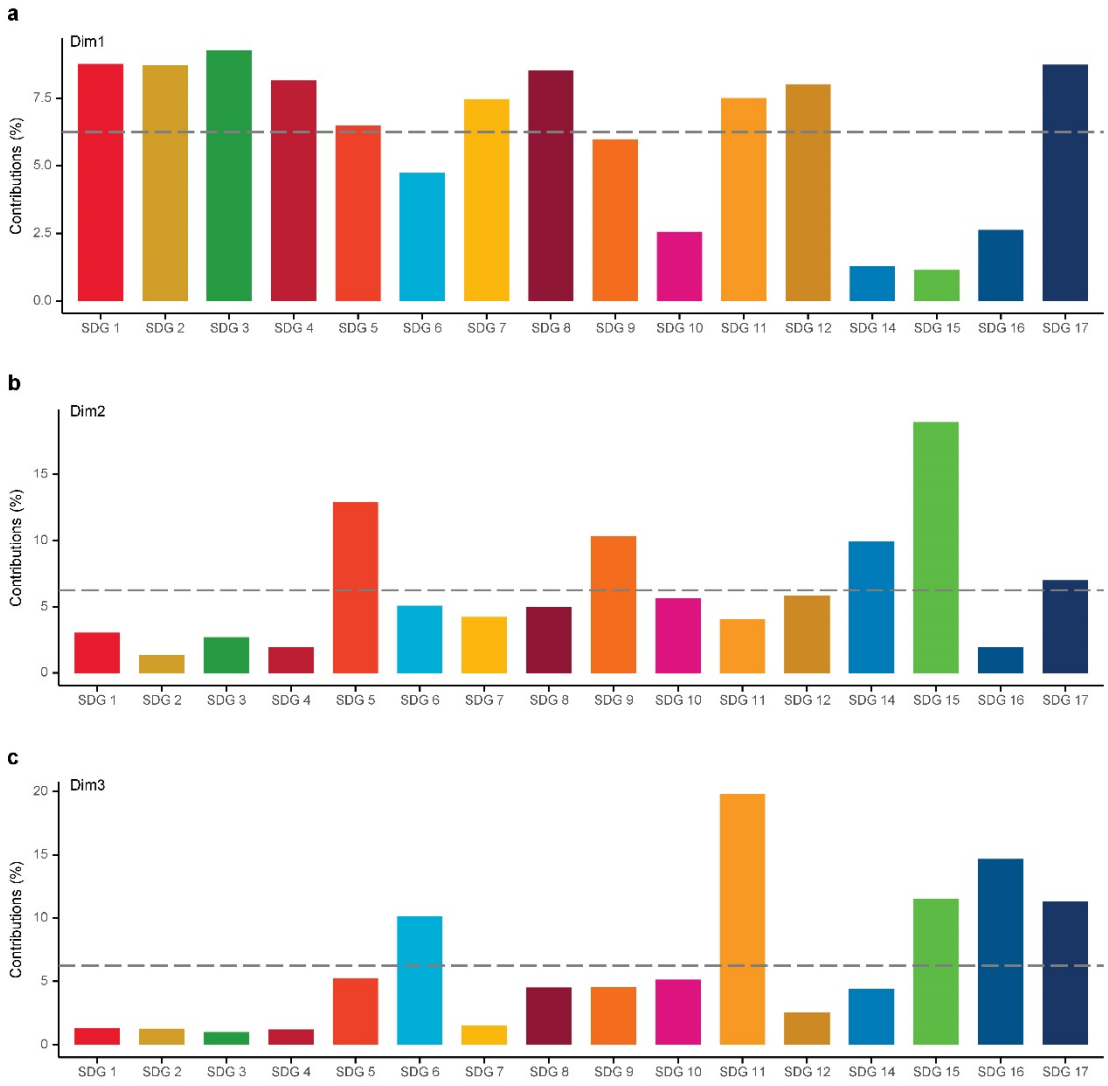

Fig. S7 Contributions of each SDG to the three dimensions identified by United Nations' official SDG indicator data. Gray dashed line represents the average contribution of all SDGs.

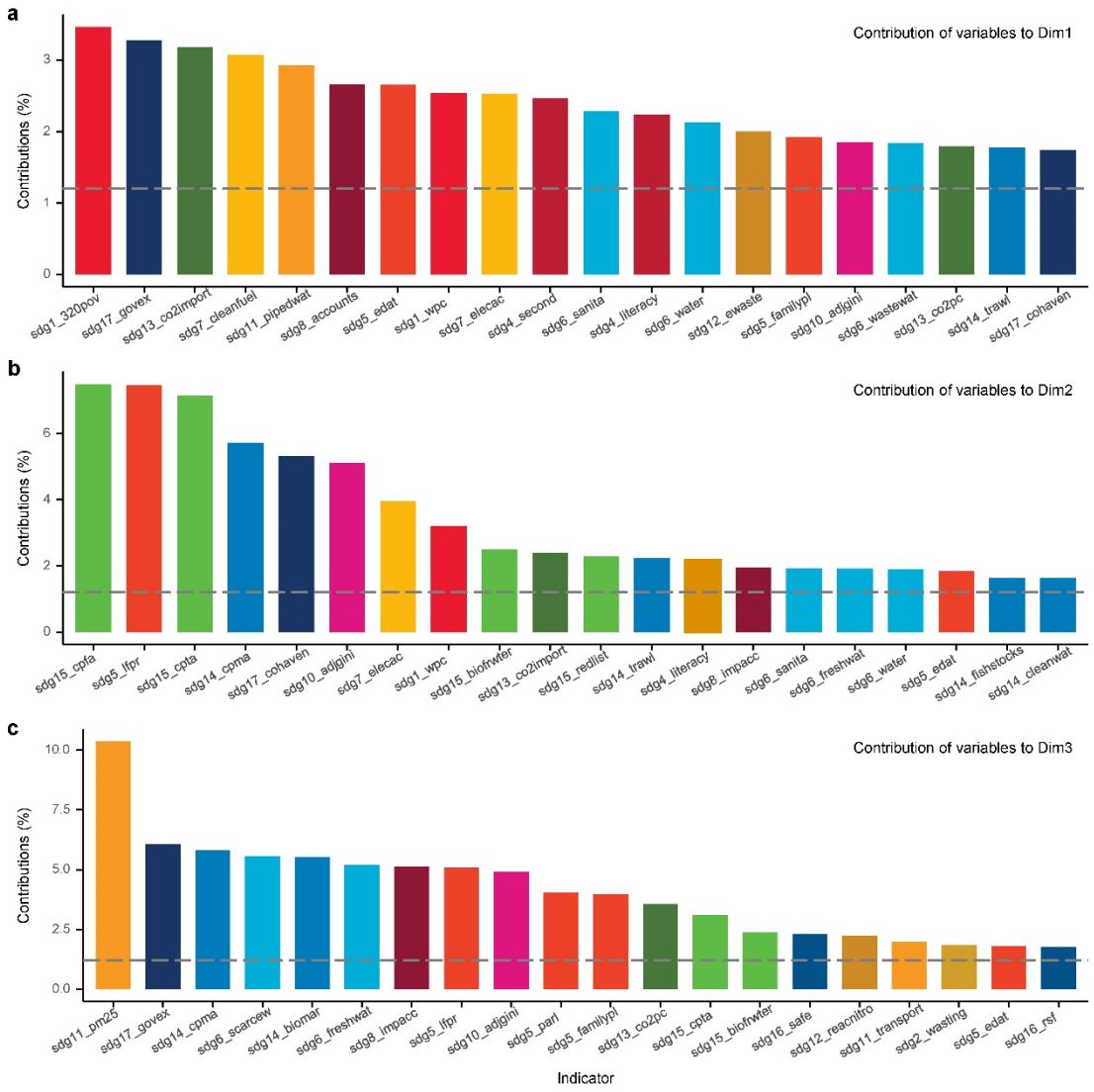

Fig. S8 Contributions of the top 20 contributing indicators to the three dimensions identified by SDR SDG indicator data. Gray dashed line represents the average contribution of all indicators.

