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Analysis of the Sustainable Society Index Worldwide: A Study from the Biplot Perspective

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Abstract Since the Brundtland Report defined the concept of sustainability in 1987, several different indices and indicators have been developed in this area, which is becoming an ever greater concern in society, since it will affect future generations. The main objective of this research study is to analyze whether there are differences in the scores obtained by a broad sample of countries in the Sustainable Society Index according to the geographical area in which the country is located. We apply the HJ-biplot method (Galindo in Questíio 10(1):13–23, 1986), a statistical technique that provides a joint graphical representation in a low dimensional Euclidean space (usually a plane), of a multivariate data matrix; in our study, this is formed by the countries grouped by geographical areas and variables relating to sets of economic, social and environmental indicators included in the Sustainable Society Index. Our findings stress that the variables related to Human Wellbeing fall mainly within the proximity of the countries located in the geographical areas of Europe, America and, to a lesser extent, Asia. In contrast, other variables associated with Environmental Wellbeing, such as greenhouse gases, renewable energy, and air quality are mainly located closer to Africa, and more residually to Asia. In order to represent the most relevant variables in each geographical area and corroborate the results obtained using the HJ-biplot methodology, an analysis was carried out of the radial graph that represents the values of each variable along the independent axes in the form of radii that have their starting point in the centre of the plot and end in the outer ring such that each radius corresponds to a variable. The results obtained show the characteristics of each geographical area in relation to the Sustainable Society Index, and confirm the results obtained with the HJ-biplot.

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1 Introduction

One of the most important issues in recent years at the international level is the sustainability of the different countries and geographical areas on our planet. This has become especially crucial since the Brundtland Report, released in 1987, provided a definition of sustainability that has had a deep impact on society at large. The report pointed to the importance of satisfying current needs but in a way that does not compromise the capability of future generations to satisfy their own needs.

From this definition of sustainability it can be deduced that a current and future balance must be sought in three aspects that affect humanity as a whole: the economic aspect, with an optimum combination between economic development and conservation of the natural environment; the social aspect, which involves guaranteeing intergenerational equity in social matters and quality of life; and finally the environmental aspect, which means maintaining the continuity of environmental resources over time, something that can be achieved by limiting the consumption of easily exhaustible resources and products, reducing waste and pollution in all their manifestations, conserving energy and recycling.

All of these aspects are important in attaining a sustainable society in which each individual is able to develop in a healthy way, obtain a decent education, live in a clean environment within a safe and well-balanced society, use non-renewable resources in a responsible way and contribute to a sustainable world (Van de Kerk and Manuel 2008).

To help to understand and manage all these sustainability issues, a number of indicators have been implemented. Some of the most important have been the Human Development Index (HDI), the Millennium Development Indicators, Indicators for the EU Sustainable Development Strategy, and the Index of Sustainable Economic Welfare. In this research, we use the Sustainable Society Index (SSI), employed in previous analyses (e.g. Van de Kerk and Manuel 2008).

This index includes a set of economic, social and environmental wellbeing indicators and has recently been audited by the Joint Research Centre of the European Commission, which considers it an integral and quantitative method for measuring and monitoring the health of human and environmental systems on a world-wide basis. The audit also pointed out that it is a conceptual and statistically solid tool that is widely applicable to the continuous assessment of human and environmental systems and a key point of reference with which to compare future progress and report on the current state of society (Saisana and Philippas 2012).

The technique we have chosen for this research is the HJ-biplot (Galindo 1986), which has been used in other studies (e.g. González-Cabrera et al. 2006; Gardner et al. 2005; Aerni 2009; Basille et al. 2008; Ceschin et al. 2012; Gallego-Álvarez et al. 2013). However, it has not yet been applied to the Sustainable Society Index (SSI), thereby providing some degree of novelty to the current work. This method will allow us to check whether the indicators proposed by the SSI are similar across the different countries, and whether sustainability concerns are similar in different geographical areas.

From a statistical point of view, the eigenvalues, the variance explained, and the relative contribution of factor to the element, ensure the validity of this research. The joint use of the SSI indicators and the HJ-biplot method allow us to depict the geographical zones and the most relevant indicators jointly, showing the proximity of the latter to the former. SSI indicators enable us to extend the analysis beyond a specific country or geographical area, and thus include different contexts in our study. Unlike other techniques, the biplot easily allows us to detect differences between geographical areas in relation to different dimensions (SSI indicators) in a visual way, as well as the proximity of each country to a specific set of indicators. The biplot can also be used to compress the data, by reducing the number of dimensions, without much loss of information. When using HJ-biplot analysis to analyze a data set, it is usually possible to explain a large percentage of the total variance with only a few components, and it allows us to represent the countries and variables in our sample with the maximum quality, at the same time being a technique that is based on simple geometric concepts such as angles, lines and vectors.

Observed in this way, our findings show that the variables related to Human Wellbeing are mainly in closer proximity[1] to the countries located in the geographical areas of Europe, America and, to a lesser extent, to Asian countries. Meanwhile, other variables associated with Environmental Wellbeing, such as greenhouse gas emissions, renewable energy, and air quality are mainly located closer to Africa on the biplot, and more residually to Asia.

The paper is structured as follows: after the introduction, in Sect. 2 we analyze the theoretical framework and the meaning of a sustainable society. Section 3 describes our research methods, including the sample and analysis techniques. In Sect. 4, the results of the empirical analysis are given and then discussed in Sect. 5. Section 6 summarizes the main findings and consequences and presents the conclusions.

2 Sustainable Development and Sustainability Indicators

2.1 Theoretical Framework

Sustainable development and sustainability have become watchwords in recent years owing to the great interest taken in this subject worldwide both at the micro- and macro-economic levels. At the micro-economic level this means sustainability in the business world, as published in sustainability reports presented by companies, a measure that is becoming more and more frequent internationally. Sustainability at the macro-economic level refers to the sustainability of different countries, a research topic that is perhaps less developed than at the business level, but which is unquestionably of great importance.

This research study is focused on sustainability at the country level and the analysis is done according to the geographical area where the country is located, an issue that gained importance starting with the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992. This Conference raised public awareness and placed sustainable development on the world's political agenda, reaffirming the concept introduced in 1987 by the Brundtland Report. That Report was the first to include the concept of

[1] By "closer proximity" we mean the proximity between the countries grouped in geographical areas and the variables that are the sustainability indicators. Put more technically, the countries grouped by geographical area have similar profiles with respect to the variables, since all of them project close to the end of the vector representing the variable (see Fig. 4), e.g. Africa and greenhouse gases. As for the individuals (countries grouped by geographical area), when they are close to a vector, it implies that they take predominant values for that variable, in the sense that the individuals are significant to explain the variable and that the variable is of great value for the individuals.

sustainable development in an official document, defining it as development that satisfies present needs without compromising the capability of future generations to satisfy their own needs (World Commission on Environment and Development, WCED 1987). Thus, general principles were set up to guide relations between the economy and the environment at the global level, with emphasis on the need to find strategies that allow economies to grow while remaining sustainable (Erias Rey 2003).

Attaining sustainable development entails making progress in three fundamental pillars: economic development, social cohesion and protection of the environment. In other words, it involves the integration of three dimensions:

- The environmental (ecological) dimension, through environmental sustainability. This is defined as the need to maintain the continuity of environmental resources over time. This can be achieved by limiting the consumption of easily exhaustible resources and products, reduction of waste and pollution in all their aspects, energy conservation and recycling.
- The social dimension, through social sustainability. This involves guaranteeing intergenerational equity, that is, satisfying the current basic needs of all persons but at the same time guaranteeing that when the time comes, future generations will be able to do the same.
- The economic dimension, through economic sustainability. The means seeking an economic balance by means of an optimum combination between economic development and conservation of natural resources.

Aiming for sustainability implies, first, defining its components in measurable terms and clearly fixing the responsibility to assess progress comprehensively (Hales and Prescott-Allen 2002). Nevertheless, the notion of what is meant by sustainability varies considerably and its definition is still ambiguous (Mori and Christodoulou 2012). It is no wonder that the relevant literature is abundant with studies on sustainability (Hák et al. 2007; Arezki and Van Der Ploeg 2007; Bell and Morse 2008; Betsill and Rabe 2009) and many of them define it in a way similar to that of the Brundtland Report. Thus, Baumgärtner and Quaas (2010) consider sustainability to be a normative notion that indicates the way humans should act towards nature, and how they are responsible towards one another and future generations, and Kates et al. (2001), consider that the essence of sustainable development is to meet fundamental human needs while preserving the life-support systems of planet Earth.

According to Van de Kerk and Manuel (2008), a sustainable society is one in which each human being is capable of developing in a healthy manner and obtaining a proper education; lives in a clean environment; lives in a safe and well-balanced society; uses non-renewable resources responsibly so that future generations will not be left without them, and contributes to a sustainable world.

For Saisana and Philippas (2012), the term sustainability has also been used by politicians and economists to mean that a society is economically viable, environmentally rational and socially responsible, although the great changes taking place in social and economic matters have made the measuring of sustainability very complicated, despite the great progress already achieved in this sense.