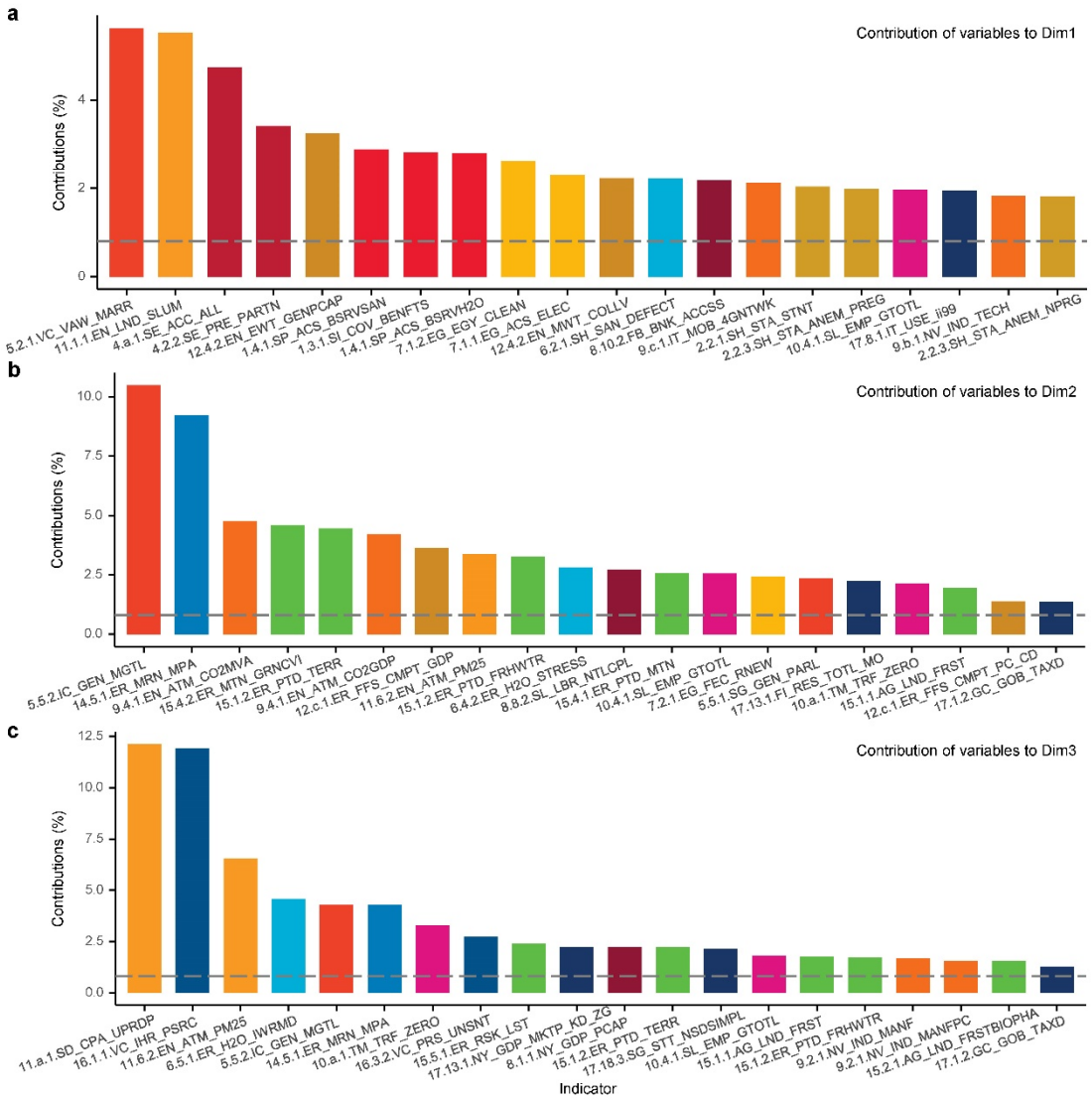

Fig. S9 Contributions of the top 20 contributing indicators to the three dimensions identified by United Nations' official SDG indicator data. Gray dashed line represents the average contribution of all indicators.

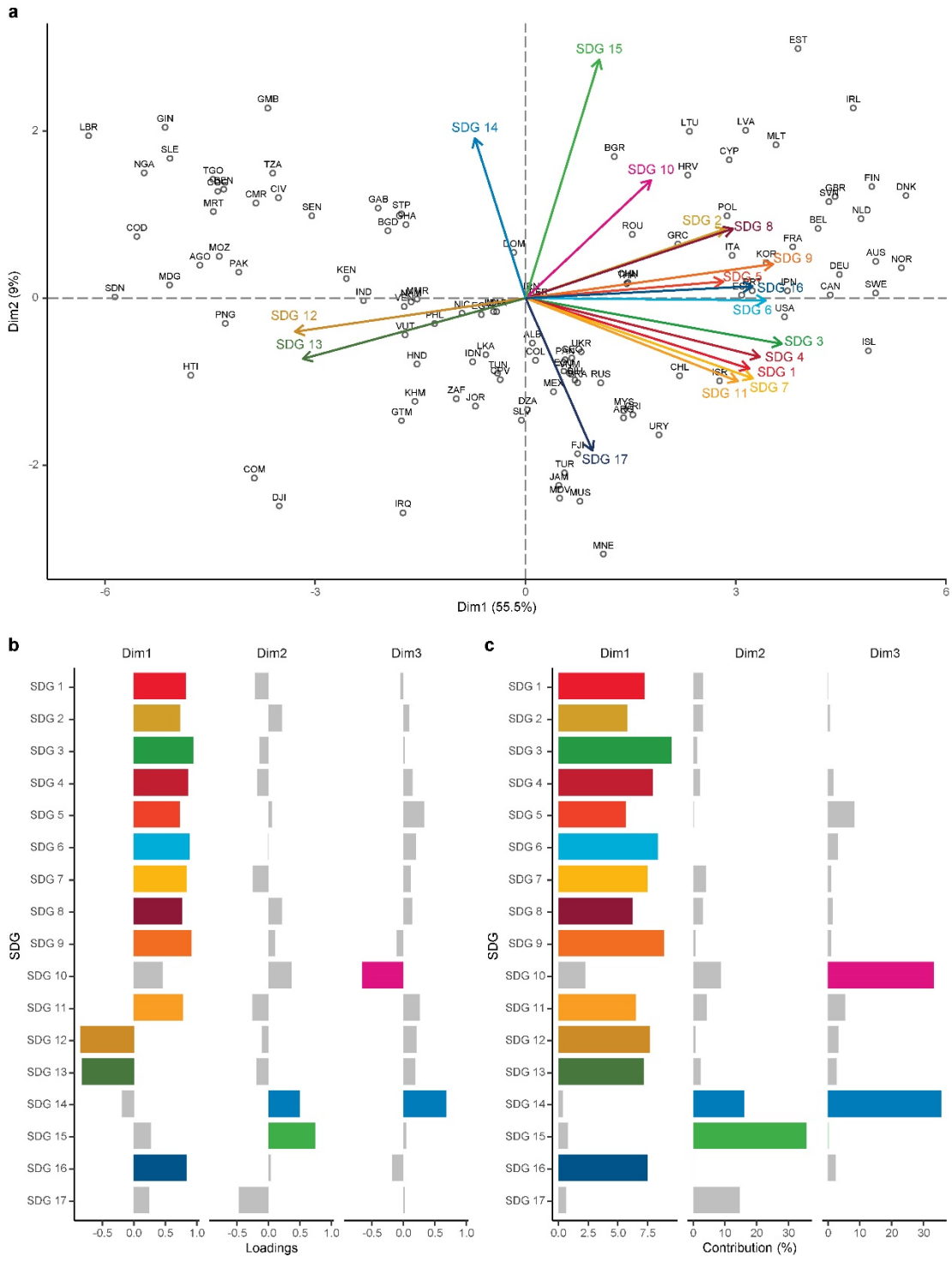

Fig. S10 Main dimensions identified by non-imputed national SDG performances. a, Biplot of PCA results. The full names and principal component values of the countries are shown in Table S1. **b**, Loading of each SDG to each dimension. **c**, Contribution of each SDG to each dimension. Non-gray bars indicate the SDGs with significant loadings (i.e., with an absolute value > 0.5).

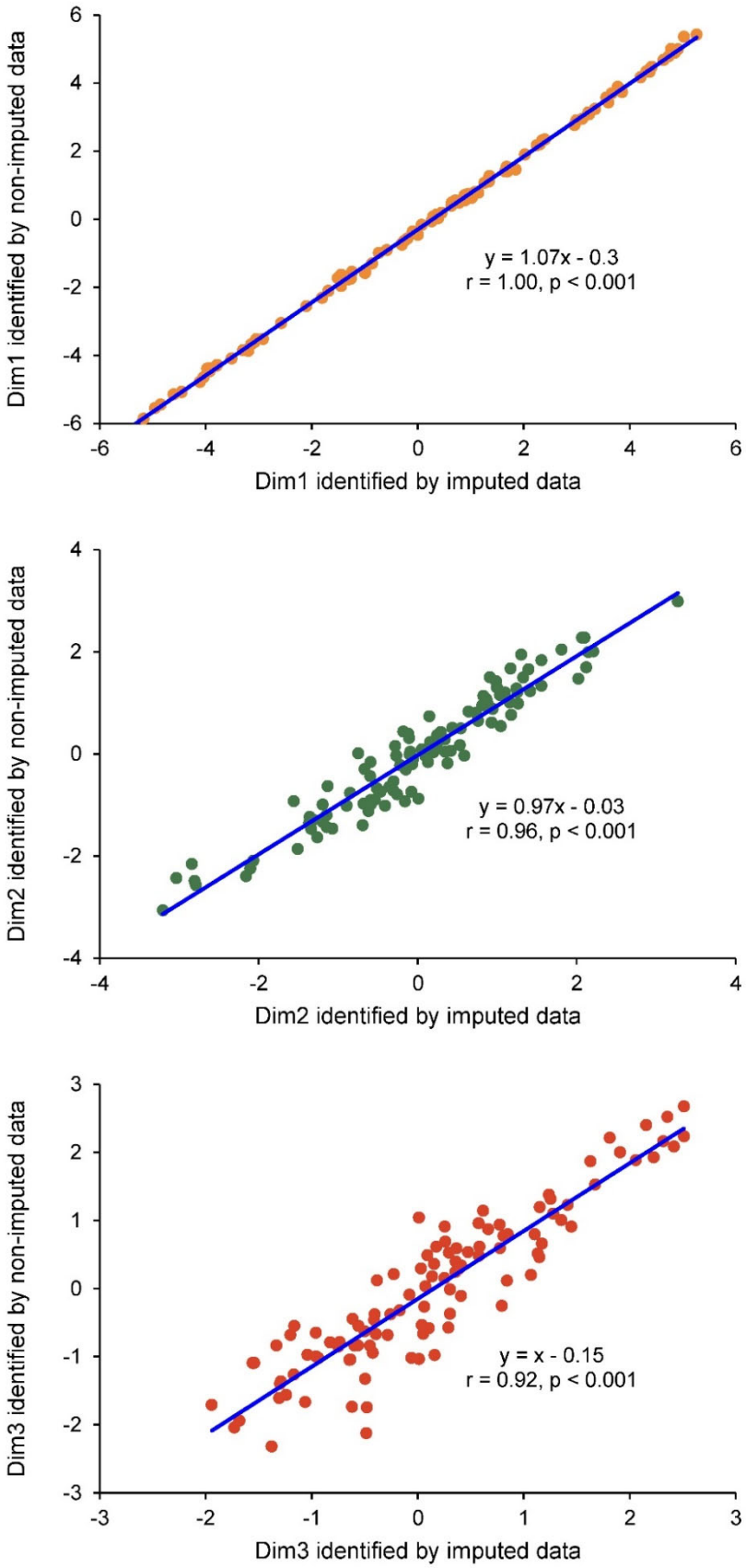

Fig. S11 Comparisons between the dimensions identified by imputed SDR SDG data and non-imputed SDR SDG data.

Table S1 Principal component values of the analyzed countries.