Given this situation, more and more new indicators are being developed in an attempt to measure these three aspects of sustainability: environmental, social and economic. Some of these indicators have been established by the OECD and the UN, among others, but the SSI (Sustainable Society Index), developed in 2006, does so in a more complete way, as it covers all three aspects. It can thus be considered innovative (Van de Kerk and Manuel 2012).

Moreover, the SSI has recently been audited by the Joint Research Centre of the European Commission, which considers it to be an integral and quantitative method for measuring and supervising the health of human and environmental systems the world over, in addition to being a conceptually and statistically solid tool that is broadly applicable for a continuous assessment of human and environmental systems and a key reference point with which to compare future progress and report on the current state of society (Saisana and Philippas 2012).

These sustainability indicators can be useful individually to view the state of each country in regard to matters of sustainability, what its deficiencies and most relevant aspects are, and to compare each country's sustainability with that of other countries in its geographical area as well as identify its most effective aspects. For governments, these sustainability indicators serve to show the sustainability situation in each country and geographical area to the general public in a transparent and effective way. They can also help governments make decisions regarding their social, environmental and economic policies, and the projects and strategies to be adopted in this sense. As regards education, sustainability subject matter can be introduced in secondary and higher education to make students aware of the situation of the world around us. As far as the business world is concerned, sustainability indicators for the different countries business is conducted in can help firms to determine whether they will have some kind of competitive advantage and to be innovative.

2.2 Sustainability Indicators: With Special Reference to the Sustainable Society Index

Recently, composite indicators have been used for concerns such as quality of life and the environment, mainly in order to rank performance at country level (Karavanas et al. 2009). Furthermore, they provide information on the status of the environment and assess the economic, social and environmental impact of development.

Generally speaking, indicators have three main functions. First, they reduce the number of measurements necessary to give a description of a situation (OECD 2003). As such, they are indispensable for measuring progress towards policy objectives (Dalal-Clayton and Krikhaar 2007) and for evaluating the effectiveness of policies (European Commission 2005).

Hansen (1996), Jasch (2000) and Perotto et al. (2008) observed that the development of indicators at the national, regional, local or field level had become a commonly used approach to meet the crucial need for assessment tools. Such tools are a prerequisite to the implementation of the concept of sustainability.

With a view to studying sustainability internationally, many current indices and indicators relating to sustainability have been reviewed and it has been found that the good indicators, that is, those that provide a complete picture of all the relevant aspects of sustainability in a transparent and easily understandable way, must fulfil the following criteria (Bell and Morse 2008; Meadows 1998; Guy and Kibert 1998, Van de Kerk and Manuel 2008):

- They must be relevant for one of the issues relating to the above-mentioned definition of sustainability.
- They must cover the complete field of sustainability according to the definition used.
- They must be independent of each other and not overlap.

- They must be measurable.
- They must be easy to access, for the general public as well. This in turn means that the number of indicators should be limited.
- The data used to build the indicators must be publically available.
- The data must be available for all countries, at least for all those except the smallest ones.
- The data must be reliable.
- The data must be recent and regularly updated.
- The complete set of indicators should provide a good picture of the current situation of sustainability and point out the differences between the present situation and the optimum situation of complete sustainability.
- They must permit comparisons among countries.

The general conclusion is that none of the existing indices seems to completely fulfil our needs, since either none is completely suitable or they serve more or less different objectives. Below we list some of the most important indices in the field of sustainability (Van de Kerk and Manuel 2012; Saisana and Philippas 2012):

- *Human Development Index (HDI)* This covers a small part of all the aspects involved in sustainable development and it has sometimes even been considered a redundant indicator that provides little additional information on inter-country development levels, especially in regard to life expectancy, education attained and income per capita. It was drawn up by the United Nations Development Programme (UNDP 2005).
- Environmental Sustainability Index (ESI-2005): This one lacks indicators on gender equality, and good governance does not receive enough attention. The ESI benchmarks the ability of nations to protect the environment over the next several decades. This index was developed by Esty (2005) in the Yale Center for Environmental Law and Policy.
- *Environmental Performance Index (EPI-2006)* This only partially covers sustainable development in its broadest context, particularly environmental items. It was developed by Esty (2005 in the Yale Center for Environmental Law and Policy por Esty (2005).
- *Commitment to Development Index (CDI)* This addresses sustainable development only partly and offers information on no more than 27 countries. It was devised by the Center for Global Development (2007).
- *Index of Sustainable Economic Welfare (ISEW)* This index does not include the main aspects of quality of life and does not offer a clear picture of a country's level of sustainability. Developed by Daly and Cobb (1989a, b), it is available only for a limited number of countries.
- *Genuine Progress Indicator (GPI)* This one has the same deficiencies as the ISEW. It was developed with a view to redefining progress and was first published in 1998. Its importance has increased because of authors such as Talberth et al. (2006).
- *Ecological Footprint* This only partially covers sustainability in the broadest sense. There is quite a bit of debate about the method used in its calculation. It was initially created by Wackernagel and Rees (1996).
- *Wellbeing of Nations* This provides an enormous amount of information, which makes it too complicated. Developed initially by Prescott-Allen (2001), it has only been published once.
- *Millennium Development Indicators* Of limited use for visualizing a country's level of sustainability. It does not cover the whole concept of a sustainable society (United Nations 2005).

- *Indicators for the EU Sustainable Development Strategy* This includes a number of indicators that are not closely related to sustainability, and little or no attention is paid to other topics such as those related to gender equality or access to drinking water. It is limited to member States of the European Union.
- *CSD Indicators* This set comprises many indicators and offers too much information. It does not cover sustainability in its broadest sense (United Nations 2007).

Considering the existing limitations for establishing an index that can be applied generally to all countries, we decided to use the one created by Van de Kerk and Manuel (2012), since their Sustainable Society Index (SSI) was recently audited by the Joint Research Centre of the European Commission, which found that it to be an integral and quantitative method for measuring and monitoring the health of human and environmental systems globally and a conceptually and statistically solid tool that can be broadly applied for the continuous evaluation of these systems. It is also a key reference point for comparing any progress made and for informing about current society (Saisana and Philippas 2012).

According to the recommendations of the Joint Research Centre, the geometric average was used to develop the Sustainable Society Index, aggregating the indicators into categories and then aggregating the categories into the dimensions of sustainability, to finally result in a single index, the Sustainable Society Index (SSI).

According to Van de Kerk and Manuel (2012), owing to the lack of a scientific basis for the attribution of different weights to the indicators, every indicator received the same weight for the aggregation into categories. The same applies for the aggregation of the eight categories into the three wellbeing dimensions and finally into one figure for the overall index.

Our decision to use the Sustainable Society Index instead of other indices such as the Human Development Index or the Environmental Performance Index, which address specific issues (such as life expectancy, education and income in the former and ecosystem vitality and environmental health in the latter), was due to the following aspects: on the one hand it describes societal progress along all three dimensions: human, environmental and economic. Thus, the SSI comprises three wellbeing dimensions (human, environmental and economic) and is calculated for 151 countries accounting for 99 % of the world population. Thus it is much broader in scope than others that refer only to one specific geographical area, such as Europe. Furthermore, the SSI-2012 is based on a definition of sustainability that was provided by the Brundtland Commission (WCED 1987), to make explicitly clear that sustainability includes human wellbeing as well as environmental wellbeing. Another aspect that led us to consider the SSI is that the 21 indicators that populate the SSI-2012 framework come from fifteen sources: the Food and Agriculture Organization (FAO), World Health Organization (WHO)-Unicef Joint Monitoring Programme, WHO, UN Population Division, Yale and Columbia University, UNESCO, World Economic Forum, World Bank, United Nations Environment Programme–World Conservation Monitoring Centre (UNEP-WCMC), FAO global information system on water and agriculture (Aquastat), Global Footprint Network, International Energy Agency (IEA), Research Institute of Organic Agriculture (FiBL), International Monetary Fund (IMF), International Labour Organization (ILO) and Central Intelligence Agency (CIA), World Factbook (Saisana and Philippas 2012, p. 17). Furthermore, it has recently been audited by the Joint Research Centre of the European Commission, in particular its Institute for the Protection and Security of the Citizen, confirming that the SSI is well-structured and guaranteeing a control process to ensure transparency and the credibility of the results. The Joint Research Centre, moreover, is based on the recommendations of the OECD (2008).

It is also important to point out that the SSI is framed within the Pressure-State-Response model proposed by Rapport and Friend (1979) and followed by the OECD. This model has subsequently been used and modified by the UN Commission on Sustainable Development to adapt it to the three dimensions of sustainability (economic, social and environmental aspects), giving rise to the DPSIR, the acronym for the Driving Forces-Pressure-State-Impact-Reponse framework. The model is based on a sequential evolution in which social and economic development give rise to pressures on the environment, which in turn give rise to a series of changes in the state of the environment. As a result of these changes there are impacts on health, availability of resources, natural ecosystems, and so on. These lead to a series of responses on the part of social agents and public authorities addressed to improving economic and social management by eliminating or reducing these pressures, thus restoring and recovering the state of the environment and the alterations that are the result of the impacts. As can be observed, this model adds to the previous model environmentally relevant social and economic trends that are responsible for the situation (driving forces), as well as the adverse effects of the changes in state detected in human health and behaviour, the environment, the economy and society (impacts).