Order	Abbreviation	Country name	UN regional grouping	PC1	PC2	PC3
1	AFG	Afghanistan	Central and Southern Asia	-4.99	-1.15	-1.00
2	AGO	Angola	Sub-Saharan Africa	-4.04	-0.12	-0.75
3	ALB	Albania	Europe and North America	0.38	-0.31	0.10
4	ARE	United Arab Emirates	Northern Africa and Western Asia	2.71	0.20	-2.18
5	ARG	Argentina	Latin America and the Caribbean	1.65	-1.15	1.13
6	ARM	Armenia	Northern Africa and Western Asia	0.24	-0.77	0.49
7	AUS	Australia	Australia and New Zealand	4.78	-0.18	-1.56
8	AUT	Austria	Europe and North America	4.86	0.88	-0.81
9	AZE	Azerbaijan	Northern Africa and Western Asia	0.72	-0.52	0.33
10	BDI	Burundi	Sub-Saharan Africa	-4.04	1.30	-0.39
11	BEL	Belgium	Europe and North America	4.20	0.64	-1.31
12	BEN	Benin	Sub-Saharan Africa	-3.80	0.99	-0.17
13	BFA	Burkina Faso	Sub-Saharan Africa	-3.72	2.53	-0.95
14	BGD	Bangladesh	Central and Southern Asia	-1.45	0.73	-0.08
15	BGR	Bulgaria	Europe and North America	1.35	2.12	0.66
16	BHR	Bahrain	Northern Africa and Western Asia	1.42	0.60	-1.08
17	BIH	Bosnia and Herzegovina	Europe and North America	0.88	-0.59	0.16
18	BLR	Belarus	Europe and North America	1.91	0.81	1.02
19	BLZ	Belize	Latin America and the Caribbean	0.00	-2.14	0.51
20	BOL	Bolivia	Latin America and the Caribbean	-0.07	-0.19	1.43
21	BRA	Brazil	Latin America and the Caribbean	0.96	-0.41	2.32
22	BRB	Barbados	Latin America and the Caribbean	1.84	-1.87	-0.70
23	BRN	Brunei Darussalam	Eastern and Southeastern Asia	2.49	-0.60	-1.11
24	BTN	Bhutan	Central and Southern Asia	0.27	-0.28	0.18
25	BWA	Botswana	Sub-Saharan Africa	-1.08	-1.30	1.04
26	CAF	Central African Republic	Sub-Saharan Africa	-7.00	1.99	-1.59
27	CAN	Canada	Europe and North America	4.31	-0.10	-0.56
28	CHE	Switzerland	Europe and North America	4.72	0.31	-0.76
29	CHL	Chile	Latin America and the Caribbean	2.30	-0.16	2.42
30	CHN	China	Eastern and Southeastern Asia	1.84	0.24	0.30
31	CIV	Cote d'Ivoire	Sub-Saharan Africa	-3.05	1.10	0.15
32	CMR	Cameroon	Sub-Saharan Africa	-3.30	0.82	0.03
33	COD	Congo, Dem. Rep.	Sub-Saharan Africa	-4.96	0.14	-0.94
34	COG	Congo, Rep.	Sub-Saharan Africa	-3.98	1.24	0.57
35	COL	Colombia	Latin America and the Caribbean	0.36	-0.08	2.51
36	COM	Comoros	Sub-Saharan Africa	-3.20	-2.85	-1.38
37	CPV	Cabo Verde	Sub-Saharan Africa	-0.09	-0.68	1.17
38	CRI	Costa Rica	Latin America and the Caribbean	1.68	-0.70	2.23
39	CUB	Cuba	Latin America and the Caribbean	1.02	-0.53	2.15
40	CYP	Cyprus	Northern Africa and Western Asia	2.99	1.39	-1.33
41	CZE	Czech Republic	Europe and North America	3.59	2.34	-0.28
42	DEU	Germany	Europe and North America	4.42	0.34	-0.45

Order	Abbreviation	Country name	UN regional grouping	PC1	PC2	PC3
43	DJI	Djibouti	Sub-Saharan Africa	-2.92	-2.81	-0.06
44	DNK	Denmark	Europe and North America	5.26	1.41	-0.56
45	DOM	Dominican Republic	Latin America and the Caribbean	0.07	1.04	1.81
46	DZA	Algeria	Northern Africa and Western Asia	0.38	-1.19	-0.48
47	ECU	Ecuador	Latin America and the Caribbean	0.70	0.01	2.51
48	EGY	Egypt, Arab Rep.	Northern Africa and Western Asia	-0.25	-0.07	0.41
49	ESP	Spain	Europe and North America	3.23	0.20	0.13
50	EST	Estonia	Europe and North America	3.78	3.27	0.01
51	ETH	Ethiopia	Sub-Saharan Africa	-3.64	1.03	-0.76
52	FIN	Finland	Europe and North America	4.85	1.55	-0.41
53	FJI	Fiji	Oceania	1.04	-1.51	1.45
54	FRA	France	Europe and North America	3.83	0.93	0.36
55	GAB	Gabon	Sub-Saharan Africa	-1.69	0.86	-0.83
56	GBR	United Kingdom	Europe and North America	4.38	1.25	-0.23
57	GEO	Georgia	Northern Africa and Western Asia	0.91	-0.31	1.10
58	GHA	Ghana	Sub-Saharan Africa	-1.28	0.94	0.38
59	GIN	Guinea	Sub-Saharan Africa	-4.61	1.81	-0.62
60	GMB	Gambia, The	Sub-Saharan Africa	-3.14	2.10	-0.96
61	GRC	Greece	Europe and North America	2.25	0.76	0.18
62	GTM	Guatemala	Latin America and the Caribbean	-1.31	-1.34	1.28
63	GUY	Guyana	Latin America and the Caribbean	0.66	-2.79	-1.66
64	HND	Honduras	Latin America and the Caribbean	-1.24	-0.26	2.06
65	HRV	Croatia	Europe and North America	2.35	2.02	0.77
66	HTI	Haiti	Latin America and the Caribbean	-4.11	-1.56	-1.06
67	HUN	Hungary	Europe and North America	2.67	2.26	0.11
68	IDN	Indonesia	Eastern and Southeastern Asia	-0.30	-0.85	0.58
69	IND	India	Central and Southern Asia	-1.81	-0.27	-0.50
70	IRL	Ireland	Europe and North America	4.63	2.07	-1.17
71	IRN	Iran, Islamic Rep.	Central and Southern Asia	0.29	0.35	0.47
72	IRQ	Iraq	Northern Africa and Western Asia	-1.26	-2.79	-0.62
73	ISL	Iceland	Europe and North America	4.85	-1.14	-1.68
74	ISR	Israel	Northern Africa and Western Asia	2.96	-1.20	-0.40
75	ITA	Italy	Europe and North America	3.10	0.43	-0.59
76	JAM	Jamaica	Latin America and the Caribbean	0.77	-2.11	0.79
77	JOR	Jordan	Northern Africa and Western Asia	-0.30	-1.32	-0.43
78	JPN	Japan	Eastern and Southeastern Asia	3.86	0.05	-0.65
79	KAZ	Kazakhstan	Central and Southern Asia	1.67	-0.30	0.17
80	KEN	Kenya	Sub-Saharan Africa	-2.10	0.16	0.58
81	KGZ	Kyrgyz Republic	Central and Southern Asia	0.50	0.09	0.53
82	KHM	Cambodia	Eastern and Southeastern Asia	-1.00	-1.36	-0.50
83	KOR	Korea, Rep.	Eastern and Southeastern Asia	3.60	0.29	-0.74
84	KWT	Kuwait	Northern Africa and Western Asia	1.41	-1.90	-2.83
85	LAO	Lao PDR	Eastern and Southeastern Asia	-1.36	-0.04	1.15

Order	Abbreviation	Country name	UN regional grouping	PC1	PC2	PC3
86	LBN	Lebanon	Northern Africa and Western Asia	0.00	-0.59	-1.73
87	LBR	Liberia	Sub-Saharan Africa	-5.52	1.30	-1.20
88	LKA	Sri Lanka	Central and Southern Asia	-0.19	-0.51	0.85
89	LSO	Lesotho	Sub-Saharan Africa	-3.74	-0.73	1.89
90	LTU	Lithuania	Europe and North America	2.39	2.15	0.25
91	LUX	Luxembourg	Europe and North America	4.37	-0.29	-1.87
92	LVA	Latvia	Europe and North America	3.22	2.21	0.09
93	MAR	Morocco	Northern Africa and Western Asia	-0.07	0.13	0.04
94	MDA	Moldova	Europe and North America	0.94	-0.09	0.59
95	MDG	Madagascar	Sub-Saharan Africa	-4.46	-0.28	0.29
96	MDV	Maldives	Central and Southern Asia	0.64	-2.16	1.35
97	MEX	Mexico	Latin America and the Caribbean	0.63	-0.62	2.36
98	MKD	North Macedonia	Europe and North America	0.81	0.33	0.52
99	MLI	Mali	Sub-Saharan Africa	-4.46	1.82	-0.96
100	MLT	Malta	Europe and North America	3.56	1.55	-1.54
101	MMR	Myanmar	Eastern and Southeastern Asia	-0.99	-0.10	-0.29
102	MNE	Montenegro	Europe and North America	1.34	-3.21	-0.49
103	MNG	Mongolia	Eastern and Southeastern Asia	-0.10	0.31	-0.88
104	MOZ	Mozambique	Sub-Saharan Africa	-3.93	0.54	1.24
105	MRT	Mauritania	Sub-Saharan Africa	-3.95	0.87	-1.29
106	MUS	Mauritius	Sub-Saharan Africa	1.14	-3.04	-0.60
107	MWI	Malawi	Sub-Saharan Africa	-3.83	0.74	0.53
108	MYS	Malaysia	Eastern and Southeastern Asia	1.69	-1.37	0.06
109	NAM	Namibia	Sub-Saharan Africa	-1.45	0.10	1.63
110	NER	Niger	Sub-Saharan Africa	-5.06	1.69	-1.21
111	NGA	Nigeria	Sub-Saharan Africa	-4.85	0.91	-0.39
112	NIC	Nicaragua	Latin America and the Caribbean	-0.58	0.37	1.67
113	NLD	Netherlands	Europe and North America	4.73	0.81	-1.17
114	NOR	Norway	Europe and North America	5.02	0.24	-0.96
115	NPL	Nepal	Central and Southern Asia	-1.24	1.16	0.16
116	NZL	New Zealand	Australia and New Zealand	4.59	-0.39	0.06
117	OMN	Oman	Northern Africa and Western Asia	0.77	-0.58	-0.51
118	PAK	Pakistan	Central and Southern Asia	-3.51	-0.11	-1.30
119	PAN	Panama	Latin America and the Caribbean	0.82	-0.47	1.25
120	PER	Peru	Latin America and the Caribbean	0.45	0.59	2.15
121	PHL	Philippines	Eastern and Southeastern Asia	-0.86	-0.15	1.15
122	PNG	Papua New Guinea	Oceania	-3.79	-0.67	-0.26
123	POL	Poland	Europe and North America	2.99	1.26	0.36
124	PRT	Portugal	Europe and North America	3.34	0.23	0.25
125	PRY	Paraguay	Latin America and the Caribbean	0.52	-0.88	1.21
126	QAT	Qatar	Northern Africa and Western Asia	1.63	0.25	-2.97
127	ROU	Romania	Europe and North America	1.69	1.17	0.81
128	RUS	Russian Federation	Europe and North America	1.26	-0.90	0.41

Order	Abbreviation	Country name	UN regional grouping	PC1	PC2	PC3
129	RWA	Rwanda	Sub-Saharan Africa	-2.37	0.67	0.44
130	SAU	Saudi Arabia	Northern Africa and Western Asia	0.17	-1.49	-1.54
131	SDN	Sudan	Northern Africa and Western Asia	-5.18	-0.75	-1.94
132	SEN	Senegal	Sub-Saharan Africa	-2.58	0.88	0.07
133	SGP	Singapore	Eastern and Southeastern Asia	4.65	-4.27	-3.57
134	SLE	Sierra Leone	Sub-Saharan Africa	-4.46	1.17	-1.04
135	SLV	El Salvador	Latin America and the Caribbean	0.26	-1.07	1.07
136	SOM	Somalia	Sub-Saharan Africa	-5.65	-0.67	-0.57
137	SRB	Serbia	Europe and North America	1.60	-0.37	0.14
138	SSD	South Sudan	Sub-Saharan Africa	-6.54	-0.06	-1.00
139	STP	Sao Tome and Principe	Sub-Saharan Africa	-1.45	1.16	0.62
140	SUR	Suriname	Latin America and the Caribbean	0.52	1.32	0.98
141	SVK	Slovak Republic	Europe and North America	2.96	2.00	-0.19
142	SVN	Slovenia	Europe and North America	4.37	1.03	-1.24
143	SWE	Sweden	Europe and North America	4.90	0.42	0.05
144	SWZ	Eswatini	Sub-Saharan Africa	-2.97	-1.95	0.52
145	SYR	Syrian Arab Republic	Northern Africa and Western Asia	-2.84	-1.96	-0.71
146	TCD	Chad	Sub-Saharan Africa	-6.77	0.91	-1.28
147	TGO	Togo	Sub-Saharan Africa	-3.93	0.99	-0.41
148	THA	Thailand	Eastern and Southeastern Asia	1.66	0.53	0.77
149	TJK	Tajikistan	Central and Southern Asia	-0.15	0.06	-0.07
150	TKM	Turkmenistan	Central and Southern Asia	-0.28	-0.54	-0.29
151	TTO	Trinidad and Tobago	Latin America and the Caribbean	1.24	-0.15	-0.51
152	TUN	Tunisia	Northern Africa and Western Asia	-0.10	-0.59	0.30
153	TUR	Turkey	Northern Africa and Western Asia	0.89	-2.07	0.29
154	TZA	Tanzania	Sub-Saharan Africa	-3.08	1.32	0.26
155	UGA	Uganda	Sub-Saharan Africa	-3.70	1.58	-0.50
156	UKR	Ukraine	Europe and North America	1.08	-0.35	0.01
157	URY	Uruguay	Latin America and the Caribbean	2.02	-1.26	1.15
158	USA	United States	Europe and North America	3.66	-0.22	0.36
159	UZB	Uzbekistan	Central and Southern Asia	0.47	-0.58	1.15
160	VEN	Venezuela, RB	Latin America and the Caribbean	-1.51	-0.06	1.41
161	VNM	Vietnam	Eastern and Southeastern Asia	1.02	-0.54	0.84
162	VUT	Vanuatu	Oceania	-1.37	-0.60	-0.64
163	YEM	Yemen, Rep.	Northern Africa and Western Asia	-5.96	-1.74	-0.78
164	ZAF	South Africa	Sub-Saharan Africa	-0.73	-1.15	1.91
165	ZMB	Zambia	Sub-Saharan Africa	-3.85	-0.03	1.16
166	ZWE	Zimbabwe	Sub-Saharan Africa	-2.75	1.04	0.58

Table S2 List of SDG indicators used in *Sustainable Development Report 2020*. More details are available from the *Sustainable Development Report* (https://www.sustainabledevelopment.report/).