The Sustainable Society Index (SSI) consists of 21 indicators grouped into three dimensions: Human Wellbeing, Environmental Wellbeing, and Economic Wellbeing. The different indicators comprising these dimensions are listed below (Van de Kerk and Manuel 2012).

- Human Wellbeing
    - *Sufficient food* Number of undernourished people in percentage of total population.
    - *Sufficient to drink* Number of people as percentage of the total population, with sustainable access to an improved water source.
    - *Safe sanitation* Number of people in percentage of total population, with sustainable access to improved sanitation.
    - *Healthy life* Life expectancy at birth in number of healthy life years (HALE—Health Adjusted Life Expectancy).
    - *Clean air* Air pollution in its effects on humans.
    - *Clean water* Surface water quality.
    - *Education* Combined gross enrolment ratio for primary, secondary and tertiary schools.
    - *Gender equality* Gender Gap Index.
    - *Income distribution* Ratio of income of the richest 10 % to the poorest 10 % of the people in a country.
    - *Good governance* The average of values of the six Governance Indicators of the World Bank.
- Environmental Wellbeing
    - *Air quality* Air pollution in its effects on nature.
    - *Biodiversity* Size of protected areas (in percentage of land area).
    - *Renewable water resources* Annual water withdrawals (m^2 per capita) as percentage of renewable water resources.
    - *Consumption* Ecological Footprint minus Carbon Footprint.
    - *Renewable energy*: Renewable energy as percentage of total energy consumption.

- *Greenhouse gases* This indicator uses the common measure for greenhouse gas emissions (GHG): CO_2 emissions per capita per year.

- Economic Wellbeing

  - *Organic farming*: Area for organic farming as percentage of total agricultural area of a country.
  - *Genuine savings* Genuine Savings (Adjusted Net Savings) as percentage of Gross National Income (GNI).
  - *Gross domestic product*: GDP, per capita, in Purchasing Power Parity, in current international dollars.
  - *Employment* Unemployment as percentage of total labour force.
  - *Public debt* The level of public debt of a country as percentage of GDP.

In regard to the range of the SSI indicators, if the sustainability value of an indicator in known, the value of the indicator is scored with 10 in the case of 100 % sustainability, and if there is no sustainability at all, the indicator value is 0. If an indicator already has a set of values, the data for this indicator are transformed on a scale of 0–10. This transformation from basic data to indicator values was done by standardization and certain more complex formulas need to be used in the case of some indicators, according to their characteristics.

3 Research Method

3.1 Population and Sample

Taking into account the indicators mentioned above, in this study we selected most countries in the world as our target population. This population was chosen in order to broaden and generalize the results obtained in previous studies, and also in order to overcome two limitations posed previously: the countries being studies and the data analysis techniques used.

Previous studies have usually focused on specific geographical contexts, such as Western industrialised countries (Scruggs 2003; Jahn 1998; Crepaz 1995), 21 OECD countries (Neumayer 2003), 17 industrialised democracies (Scruggs 1999, 2001; 14 OECD countries considering five measures of well-being (Giles and Feng 2005) and 131 countries (Hosseini and Kaneko 2011).

The sample we use comprises the 151 countries selected by Van de Kerk and Manuel (2008) (see Appendix 1) corresponding to the latest information available from 2012, and incorporates the advantages derived from considering different geographical contexts: Europe (Eu), Africa (Afr), America (Am), Asia (As) and Oceania (Oc) (see Appendix 2).

Although the initial population comprised 194 countries, data on these indicators were only available for 151 countries. It was thus possible to calculate the SSI for most large or medium-sized countries. The largest countries that could not be included were Afghanistan, Djibouti, Eritrea, Somalia and Surinam.

3.2 Statistical Analysis

We therefore consider in this research the 151 countries around the world presented in Appendix 1, grouped into 5 geographical areas; the 21 numerical characteristics are the scores obtained by the countries selected concerning the policy categories proposed in the

SSI in the last available year (2012), basically sufficient food, sufficient to drink, safe sanitation, healthy life, clean air, clean water, education, gender equality, income distribution, good governance, air quality, biodiversity, renewable water resources, consumption, renewable energy, greenhouse gases, organic farming, genuine saving, gross domestic product, employment and public debt (see Appendix 2). Hence, in this paper, the data consist of the SSI scores for each country, that is, a $X_{151 \times 21}$ matrix.

The analysis of several sustainability problems at once requires the storage of large volumes of data. In order to explore the data to get a better understanding of several processes, it is important to identify the salient features underlying them. The reduction in the dimensionality of the problem enables us to summarize the information captured in a large number of variables with a smaller number of latent variables. Plots which simultaneously show both the countries and the indices can be of great assistance in this respect. These plots, called biplots, are used in this paper.

A biplot is a graphic display of multivariate data: a joint representation, in a low dimensional Euclidean space (usually a plane), of a matrix $X_{n \times p}$, with markers $a_1, \ldots, a_n$ for its rows and markers $b_1, \ldots, b_p$ for its columns, chosen in such a way that the inner (or scalar) product $a_i^t \cdot b_j$ represents the element x_{ij} of matrix X (Gabriel 1971). First it carries out the approximation of the data matrix by a singular value decomposition (SVD) and then, this matrix is factorized in row and column markers. The biplot is a powerful multivariate data visualization tool, due to its inner product properties. Gabriel proposed several biplots: the JK-biplot (in which only the rows are represented with high quality), and the GH-biplot (only the columns are represented with high quality). Galindo (1986) proposed a new form of representation, the HJ-biplot, in which the coordinates for columns coincide with the column markers in the GH-biplot, and the coordinates for the rows coincide with the row markers in the JK-biplot, but these coordinates may be represented in the same reference system. The HJ-biplot is a joint representation, in a low dimensional vector space (usually two), of the rows and columns of X, using markers (points/vectors), for its rows and for its columns. Like the classic biplots proposed by Gabriel, this alternative allows nearby points and closely angled lines to be interpreted as showing similarity/correlation, but with a very important advantage since it is possible to interpret narrowly between unit-points and variable-points.

All these representations (GH, JK and HJ-biplots) are just exploratory techniques; no parametrical assumptions are considered.

The technique we have chosen for this research is the HJ-biplot, (Galindo 1986) which has been used in other studies (e.g. González-Cabrera et al. 2006; Gardner et al. 2005; Aerni 2009; Basille et al. 2008; Ceschin et al. 2012; Gallego-Álvarez et al. 2013). However, it has not yet been applied to the Sustainable Society Index (SSI), thereby providing some degree of novelty to the current work.

From an analytical point of view, the HJ-biplot is a multivariate graphic display of a matrix $X_{n \times p}$ by means of markers $j_i = (j_{i1}, j_{i2})$ $i = 1,\ldots,n$ for its rows and $h_j = (h_{j1}, h_{j2})$ $j = 1,\ldots,p$ for its columns, such that both markers can be represented in the same reference system, with optimal quality of representation and reaching the best simultaneous representation. The aim of the HJ-biplot is to describe the configuration of the rows and columns and the relationships between them, an aim different from that of the classical biplots in which it is necessary to reproduce each element of matrix X. Usually the row markers are displayed as points on a two-dimensional plot and the column markers as vectors on the same plot.

Let $X = U\sum V^T$ be the usual singular value decomposition (SVD) of X with U and V orthogonal matrices and $\sum = \text{diag}(\lambda_1, \ldots, \lambda_p)$ containing the singular values. Let J and H be the matrices of the first two columns of $U\sum$ and $V\sum$, respectively. This selection provides an HJ-biplot representation in the sense defined. Obviously, if X has rank *p* (*p* > 2) the solution is only an approximation, as in the classical biplots.

(a) Rows and columns can be represented in the same reference system.

It is known that V are the eigenvectors of X′X and U are the eigenvectors of XX′. U and V are related

$$U = XV\sum^{-1} \quad V = X'U\sum^{-1} \tag{1}$$

thus

$$\begin{aligned} U\sum &= XV\sum^{-1} \quad \sum = XV \\ V\sum &= X'U\sum^{-1} \quad \sum = X'U \end{aligned} \tag{2}$$

Putting J = XV and H = X′U

$$\begin{aligned} H &= X'J\sum^{-1} \\ J &= XH\sum^{-1} \end{aligned} \tag{3}$$

i.e.

$$\begin{aligned} b_{jh} &= \left\{x_{1j}a_{lh}\ldots + x_{nj}\ a_{nh}\right\}(1/\sqrt{\lambda}h) \\ a_{ih} &= \left\{x_{il}b_{lh} + \ldots x_{ip}\ b_{ph}\right\}(1/\sqrt{\lambda}h) \end{aligned}$$

The hth coordinate of the ith row is a function of the hth coordinates of the *p* variables and each coordinate of the jth variable is a linear combination of the coordinates of the n individuals, where each of these coordinates is weighted by the value that the variable X_j takes on the individuals; likewise, each individual occupies the point of equilibrium of the set of the variables.

The dispersion of both clouds (scatters of rows and columns) is relative to the same eigenvalues

$$\begin{aligned} XX' &= U\sum 2U' \\ X'X &= V\sum 2V' \end{aligned} \tag{4}$$

The relation between the coordinates and the equal dispersion of the two clouds justifies the representation in the same reference system (Greenacre 1984).

Furthermore, HJ-biplot is a symmetrical display. (Galindo 1986).

b. The goodness of fit is identical for rows and columns.

If we take the decompositions of cross-products matrices (4) in the form

$$XX' = \left(U\sum\right)\left(\sum U\right)' \tag{5}$$

$$X'X = \left(V\sum\right)\left(\sum V\right)' \tag{6}$$

it is possible to display the matrices in a biplot. The row and column markers are identical in both displays. The row markers of X are the same as (5) and the column markers of X are the same as (6). It is evident that the goodness of fit for the two approximations of scalar products, (rows and columns) in a k-dimensional display, is the same

$$\left(\lambda_1^4, \ldots, \lambda_k^4\right) \Big/ \left(\lambda_1^4, \ldots, \lambda_p^4\right) \tag{7}$$

Thus, it is possible to interpret the configuration (distances and scalar products) of the row scatter in an optimal representation, the configuration of the column scatter and the relationship between the two representations through the relation shown in (3).

The HJ-biplot is in some ways similar to Correspondence Analysis but is not restricted to categorical data. The markers are obtained from the usual singular value decomposition (SVD) of the data matrix.

The rules for the interpretation of the HJ-biplot are a combination of the rules used in other multidimensional scaling techniques, correspondence analysis, factor analysis and classical biplots: (1) the distances between row markers are interpreted as an inverse function of similarities, in such a way that markers that are closer to each other (countries) are more similar. This property allows for the identification of clusters of countries with similar profiles; (2) the lengths of the column markers (vectors) approximate the standard deviation of the variables; (3) the cosines of the angles between the column vectors approximate the correlations among variables in such a way that small acute angles are associated with variables with high positive correlations; obtuse angles that are almost a straight angle are associated with variables with high negative correlations and right angles are associated with non-correlated variables; (4) the order of the orthogonal projections of the row markers (points) onto a column marker (vector) approximates the order of the row elements (values) in that column. The larger the projection of a country point onto a variable vector, the more this country deviates from the average of that variable.

In short, HJ-biplot is a statistical tool to visualise the data and it is not employed to calculate the indices as such and hence not free from underlying ambiguities and assumptions. It is, however, a technique that allows the dimensionality of the problem to be reduced and allows us to represent the countries and the variables in our sample with the same quality of representation. It is also a technique that is based on simple geometric concepts such as angles, lines and vectors.

In comparison to other, more conventional techniques, such as Principal Component Analysis (PCA) or Correspondence Analysis (CA), the HJ-biplot has important advantages. Thus, according to González-Cabrera et al. (2006, p. 67), when PCA is used the axes are combinations of the variables, but these do not appear on the plots, such that very important information concerning the correlations among them is lost, and Correspondence Analysis tends to use categorical data and it is only possible to work with real positive integers. Moreover, with the HJ-biplot better values are obtained for parameters as relative contributions of the factor to the element and better quality or representation for both rows (where the countries grouped into geographical areas are located and represented as points) and columns (where the variables that are the SSI indictors are represented by vectors), that is, only the points with good quality of representation can be interpreted correctly in the subspace observed.

It is important take into account that the HJ-biplot is just an exploratory, completely nonparametric, technique: any data set can be plugged in and an answer comes out, requiring no parameters to tweak and no regard for how the data were recorded; it is not a statistical method from the viewpoint that there is no probability distribution specified for the observations. Therefore it is important to keep in mind that the HJ-Biplot best serves to represent data in simpler reduced form.

Nonetheless, this method will allow us to check whether the indicators proposed by the SSI are similar across the different countries (for example, whether economic, social or environmental concerns are similar in different geographical areas), to find geographical areas with similar sustainability profiles, to identify the most differentiated ones and to order them according to a sustainability gradient. We will likewise be able to identify the most important components of sustainability in each geographical area.

The software used to implement the HJ-biplot was developed by Vicente-Villardón (2010), and is available free of charge (http://biplot.usal.es/ClassicalBiplot/index.htlm).

4 Results of Empirical Analysis

According to Galindo (1986), several measures are essential for a correct implementation of the HJ biplot; specifically, eigenvalues and explained variance (Table 1) and the relative contribution of the factor to the element (Table 2) through which it is possible to detect the variables responsible for the position of axes and, therefore, the configuration obtained in them.

The first three axes of the HJ-biplot analysis explained 62.33 % of data variability (Fig. 1 and Table 1).

It can be deduced from Table 1 and Fig. 1 that there is a dominant axis (axis 1) that takes 43.73 % of the total inertia of the system. The trend in the eigenvalues is truncated in the third axis, achieving an accumulative inertia of 62.33. In other words, 62 % of the total inertia is absorbed by only the first three factorial axes, indicating that this percentage of the total information is present on these three axes. Factorial plane 1–2 absorbs 56.23 % of the total inertia. This factorial plane is used in the different figures to represent geographical areas and variables (see Figs. 2, 3, 4 where axis 1—horizontal- and axis 2—vertical-are represented). The remaining factors provide a smaller load of information.

Table 2 contains the contribution of each factor to the element, which lets us know the variables responsible for the positions of axes and their configuration.

The variables 'sufficient food', 'sufficient to drink', 'safe sanitation', 'healthy life', 'clean air', 'education', 'good governance', 'GDP' make a high contribution to Axis 1 and a low contribution to the remaining axes. In contrast, 'air quality', 'biodiversity' and 'renewable water resources' heavily contribute to axis 2 (see Figs. 2, 3, 4 where axis 1—horizontal and axis 2—vertical are represented).

Analysis of the contributions to the different axes shows that the first axis (axis 1 horizontal) is explained by most indicators linked to human wellbeing (see Figs. 3 and 4), such as sufficient food, sufficient to drink, safe sanitation, healthy life, clean air, education, good governance, respectively (621, 703, 739, 840, 694, 757, 684). The second factorial

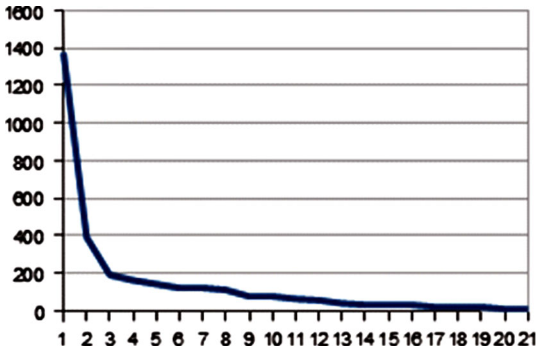
Table 1 Eigenvalues and explained variance

Axis	Eigenvalue	Expl var	Cummulative
Axis 1	1,377.48	43.73	43.73
Axis 2	393.61	12.50	56.23
Axis 3	192.41	6.11	62.33

Table 2 Relative contribution of the factor to the element

Variables	Axis 1	Axis 2	Axis 3
Sufficient food	621	32	0
Sufficient to drink	703	19	22
Safe sanitation	739	83	5
Healthy life	840	2	3
Clean air	694	5	8
Clean water	285	215	4
Education	757	1	6
Gender equality	330	199	33
Income distribution	152	12	320
Good governance	684	111	4
Air quality	98	334	85
Biodiversity	3	339	38
Renewable water resources	16	650	34
Consumption	449	67	0
Renewable energy	578	195	17
Greenhouse gases	735	38	2
Organic farming	381	162	69
Genuine savings	76	117	51
GDP	885	0	0
Employment	70	1	186
Public debt	85	10	396

Fig. 1 Eigenvalues



axis (axis 2) is determined by the variables air quality, biodiversity and renewable water resources (334, 339, 650).

The graphic representation of the five geographical areas which include the countries analysed (see Appendix 1; in our biplot, individuals) are presented in Fig. 2.