Indicator	Indicator description
sdg1_wpc	Poverty headcount ratio at $1.90/day (%)
sdg1_320pov	Poverty headcount ratio at $3.20/day (%)
sdg1_oecdpov	Poverty rate after taxes and transfers (%)
sdg2_undernsh	Prevalence of undernourishment (%)
sdg2_stunting	Prevalence of stunting in children under 5 years of age (%)
sdg2_wasting	Prevalence of wasting in children under 5 years of age (%)
sdg2_obesity	Prevalence of obesity, BMI ≥ 30 (% of adult population)
sdg2_trophic	Human Trophic Level (best 2-3 worst)
sdg2_crlyld	Cereal yield (tonnes per hectare of harvested land)
sdg2_snmi	Sustainable Nitrogen Management Index (best 0-1.41 worst)
sdg2_yieldgap	Yield gap closure (% of potential yield)
sdg3_matmort	Maternal mortality rate (per 100,000 live births)
sdg3_neonat	Neonatal mortality rate (per 1,000 live births)
sdg3_u5mort	Mortality rate, under-5 (per 1,000 live births)
sdg3_tb	Incidence of tuberculosis (per 100,000 population)
sdg3_hiv	New HIV infections (per 1,000 uninfected population)
sdg3_ncds	Age-standardized death rate due to cardiovascular disease, cancer, diabetes, or chronic respiratory disease in adults aged 30–70 years (%)
sdg3_pollmort	Age-standardized death rate attributable to household air pollution and ambient air pollution (per 100,000 population)
sdg3_traffic	Traffic deaths (per 100,000 population)
sdg3_lifee	Life expectancy at birth (years)
sdg3_fertility	Adolescent fertility rate (births per 1,000 adolescent females aged 15 to 19)
sdg3_births	Births attended by skilled health personnel (%)
sdg3_vac	Percentage of surviving infants who received 2 WHO-recommended vaccines (%)
sdg3_uhc	Universal health coverage (UHC) index of service coverage (worst 0-100 best)
sdg3_swb	Subjective well-being (average ladder score, worst 0-10 best)
sdg3_region	Gap in life expectancy at birth among regions (years)
sdg3_incomeg	Gap in self-reported health status by income (percentage points)
sdg3_smoke	Daily smokers (% of population aged 15 and over)
sdg4_primary	Net primary enrollment rate (%)
sdg4_second	Lower secondary completion rate (%)
sdg4_literacy	Literacy rate (% of population aged 15 to 24)
sdg4_earlyedu	Participation rate in pre-primary organized learning (% of children aged 4 to 6)
sdg4_tertiary	Tertiary educational attainment (% of population aged 25 to 34)
sdg4_pisa	PISA score (worst 0-600 best)
sdg4_socioec	Variation in science performance explained by socio-economic status (%)
sdg4_science	Underachievers in science (% of 15-year-olds)
sdg4_resil	Resilient students in science (% of 15-year-olds)
sdg5_familypl	Demand for family planning satisfied by modern methods (% of females aged 15 to 49 who are married or in unions)

Indicator	Indicator description
sdg5_edat	Ratio of female-to-male mean years of education received (%)
sdg5_lfpr	Ratio of female-to-male labor force participation rate (%)
sdg5_parl	Seats held by women in national parliament (%)
sdg5_paygap	Gender wage gap (% of male median wage)
sdg5_unpaid	Gender gap in time spent doing unpaid work (minutes/day)
sdg6_water	Population using at least basic drinking water services (%)
sdg6_sanita	Population using at least basic sanitation services (%)
sdg6_freshwat	Freshwater withdrawal (% of available freshwater resources)
sdg6_wastewat	Anthropogenic wastewater that receives treatment (%)
sdg6_scarcew	Scarce water consumption embodied in imports (m^3/capita)
sdg6_safewat	Population using safely managed water services (%)
sdg6_safesan	Population using safely managed sanitation services (%)
sdg7_elecac	Population with access to electricity (%)
sdg7_cleanfuel	Population with access to clean fuels and technology for cooking (%)
sdg7_co2twh	CO_2 emissions from fuel combustion for electricity and heating per total electricity output ($MtCO_2$/TWh)
sdg7_ren	Share of renewable energy in total primary energy supply (%)
sdg8_impacc	Fatal work-related accidents embodied in imports (per 100,000 population)
sdg8_adjgrowth	Adjusted GDP growth (%)
sdg8_slavery	Victims of modern slavery (per 1,000 population)
sdg8_accounts	Adults with an account at a bank or other financial institution or with a mobile-money-service provider (% of population aged 15 or over)
sdg8_unemp	Unemployment rate (% of total labor force)
sdg8_empop	Employment-to-population ratio (%)
sdg8_yneet	Youth not in employment, education or training (NEET) (% of population aged 15 to 29)
sdg9_intuse	Population using the internet (%)
sdg9_mobuse	Mobile broadband subscriptions (per 100 population)
sdg9_lpi	Logistics Performance Index: Quality of trade and transport-related infrastructure (worst 1-5 best)
sdg9_qs	The Times Higher Education Universities Ranking: Average score of top 3 universities (worst 0-100 best)
sdg9_articles	Scientific and technical journal articles (per 1,000 population)
sdg9_rdex	Expenditure on research and development (% of GDP)
sdg9_rdres	Researchers (per 1,000 employed population)
sdg9_patents	Triadic patent families filed (per million population)
sdg9_netacc	Gap in internet access by income (percentage points)
sdg9_womensci	Women in science and engineering (% of tertiary graduates in science and engineering)
sdg10_adjgini	Gini coefficient adjusted for top income
sdg10_palma	Palma ratio
sdg10_elder	Elderly poverty rate (% of population aged 66 or over)
sdg11_pm25	Annual mean concentration of particulate matter of less than 2.5 microns in diameter (PM2.5) ($\mu g/m^3$)
sdg11_pipedwat	Access to improved water source, piped (% of urban population)
sdg11_transport	Satisfaction with public transport (%)
sdg11_rentover	Population with rent overburden (%)

Indicator	Indicator description
sdg12_msw	Municipal solid waste (kg/capita/day)
sdg12_ewaste	Electronic waste (kg/capita)
sdg12_so2prod	Production-based SO_2 emissions (kg/capita)
sdg12_so2import	SO_2 emissions embodied in imports (kg/capita)
sdg12_prodnitro	Production-based nitrogen emissions (kg/capita)
sdg12_reacnitro	Nitrogen emissions embodied in imports (kg/capita)
sdg12_mswrecycl	Non-recycled municipal solid waste (kg/capita/day)
sdg13_co2pc	Energy-related CO_2 emissions (tCO_2/capita)
sdg13_co2import	CO_2 emissions embodied in imports (tCO_2/capita)
sdg13_co2export	CO_2 emissions embodied in fossil fuel exports (kg/capita)
sdg13_ecr	Effective carbon rate (EUR/tCO_2)
sdg14_cpma	Mean area that is protected in marine sites important to biodiversity (%)
sdg14_cleanwat	Ocean Health Index: Clean Waters score (worst 0-100 best)
sdg14_fishstocks	Fish caught from overexploited or collapsed stocks (% of total catch)
sdg14_trawl	Fish caught by trawling (%)
sdg14_biomar	Marine biodiversity threats embodied in imports (per million population)
sdg15_cpta	Mean area that is protected in terrestrial sites important to biodiversity (%)
sdg15_cpfa	Mean area that is protected in freshwater sites important to biodiversity (%)
sdg15_redlist	Red List Index of species survival (worst 0-1 best)
sdg15_forchg	Permanent deforestation (% of forest area, 5-year average)
sdg15_biofrwter	Terrestrial and freshwater biodiversity threats embodied in imports (per million population)
sdg16_weaponsexp	Exports of major conventional weapons (TIV constant million USD per 100,000 population)
sdg16_homicides	Homicides (per 100,000 population)
sdg16_detain	Unsentenced detainees (% of prison population)
sdg16_safe	Percentage of population who feel safe walking alone at night in the city or area where they live (%)
sdg16_prs	Property Rights (worst 1-7 best)
sdg16_u5reg	Birth registrations with civil authority (% of children under age 5)
sdg16_cpi	Corruption Perception Index (worst 0-100 best)
sdg16_clabor	Children involved in child labor (% of population aged 5 to 14)
sdg16_rsf	Press Freedom Index (best 0-100 worst)
sdg16_prison	Persons held in prison (per 100,000 population)
sdg17_oda	For high-income and all OECD DAC countries: International concessional public finance, including official development assistance (% of GNI)
sdg17_cohaven	Corporate Tax Haven Score (best 0-100 worst)
sdg17_govex	Government spending on health and education (% of GDP)
sdg17_govrev	Other countries: Government revenue excluding grants (% of GDP)

Table S3 List of United Nations' official SDG indicators used in this study. More details are available from the SDG Global Database of the United Nations (https://unstats.un.org/sdgs/dataportal).

Indicator	Series code	Series description
1.3.1	SI_COV_BENFTS	Proportion of population covered by at least one social protection benefit (%)
1.4.1	SP_ACS_BSRVH2O	Proportion of population using basic drinking water services (%)
1.4.1*	SP_ACS_BSRVSAN	Proportion of population using basic sanitation services (%)
1.5.1/11.5.1/13.1.1	VC_DSR_DAFF	Number of directly affected persons attributed to disasters per 100,000 population (number)
1.5.1/11.5.1/13.1.1	VC_DSR_MTMP	Number of deaths and missing persons attributed to disasters per 100,000 population (number)
1.a.2	SD_XPD_ESED	Proportion of total government spending on essential services, education (%)
2.1.1	SN_ITK_DEFC	Prevalence of undernourishment (%)
2.2.1	SH_STA_STNT	Prevalence of stunting in children under 5 years of age (%)
2.2.2	SH_STA_WAST	Prevalence of wasting in children under 5 years of age (%)
2.2.3	SH_STA_ANEM_NPRG	Proportion of women aged 15-49 years with anaemia, non-pregnant (%)
2.2.3	SH_STA_ANEM_PREG	Proportion of women aged 15-49 years with anaemia, pregnant (%)
2.c.1	AG_FPA_CFPI	Indicator of Food Price Anomalies (IFPA), by Consumer Food Price Index
3.1.1	SH_STA_MORT	Maternal mortality ratio
3.1.2	SH_STA_BRTC	Proportion of births attended by skilled health personnel (%)
3.2.1	SH_DYN_MORT	Under-five mortality rate (deaths per 1,000 live births)
3.2.2	SH_DYN_NMRT	Neonatal mortality rate (deaths per 1,000 live births)
3.3.2	SH_TBS_INCD	Tuberculosis incidence (per 100,000 population)
3.3.4	SH_HAP_HBSAG	Prevalence of hepatitis B surface antigen (HBsAg) (%)
3.4.1	SH_DTH_NCOM	Mortality rate attributed to cardiovascular disease, cancer, diabetes or chronic respiratory disease (probability)
3.4.2	SH_STA_SCIDE	Suicide mortality rate (deaths per 100,000 population)
3.5.1	SH_SUD_ALCOL	Alcohol use disorders, 12-month prevalence (%)
3.5.2	SH_ALC_CONSPT	Alcohol consumption per capita (aged 15 years and older) within a calendar year (litres of pure alcohol)
3.6.1	SH_STA_TRAF	Death rate due to road traffic injuries (per 100,000 population)
3.7.2	SP_DYN_ADKL	Adolescent birth rate (per 1,000 women aged 15-19 and 10-14 years)
3.7.2	SP_DYN_ADKL	Adolescent birth rate (per 1,000 women aged 15-19 and 10-14 years)
3.8.1	SH_ACS_UNHC	Universal health coverage (UHC) service coverage index
3.9.1	SH_STA_ASAIRP	Age-standardized mortality rate attributed to household and ambient air pollution (deaths per 100,000 population)
3.9.2	SH_STA_WASHARI	Mortality rate attributed to unsafe water, unsafe sanitation and lack of hygiene from diarrhoea, intestinal nematode infections, malnutrition and acute respiratory infections (deaths per 100,000 population)
3.9.3	SH_STA_POISN	Mortality rate attributed to unintentional poisonings (deaths per 100,000 population)
3.a.1	SH_PRV_SMOK	Age-standardized prevalence of current tobacco use among persons aged 15 years and older (%)
3.b.1	SH_ACS	Average proportion of the target population with access to 3 doses of diphtheria-tetanus-pertussis (DTP3), measles-containing-vaccine second-dose (MCV2), and pneumococcal conjugate 3rd dose (PCV3) (%)
3.c.1	SH_MED_DEN	Health worker density (per 10,000 population)
3.d.1	SH_IHR_CAPS	International Health Regulations (IHR) capacity (%)

Indicator	Series code	Series description
4.2.2	SE_PRE_PARTN	Participation rate in organized learning (one year before the official primary entry age) (%)
4.5.1	SE_GPI_PTNPRE	Adjusted gender parity index for participation rate in organized learning (one year before the official primary entry age), (ratio)
4.a.1	SE_ACC_ALL	Proportion of schools with basic facilities
5.2.1	VC_VAW_MARR	Proportion of ever-partnered women and girls subjected to physical and/or sexual violence by a current or former intimate partner in the previous 12 months (%)
5.5.1	SG_GEN_PARL	Proportion of seats held by women in national parliaments (% of total number of seats)
5.5.2	IC_GEN_MGTL	Proportion of women in managerial positions (%)
6.2.1	SH_SAN_DEFECT	Proportion of population practicing open defecation (%)
6.4.1	ER_H2O_WUEYST	Water Use Efficiency (United States dollars per cubic meter)
6.4.2	ER_H2O_STRESS	Level of water stress: freshwater withdrawal as a proportion of available freshwater resources (%)
6.5.1	ER_H2O_IWRMD	Degree of integrated water resources management implementation (%)
6.6.1	EN_LKRV_PWAC	Lakes and rivers permanent water area change (%)
6.6.1	EN_LKRV_SWAC	Lakes and rivers seasonal water area change (%)
6.6.1	EN_RSRV_MNWAP	Reservoir minimum water area (% of total land area)
6.6.1	EN_RSRV_MXWAP	Reservoir maximum water area (% of total land area)
6.6.1	EN_WBE_WTLP	Wetlands area (% of total land area)
7.1.1	EG_ACS_ELEC	Proportion of population with access to electricity, by urban/rural (%)
7.1.2	EG_EGY_CLEAN	Proportion of population with primary reliance on clean fuels and technology (%)
7.2.1	EG_FEC_RNEW	Renewable energy share in the total final energy consumption (%)
7.3.1	EG_EGY_PRIM	Energy intensity level of primary energy (megajoules per constant 2017 purchasing power parity GDP)
7.b.1/12.a.1	EG_EGY_RNEW	Installed renewable electricity-generating capacity (watts per capita)
8.1.1	NY_GDP_PCAP	Annual growth rate of real GDP per capita (%)
8.2.1	SL_EMP_PCAP	Annual growth rate of real GDP per employed person (%)
8.4.2/12.2.2	EN_MAT_DOMCMPC	Domestic material consumption per capita (tonnes)
8.4.2/12.2.2	EN_MAT_DOMCMPG	Domestic material consumption per unit of GDP (kilograms per constant 2015 United States dollars)
8.5.2	SL_TLF_UEM	Unemployment rate (%)
8.6.1	SL_TLF_NEET	Proportion of youth not in education, employment or training (%)
8.8.2	SL_LBR_NTLCPL	Level of national compliance with labour rights (freedom of association and collective bargaining) based on International Labour Organization (ILO) textual sources and national legislation
8.10.1	FB_ATM_TOTL	Number of automated teller machines (ATMs) per 100,000 adults
8.10.1	FB_CBK_BRCH	Number of commercial bank branches per 100,000 adults
8.10.2	FB_BNK_ACCSS	Proportion of adults (15 years and older) with an account at a financial institution or mobile-money-service provider (% of adults aged 15 years and older)
9.1.2	IS_RDP_FRGVOL	Freight volume (tonne kilometres)
9.1.2	IS_RDP_PFVOL	Passenger volume (passenger kilometres)
9.2.1	NV_IND_MANF	Manufacturing value added (constant 2015 United States dollars) as a proportion of GDP (%)
9.2.1	NV_IND_MANFPC	Manufacturing value added per capita (constant 2015 United States dollars)
9.2.2	SL_TLF_MANF	Manufacturing employment as a proportion of total employment (%)