All the countries grouped in five geographical areas are represented by different forms in four quadrants. The continents are represented as follows: Africa with black five-point stars, America with red inverted triangles, Asia with purple circles, Europe with blue triangles and Oceania with green squares. The countries located in Europe, America and Oceania are mainly represented in quadrants 1 (upper-right) and countries located in Africa

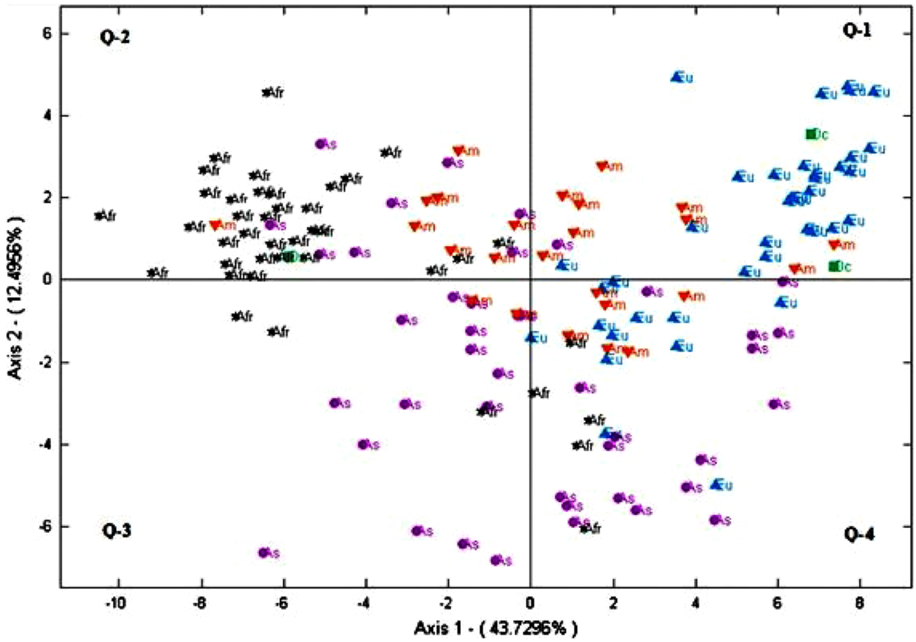


Fig. 2 Factorial plane 1–2 with the geographical areas including the 151 countries

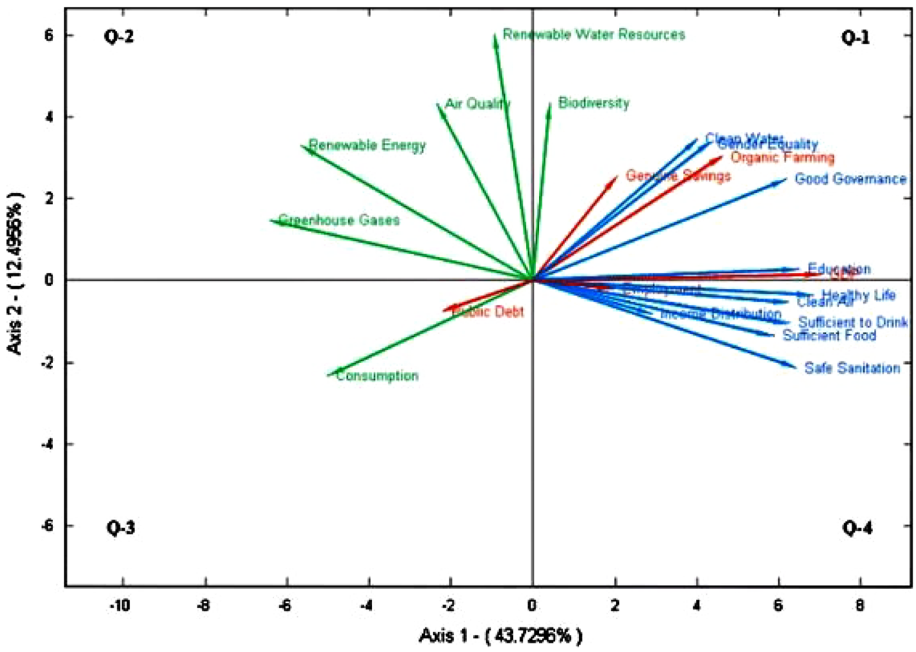


Fig. 3 Factorial plane 1–2 with the Sustainable Society Index indicators

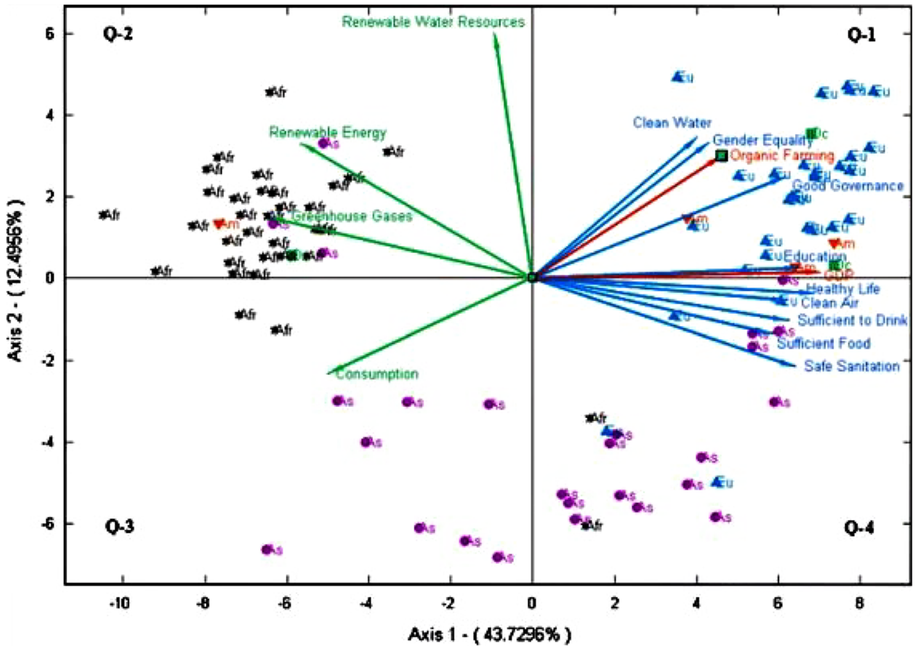


Fig. 4 Factorial plane 1–2 including the countries and variables with high quality of representation

are mainly represented in quadrants 2 (upper-left), whereas quadrants 3 (lower-left) and 4 (lower-right) contain the Asian countries.

In Fig. 3, the following variables are displayed: sufficient food, sufficient to drink, safe sanitation, healthy life, clean air, clean water, education, gender equality, income distribution, good governance, air quality, biodiversity, renewable water resources, consumption, renewable energy, greenhouse gases, organic farming, genuine saving, gross domestic product, employment and public debt. The first ten variables have to do with Human Wellbeing, while the remaining variables are associated with Environmental Wellbeing and Economic Wellbeing, according to the Sustainable Society Index. Environmental wellbeing variables are represented with green arrows, social wellbeing variables with blue arrows, and economic variables with red arrows.

As commented above, interpretation of the variables is based on the angles between the vectors, such that variables with vectors forming small angles are variables with similar behaviours. As can be observed from Fig. 3, the variables linked to Human Wellbeing, such as sufficient food, sufficient to drink, and safe sanitation, show small angles and, therefore, have similar behaviours.

Similarly, for Environmental Wellbeing (variables: air quality, biodiversity, renewable water resources), the variables are quite close, also showing a small angle. Hence, they are highly correlated and behave in a similar way.

In Fig. 4, the geographical areas (different forms) and the variables (vectors) representing human, environmental and economic wellbeing are displayed jointly. Only those countries and variables that obtained a good quality representation or goodness of fit are shown, not the total number of countries and variables.

As for the individuals, that is, countries grouped by geographical areas, when they are close to a vector-variable, it implies that they take predominant values for that variable, in the sense that the individuals are significant to explain the variable and that the variable is of great value for the individuals.

In Fig. 4, it can be observed that the variables related to Human Wellbeing are mainly closer to the countries located in the geographical areas of Europe, America and, to a lesser extent, to Asian countries. Meanwhile, other variables associated with Environmental Wellbeing, such as greenhouse gases, renewable energy, and air quality, are mainly closer to Africa, and more residually to Asia.

The continents can thus be described as follows: Africa is characterized in general by high values in consumption, greenhouse gases, renewable energy and renewable water resources, and by low values in all the social variables.

In contrast to Africa, for America we can see that its countries have high values in the social variables, organic farming and GDP, whereas it shows low values in renewable energy, greenhouse gases and consumption.

Asia, however, does not follow a set pattern for these variables, except for low values in renewable water resources. Some Asian countries also show low values in biodiversity and air quality.

It is clear that European countries all follow the same pattern: high values in all the social variables, organic farming and GDP, and low variables in renewable energy, consumption and greenhouse gases, since all the European countries grouped in the EU geographical area (see Fig. 4) are located in the first quadrant, Q-1, and in the fourth quadrant, Q-4, where the vectors representing social and economic variables such as education, good governance, clean water, clean air, organic farming, and GDP are located.

Finally, as a result of the classification of countries into continents followed, Oceania only has three countries: Australia, New Zealand and Papua New Guinea; a specific pattern therefore cannot be determined.

In order to represent the most relevant variables in each geographical area and to corroborate the results obtained from the HJ-biplot, we carried out an analysis of the radial graphs that represent the values of each variable along the independent axes in the form of radii that have their starting point in the centre of the plot and end in the outer ring, such that each radius corresponds to one variable. Figure 5 shows a geographical area in each star plot.

As can be observed in the star plots, Africa is characterized by high values in the greenhouse gases and renewable water resources indices, as well as by low values in all the social variables. In contrast, the variables related to Human Wellbeing are mainly closer to the countries located in the geographical areas of Europe, America and, to a lesser extent, Asian countries. Asia shows a very bad performance in sustainable use of resources but no specific pattern can be determined for Oceania.

This study has enabled us to verify that this kind of plot helps to corroborate the results obtained in the analyses run using the HJ-biplot methodology.

5 Discussion

Recently, different organizations and authors have developed indicators to measure sustainability issues worldwide. Among these, the Sustainable Society Index (SSI) compiles information from 151 countries.

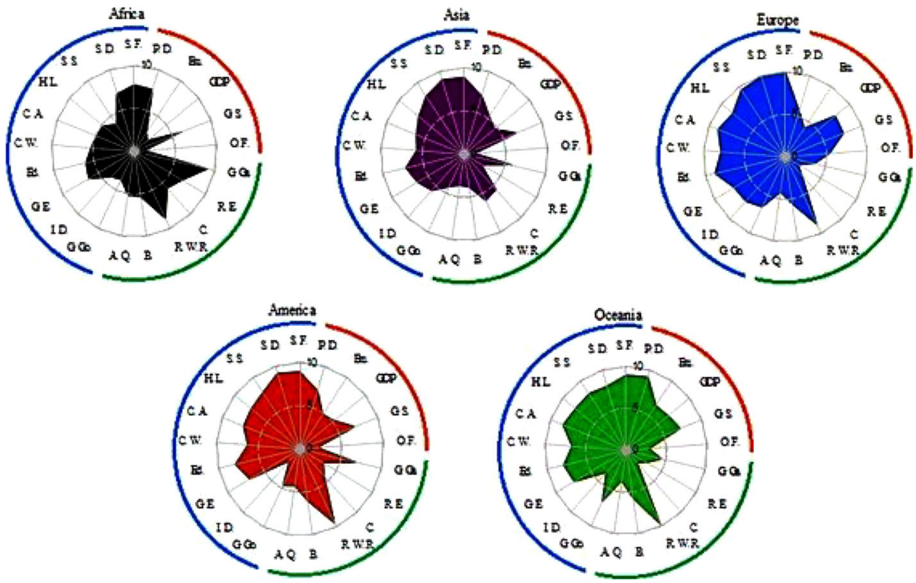


Fig. 5 Radial profiles by geographical area representing the indicators

With the purpose of studying whether these countries grouped into five geographical areas show the same interest concerning economic, social and environmental issues, we employed an HJ-biplot analysis, an exploratory data analysis method that looks for hidden patterns in the data matrix. Unlike other techniques, the biplot can allow us to detect differences easily in the behaviour of geographical areas with regard to different dimensions (SSI indicators) in a visual form, as well as the proximity of each country to a specific set of indicators. This technique enables us to reflect both the indicators and the geographical areas at the same time, showing the proximity of the latter to the former. Also, it permits analysis of different dimensions (sets of SSI indicators) simultaneously.

In the interpretation of the biplots, the different forms reflect individuals (in our study, the countries grouped into five geographical areas) and the vectors represent variables (in our study, the variables related to Basic Needs, Health, Personal and Social Development, Nature and Environment, Natural Resources, Climate and Energy Transition, Economy).

From the results obtained, it can be deduced that the core policy categories for Environmental Wellbeing, such as greenhouse gas emissions, renewable energy, and air quality, are mainly closer to Africa, and more residually to Asia. In contrast, other variables related to Human Wellbeing (education, gender equality, clean water, good governance) are mainly in closer proximity to the countries located in the geographical areas of Europe, America and, to a lesser extent, Asian countries.

Similarly to Van de Kerk and Manuel (2008), we find that the relationship between economic, social and environmental wellbeing is weak, such that countries with high environmental wellbeing do not necessarily attain high scores in social or economic wellbeing. In line with those authors, our findings show that Europe has relatively high values in the category of personal development, in areas such as education, gender equality and good governance, as well as in economic issues, the most salient being organic farming, genuine savings and gross domestic product (GDP).

The relation between GDP and the non-economic dimension of a country was previously analyzed by Cracolici et al. (2010), who suggest that when the GDP of a country rises, there is also a higher level in non-economic aspects such as better health conditions and a higher percentage of educated population. They found that GDP is a basic condition for obtaining a good social performance and a high level of GDP also allows the population to have a longer life expectancy and to achieve a higher level of education (Cracolici et al. 2010, p. 354). Our findings are also in this line, if we consider the economic and social wellbeing indicators in the most developed countries where GDP is higher.

At the same time, and in line with Saisana and Philippas (2012), our findings confirm the inverted shaped relationship between Economic and Environmental Wellbeing (known as Environmental Kuznets Curve) since Environmental Wellbeing has a negative correlation to Human Wellbeing and to Economic Wellbeing, although this is not necessarily the case in all countries (Cole et al. 1997; Daly and Cobb 1989a, b; Ekins 1997; Kuznets 1955).

On the opposite end we have Africa, where issues related to climate and energy take maximum priority, especially renewable energy and greenhouse gas emissions; other environmental issues that also manifest as latent in this geographical area are air quality and renewable water resources. In contrast, a well-balanced society does not appear as a priority in African countries. The results obtained by Hosseini and Kaneko (2011) are also in this line, as they found that Africa has the worst standing relative to other regions for institutional, economic and social pillars; the only positive outcome belongs to the environmental pillar.

This situation may be a result of the fact that many countries are located in arid regions or are in the midst of some type of conflict. This is the case of certain areas of Africa and Asia, and, although it must be said that in these geographical areas improvements have been made in the areas of mother–child health, child education, and infant mortality, there are still many deficiencies.

In relation to climate change, the countries most concerned are the ones with economies based on subsistence agriculture and with low industrial levels owing to economic limitations. Africa, for example, is considered the continent most vulnerable to the adverse effects of climate change (Brown et al. 2007; Hsu et al. 2013; Kotir 2011). For the African Partnership Forum (2007), Africa is particularly vulnerable to climate change because of its dependency on dryland farming, aggravated by factors such as widespread poverty. The main long-term impacts include a change in precipitation patterns that will affect agriculture, a decrease in food safety, a deterioration of water safety, a decrease in fishing resources owing to higher temperatures and an increase in sea level that is affecting low-lying coastal areas with large populations (Wittig et al. 2007).

Looking within Africa, while countries in the northern and Sub-Saharan areas are considered the poorest and worst off, and with a worsening trend, there are nonetheless countries in these regions that are exceptions to the rule and they deserve a more in-depth analysis to find the underlying factors that may have given rise to their better performance in comparison to the other countries in their context. This is the case of Libya and Egypt, which show a certain improvement, and in Sub-Saharan Africa, Angola has shown the best performance of all countries in terms of environmental improvement in the last decade. The southern part of Africa is in a more disadvantageous position in this sense, with Eritrea and Nigeria behind other countries as regards environmental issues.

There are certain measures that could be used to palliate the environmental problems that African countries in general are suffering from. Governments could provide incentives for joint management of natural resources such as water or energy. However, they mainly provide plenty of fine words but little action in the short term, preferring to set up commissions to draft reports and establishing time periods of 10 years or more for solving problems. Another measure could be for African countries to participate in a mechanism derived from the Kyoto Protocol which offers an opportunity to combine measures to mitigate climate change with an outcome that benefits society by means of activities financed through the Clean Development Mechanism (CDM). However, African countries have hardly been given access to participate in this mechanism, and it is therefore considered necessary to foster this financing mechanism. Investing in the design of better and more modern energy systems is another possible measure to take. This could take the form of using biofuels and improving solar technology. Also, taking into account the rising population of large cities such as Lagos, Nairobi, Johannesburg and Accra, new urban designs should be posited, with low carbon emitting technologies.

In Asia, the increase in the use of fossil fuels in China and other parts of South Asia means that there will be an increase in emissions, especially of carbon dioxide. This increase in the use of energy has led to an important increase in air pollution across the whole region. There is also the problem of pollution in the Pacific Ocean, since a high percentage of water has to be treated, at the same time that waste elimination is a huge problem in such densely populated countries, especially in India and China.

The increase in production and consumption in Asia is giving rise to greater energy consumption, more carbon dioxide emissions and other forms of pollution, as well as to a greater concern for environmental issues. In this sense, and according to Roberts and Kanaley (2006), Asia will contribute 56 % of the total growth in global carbon dioxide emissions for the 1990–2025 period, with China alone contributing 34 %. This opinion is shared by Schandl et al. (2009), who refer to the fact that the rapid socio-ecological transition in China is contributing to global high energy consumption and carbon dioxide emissions and now only the United States consumes more energy and emits more carbon dioxide than China.

As regards the social aspect of sustainability, in Asia the population is moving from rural areas to the cities, which offer better quality of life, better access to education, better health care, water supply and sanitation, all of which is reflected in a higher life expectancy and lower infant mortality. Although economic and social conditions have improved in Asia in recent years, there is still great inequality as far as income level, living standards and socio-economic conditions are concerned.