Indicator	Series code	Series description
9.4.1	EN_ATM_CO2GDP	Carbon dioxide emissions per unit of GDP PPP (kilogrammes of CO2 per constant 2017 United States dollars)
9.4.1*	EN_ATM_CO2MVA	Carbon dioxide emissions per unit of manufacturing value added (kilogrammes of CO2 per constant 2015 United States dollars)
9.b.1	NV_IND_TECH	Proportion of medium and high-tech manufacturing value added in total value added (%)
9.c.1	IT_MOB_4GNTWK	Proportion of population covered by at least a 4G mobile network (%)
10.4.1	SL_EMP_GTOTL	Labour share of GDP (%)
10.7.4	SM_POP_REFG_OR	Number of refugees per 100,000 population, by country of origin (per 100,000 population)
10.a.1	TM_TRF_ZERO	Proportion of tariff lines applied to imports with zero-tariff (%)
11.1.1	EN_LND_SLUM	Proportion of urban population living in slums (%)
11.5.3	VC_DSR_BSDN	Number of disruptions to basic services attributed to disasters (number)
11.6.2	EN_ATM_PM25	Annual mean levels of fine particulate matter (population-weighted) (micrograms per cubic meter)
11.a.1	SD_CPA_UPRDP	Countries that have national urban policies or regional development plans that respond to population dynamics; ensure balanced territorial development; and increase local fiscal space (1 = YES; 0 = NO)
12.3.1	AG_FOOD_WST_PC	Food waste per capita (KG)
12.4.1	SG_HAZ	Average ratio of parties meeting their commitments and obligations in transmitting information as required by Basel Convention, Montreal Protocol, Rotterdam Convention, and Stockholm Convention on hazardous waste, and other chemicals
12.4.2	EN_EWT_GENPCAP	Electronic waste (kg/capita)
12.4.2	EN_MWT_COLLV	Municipal solid waste (kg/capita/day)
12.b.1	ST_EEV_STDACCT	Implementation of standard accounting tools to monitor the economic and environmental aspects of tourism (number of tables)
12.c.1	ER_FFS_CMPT_GDP	Fossil-fuel subsidies (consumption and production) as a proportion of total GDP (%)
12.c.1	ER_FFS_CMPT_PC_CD	Fossil-fuel subsidies (consumption and production) per capita (nominal United States dollars)
14.1.1	EN_MAR_CHLANM	Chlorophyll-a anomaly, remote sensing (%)
14.5.1	ER_MRN_MPA	Average proportion of Marine Key Biodiversity Areas (KBAs) covered by protected areas (%)
15.1.1	AG_LND_FRST	Forest area as a proportion of total land area (%)
15.1.2	ER_PTD_FRHWTR	Average proportion of Freshwater Key Biodiversity Areas (KBAs) covered by protected areas (%)
15.1.2*	ER_PTD_TERR	Average proportion of Terrestrial Key Biodiversity Areas (KBAs) covered by protected areas (%)
15.2.1	AG_LND_FRSTBIOPHA	Above-ground biomass in forest (tonnes per hectare)
15.2.1	AG_LND_FRSTCHG	Annual forest area change rate (%)
15.2.1	AG_LND_FRSTPRCT	Proportion of forest area within legally established protected areas (%)
15.4.1	ER_PTD_MTN	Average proportion of Mountain Key Biodiversity Areas (KBAs) covered by protected areas (%)
15.4.2	ER_MTN_GRNCVI	Mountain Green Cover Index
15.5.1	ER_RSK_LST	Red List Index
15.6.1	ER_CBD_SMTA	Total reported number of Standard Material Transfer Agreements (SMTAs) transferring plant genetic resources for food and agriculture to the country (number)
15.8.1	ER_IAS_LEGIS	Legislation, Regulation, Act related to the prevention of introduction and management of Invasive Alien Species (1 = YES, 0 = NO)

Indicator	Series code	Series description
15.8.1	ER_IAS_NBSAP	National Biodiversity Strategy and Action Plan (NBSAP) targets alignment to Aichi Biodiversity target 9 set out in the Strategic Plan for Biodiversity 2011-2020 (1 = YES, 0 = NO)
16.1.1	VC_IHR_PSRC	Number of victims of intentional homicide per 100,000 population (victims per 100,000 population)
16.3.2	VC_PRS_UNSNT	Unsentenced detainees as a proportion of overall prison population (%)
17.1.1	GR_G14_GDP	Total government revenue (budgetary central government) as a proportion of GDP (%)
17.1.2	GC_GOB_TAXD	Proportion of domestic budget funded by domestic taxes (% of GDP)
17.6.1	IT_NET_BBND	Fixed Internet broadband subscriptions per 100 inhabitants (per 100 inhabitants)
17.8.1	IT_USE_ii99	Internet users per 100 inhabitants
17.10.1	TM_TAX_WMFN	Worldwide weighted tariff-average, most-favoured-nation status (%)
17.12.1	TM_TAX_DMFN	Average tariff applied by developed countries, most-favored nation status (%)
17.13.1	BN_CAB_XOKA_GD_ZS	Current account balance as a proportion of GDP (%)
17.13.1	BX_KLT_DINV_WD_GD_ZS	Foreign direct investment, net inflows, as a proportion of GDP (%)
17.13.1	FI_RES_TOTL_MO	Total reserves in months of imports (ratio)
17.13.1	FM_LBL_BMNY_IR_ZS	Broad money to total reserves ratio
17.13.1	FP_CPI_TOTL_ZG	Annual inflation, consumer prices (%)
17.13.1	GC_BAL_CASH_GD_ZS	Cash surplus/deficit as a proportion of GDP (%)
17.13.1	NE_CON_GOVT_KD_ZG	Annual growth of the general government final consumption expenditure (%)
17.13.1	NE_CON_PRVT_KD_ZG	Annual growth of households and NPISHs final consumption expenditure (%)
17.13.1	NE_EXP_GNFS_KD_ZG	Annual growth of exports of goods and services (%)
17.13.1	NE_GDI_TOTL_KD_ZG	Annual growth of the gross capital formation (%)
17.13.1	NE_IMP_GNFS_KD_ZG	Annual growth of imports of goods and services (%)
17.13.1	NY_GDP_MKTP_KD_ZG	Annual GDP growth (%)
17.13.1	TG_VAL_TOTL_GD_ZS	Merchandise trade as a proportion of GDP (%)
17.18.2	SG_STT_FPOS	Countries with national statistical legislation exists that complies with the Fundamental Principles of Official Statistics (1 = YES; 0 = NO)
17.18.3	SG_STT_NSDSIMPL	Countries with national statistical plans that are under implementation (1 = YES; 0 = NO)
17.19.2	SG_REG_BRTH90N	Countries with birth registration data that are at least 90 percent complete (1 = YES; 0 = NO)
17.19.2	SG_REG_DETH75N	Countries with death registration data that are at least 75 percent complete (1 = YES; 0 = NO)