Europe and America include countries with a high and medium Gross National Income (GNI) per capita, the measure used by the World Bank (World Bank 2013) to classify countries according to income level. Thus, countries with a high income, such as Austria, Finland, Australia, the United Kingdom, the United States, Norway, Canada, etc., are characterized as being in close proximity to variables representing human and economic well-being, such as education, good governance, gender equality, clean water, and healthy life, among others. This means that when the wealth of a country increases, there is also an increase in non-economic aspects of well-being, such as better health conditions and a more educated population. The results obtained in our research corroborate those of Cracolici et al. (2010, p. 354), who found that GDP is a basic condition for good social behaviour and a high GDP also provides the population with longer life expectancy and a high level of education.

In order to represent the most significant variables in each geographical area and corroborate the results obtained with the HJ-biplot methodology, an analysis was made of the radial profiles (star plots) that represent the values of each variable along the independent axes in the form of radii that start at the centre of the plot and end in the outer ring; each radius corresponds to one variable. Our findings show the characteristics of each geographical area in relation to the Sustainable Society Index, and confirm the results obtained with the HJ Biplot methodology; furthermore, they are in line with those obtained by Van de Kerk and Manuel (2008).

6 Conclusions

The objective of this paper has been to analyze whether the scores obtained from the indicators proposed in the Sustainable Society Index are similar in different countries or whether there are differences depending on the geographical area in which the country is located. In order to pursue that aim, we analysed a broad sample (151 countries) using a statistical technique—the HJ-biplot—applied to the SSI, in order to depict jointly the geographical areas and the most relevant indicators.

The tables and figures obtained show different objectives concerning Sustainable Society issues. From a statistical point of view, the eigenvalues, the variance explained, and the relative contribution of factor to element ensure the validity of the research. The joint use of the SSI indicators and the HJ-biplot method allow us to depict the geographical zones and the most relevant indicators jointly, showing the proximity of the latter to the former. SSI indicators enable us to extend the analysis beyond a specific country or geographical area, thereby including different contexts in our study. Unlike other techniques, the biplot easily allows us to detect differences in the behaviour of different geographical areas with regard to different dimensions (SSI indicators) in a visual form, as well as the proximity of each country to a specific set of indicators.

From the empirical analyses performed, we were able to draw certain conclusions: the variables linked to Human Wellbeing, such as sufficient food, sufficient to drink, and safe sanitation, show small angles and, therefore, have similar behaviours. Likewise, for Environmental Wellbeing (variables: air quality, biodiversity, renewable water resources), the variables are quite close, also showing a small angle. Hence, they are highly correlated and behave in a similar way.

Additionally, in light of the location of the indicators in different geographical areas, we found that the variables related to Human Wellbeing place more closely to the countries located in the geographical areas of Europe, America and, to a lesser extent, Asia. Meanwhile, other variables associated with Environmental Wellbeing, such as greenhouse gases, renewable energy, and air quality, are mainly closer to Africa, and more residually so to Asia.

After analyzing one of the most significant sets of indicators for sustainability (Sustainable Society Index), the results obtained show that not all geographical areas share the same perspective on economic, social and environmental issues.

In comparison to other related works (e.g. Hosseini and Kaneko 2011), we extend previous literature by analyzing a wider sample of countries, focusing on a broad set of indicators which reflect the main sustainability concerns worldwide. Also, we improve the methodological approach, going beyond the Principal Component Analysis (PCA) and Factor Analysis (FA) used by Srebotnjak et al. (2011) and Zafiriou et al. (2012). Important advantages can be gained from using the HJ-biplot method instead of employing other perhaps more conventional ones. When principal component analysis is used, the axes are combinations of the variables, but these do not appear on the plots, so that very important information concerning the correlations among them is lost, as is the information about the relative situation of the points with respect to the variables, which is interpreted in terms of greater or lesser preponderance in the HJ-biplot method (González-Cabrera et al. 2006). Therefore, the analysis obtained is more representative and better shows the situation of the different geographical areas in regard to sustainable society issues.

As a future line of research we plan to extend this study to include the different years, that is, considering countries, indices and time (three-way-data) in order to gain information about the stability and the differences in the country profiles, according to their level of sustainability throughout the whole time period 2006–2012.

Appendix 1

See Table 3.

Table 3 Countries in the sample

Albania	Cote d'Ivoire	Iraq	Morocco	Spain
Algeria	Croatia	Ireland	Mozambique	Sri Lanka
Angola	Cuba	Israel	Myanmar	Sudan
Argentina	Cyprus	Italy	Namibia	Sweden
Armenia	Czech Republic	Jamaica	Nepal	Switzerland
Australia	Denmark	Japan	Netherlands	Syria
Austria	Dominican Republic	Jordan	New Zealand	Taiwan
Azerbaijan	Ecuador	Kazakhstan	Nicaragua	Tajikistan
Bangladesh	Egypt	Kenya	Niger	Tanzania
Belarus	El Salvador	Korea, North	Nigeria	Thailand
Belgium	Estonia	Korea, South	Norway	Togo
Benin	Ethiopia	Kuwait	Oman	Trinidad and Tobago
Bhutan	Finland	Kyrgyz Republic	Pakistan	Tunisia
Bolivia	France	Laos	Panama	Turkey
Bosnia-Herzegovina	Gabon	Latvia	Papua New Guinea	Turkmenistan
Botswana	Gambia	Lebanon	Paraguay	Uganda
Brazil	Georgia	Liberia	Peru	Ukraine
Bulgaria	Germany	Libya	Philippines	United Arab Emirates
Burkina Faso	Ghana	Lithuania	Poland	United Kingdom
Burundi	Greece	Luxembourg	Portugal	United States
Cambodia	Guatemala	Macedonia	Qatar	Uruguay
Cameroon	Guinea	Madagascar	Romania	Uzbekistan
Canada	Guinea-Bissau	Malawi	Russia	Venezuela
Central African Republic	Guyana	Malaysia	Rwanda	Vietnam
Chad	Haiti	Mali	Saudi Arabia	Yemen
Chile	Honduras	Malta	Senegal	Zambia
China	Hungary	Mauritania	Serbia	Zimbabwe
Colombia	Iceland	Mexico	Sierra Leone	
Congo	India	Moldova	Slovak Republic	
Congo Dem. Rep.	Indonesia	Mongolia	Slovenia	
Costa Rica	Iran	Montenegro	South Africa	

Appendix 2

See Table 4.

Table 4 Geographical areas and variables

	S. F.	S. D.	S. S.	H. L.	C. A.	C. W.	Ed.	G. E.	I. D.	G. Go.	A. Q.
ALB (Eu)	10.00	9.50	9.40	7.38	10.00	8.25	6.79	6.75	6.91	4.67	5.75
ALG (Afr)	10.00	8.30	9.50	7.06	10.00	5.83	7.81	5.99	6.00	3.26	6.17
ANG (Afr)	5.90	5.10	5.80	4.30	4.87	5.18	6.54	6.62	1.00	2.97	7.22
ARG (Am)	10.00	9.70	9.00	7.89	10.00	8.43	9.36	7.24	1.39	4.46	6.17
ARM (As)	7.90	9.80	9.00	6.87	4.60	5.10	7.68	6.65	7.95	4.39	3.41
AUS (Oc)	10.00	10.00	10.00	9.03	10.00	6.17	10.00	7.29	4.40	8.18	1.08
AUT (Eu)	10.00	10.00	10.00	8.68	10.00	9.51	9.13	7.17	9.05	8.13	7.04
AZE (As)	8.90	8.00	8.20	6.58	6.32	4.43	6.49	6.58	7.05	3.36	2.80
BAN (As)	7.40	8.10	5.60	6.08	1.37	8.72	4.87	6.81	8.44	3.28	6.37
BLR (Eu)	10.00	10.00	9.30	7.03	10.00	4.43	9.04	7.10	8.78	3.06	3.91
BEL (Eu)	10.00	10.00	10.00	8.70	10.00	6.63	9.68	7.53	8.66	7.67	5.37
BEN (Afr)	8.80	7.50	1.30	5.12	3.94	3.72	5.78	5.83	5.54	4.42	7.05
BHU (As)	6.70	9.60	4.40	5.93	5.64	4.28	6.56	6.30	3.07	5.20	5.52
BOL (Am)	7.30	8.80	2.70	6.44	5.89	8.34	8.12	6.86	1.00	3.90	5.63
BIH (Eu)	10.00	9.90	9.50	7.88	5.52	9.35	7.60	7.00	5.71	4.23	1.00
BOT (Afr)	7.50	9.60	6.20	4.97	5.59	4.29	6.98	6.83	1.00	6.32	1.75
BRA (Am)	9.40	9.80	7.90	7.44	6.92	8.54	8.75	6.68	1.00	5.29	4.61
BUL (Eu)	9.00	10.00	10.00	7.77	10.00	8.11	7.99	6.99	5.97	5.40	3.18
BUR (Afr)	9.20	7.90	1.70	3.97	3.50	5.05	3.85	6.15	5.33	4.46	6.37
BDI (Afr)	3.80	7.20	4.60	3.97	4.85	3.98	6.43	7.27	7.95	2.67	4.77
CAM (As)	7.50	6.40	3.10	5.64	4.20	9.00	6.17	6.46	4.45	3.30	6.44
CMR (Afr)	7.80	7.70	4.90	4.29	3.36	5.29	6.35	6.07	5.54	3.25	5.77
CAN (Am)	10.00	10.00	10.00	8.82	10.00	9.31	8.95	7.41	6.13	8.24	2.24
CAF (Afr)	6.00	6.70	3.40	3.88	4.84	4.52	4.08	6.00	1.00	2.38	5.40
CHA (Afr)	6.10	5.10	1.30	3.40	3.99	4.47	4.71	5.33	4.82	2.23	5.40
CHI (Am)	10.00	9.60	9.60	8.38	10.00	5.26	8.47	7.03	1.00	7.35	1.00

Table 4 continued

	S. F.	S. D.	S. S.	H. L.	C. A.	C. W.	Ed.	G. E.	I. D.	G. Go.	A. Q.
CHN (As)	9.00	9.10	6.40	7.74	1.97	6.80	6.96	6.87	4.19	3.84	1.82
COL (Am)	9.10	9.20	7.70	7.73	6.47	5.46	8.48	6.71	1.00	4.35	6.11
CGO (Afr)	8.70	7.10	1.80	4.75	2.82	4.90	6.12	6.00	2.64	2.98	2.70
COD (Afr)	3.10	4.50	2.40	4.27	2.91	4.79	5.38	6.00	3.46	1.69	6.78
CRC (Am)	10.00	9.70	9.50	8.21	6.49	4.77	7.41	7.27	1.48	6.22	6.02
CIV (Afr)	8.60	8.00	2.40	4.71	4.53	5.09	3.92	5.77	3.79	2.58	7.11
CRO (Eu)	10.00	9.90	9.90	8.07	6.51	9.25	8.18	7.01	6.15	5.82	3.96
CUB (Am)	10.00	9.40	9.10	8.24	7.80	8.86	9.56	7.39	2.84	3.93	1.93
CYP (As)	10.00	10.00	10.00	8.38	10.00	7.53	8.60	6.57	8.14	7.20	2.82
CZE (Eu)	10.00	10.00	9.80	8.39	10.00	7.45	8.48	6.79	9.22	6.83	3.64
DEN (Eu)	10.00	10.00	10.00	8.73	10.00	7.49	9.91	7.78	5.25	8.64	6.73
DOM (Am)	7.60	8.60	8.30	7.24	6.66	4.65	7.32	6.68	1.76	4.20	4.08
ECU (Am)	8.50	9.40	9.20	7.38	10.00	8.34	8.00	7.04	1.41	3.41	4.72
EGY (Afr)	10.00	9.90	9.50	6.74	8.47	6.24	7.12	5.93	7.63	3.87	4.21
ESA (Am)	9.10	8.80	8.70	6.89	6.09	4.98	7.09	6.57	2.21	4.80	5.19
EST (Eu)	10.00	9.80	9.50	7.97	6.31	9.43	8.95	6.98	6.95	7.16	1.00
ETH (Afr)	5.90	4.40	2.10	5.21	4.20	4.28	5.51	6.14	8.35	3.10	6.85
FIN (Eu)	10.00	10.00	10.00	8.73	10.00	8.76	10.00	8.38	9.31	8.70	4.87
FRA (Eu)	10.00	10.00	10.00	8.88	9.95	8.65	9.44	7.02	7.72	7.54	5.49
GAB (Afr)	10.00	8.70	3.30	5.46	5.95	4.21	7.58	6.00	4.36	3.85	4.51
GAM (Afr)	8.10	8.90	6.80	5.26	1.00	4.86	5.45	6.76	2.37	3.94	6.37
GEO (As)	9.40	9.80	9.50	7.38	5.61	4.02	7.19	6.62	3.26	4.88	5.64
GER (Eu)	10.00	10.00	10.00	8.88	10.00	7.86	9.52	7.59	7.72	7.87	5.89
GHA (Afr)	10.00	8.60	1.40	5.15	4.06	7.78	6.46	6.81	3.13	5.21	5.94
GRE (Eu)	10.00	10.00	9.80	8.79	10.00	7.71	9.86	6.92	5.90	5.82	2.35
GUA (Am)	7.80	9.20	7.80	6.74	5.35	5.99	7.07	6.23	1.00	3.80	4.90

Table 4 continued

	S. F.	S. D.	S. S.	H. L.	C. A.	C. W.	Ed.	G. E.	I. D.	G. Go.	A. Q.
GUI (Afr)	8.40	7.40	1.80	4.65	4.73	4.55	5.23	6.20	5.02	2.45	6.37
GBS (Afr)	7.80	6.40	2.00	3.77	5.02	4.55	6.54	6.20	6.25	2.94	6.37
GUY (Am)	9.20	9.40	8.40	5.62	6.59	4.28	6.92	7.08	1.00	4.27	4.49
HAI (Am)	4.30	6.90	1.70	5.77	5.05	3.97	5.84	7.10	1.00	2.69	6.77
HON (Am)	8.80	8.70	7.70	7.07	5.41	4.97	7.21	6.95	1.00	3.79	4.26
HUN (Eu)	10.00	10.00	10.00	7.77	10.00	7.40	8.94	6.64	9.70	6.49	4.14
ISL (Eu)	10.00	10.00	10.00	9.06	10.00	10.00	9.59	8.53	8.98	7.84	1.10
IND (As)	8.10	9.20	3.40	6.10	1.00	7.89	6.46	6.19	6.64	4.38	3.89
INA (As)	8.70	8.20	5.40	6.78	5.43	6.22	7.56	6.59	6.31	4.04	3.89
IRI (As)	10.00	9.60	10.00	6.92	8.08	4.98	7.77	5.89	5.07	2.65	2.76
IRQ (As)	9.20	7.90	7.30	5.69	3.84	4.27	6.27	6.20	8.03	2.15	2.15
IRL (Eu)	10.00	10.00	9.90	8.91	10.00	9.19	10.00	7.83	6.15	7.91	4.61
ISR (As)	10.00	10.00	10.00	8.98	9.81	5.77	9.21	6.93	4.07	6.04	1.77
ITA (Eu)	10.00	10.00	10.00	9.02	10.00	8.22	9.08	6.80	6.30	6.03	5.81
JAM (Am)	10.00	9.30	8.00	7.42	6.32	4.62	8.27	7.03	3.17	4.88	2.25
JPN (As)	10.00	10.00	10.00	9.39	10.00	8.78	8.92	6.51	10.00	7.38	5.96
JOR (As)	10.00	9.70	9.80	7.21	9.35	3.00	7.52	6.12	5.89	4.83	2.67
KAZ (As)	10.00	9.50	9.70	6.27	6.53	4.34	8.96	7.01	8.03	4.03	3.09
KEN (Afr)	6.70	5.90	3.20	4.87	5.21	5.79	6.70	6.49	2.25	3.66	5.85
PRK (As)	6.50	9.80	8.00	6.51	7.21	4.41	5.95	6.70	6.44	1.80	3.91
KOR (As)	10.00	9.80	10.00	8.65	8.90	8.49	10.00	6.28	7.22	6.44	5.37
KUW (As)	10.00	9.90	10.00	8.20	8.53	4.48	8.31	6.32	6.44	5.36	1.00
KGZ (As)	8.90	9.00	9.30	6.33	4.87	4.13	7.60	7.04	7.87	3.28	3.82
LAO (As)	7.80	6.70	6.30	5.80	3.95	8.51	6.30	6.80	6.31	3.07	4.87
LAT (Eu)	10.00	9.90	7.80	7.65	6.64	9.05	8.24	7.40	4.17	6.33	7.44
LIB (As)	10.00	10.00	9.80	7.04	10.00	4.06	8.14	6.08	5.95	3.78	2.61

Table 4 continued

	S. F.	S. D.	S. S.	H. L.	C. A.	C. W.	Ed.	G. E.	I. D.	G. Go.	A. Q.
LBR (Afr)	6.80	7.30	1.80	4.90	4.60	4.85	6.32	6.20	4.36	3.50	6.37
LBA (Afr)	10.00	9.10	9.70	7.39	10.00	4.94	9.27	6.00	6.44	2.81	4.15
LTU (Eu)	10.00	10.00	9.40	7.46	10.00	8.59	9.07	7.13	3.71	6.45	4.28
LUX (Eu)	10.00	10.00	10.00	8.83	10.00	7.03	7.55	7.22	8.44	8.42	6.25
MKD (Eu)	10.00	10.00	8.80	7.71	5.73	5.97	7.13	6.97	3.33	4.79	2.04
MAD (Afr)	7.50	4.60	1.50	5.44	5.01	4.76	6.75	6.80	3.20	3.51	4.77
MAW (Afr)	7.30	8.30	5.10	4.26	5.01	3.03	6.77	6.85	5.49	4.47	4.77
MAS (As)	10.00	10.00	9.60	7.39	9.73	5.46	7.13	6.53	2.23	5.64	4.15
MLI (Afr)	8.80	6.40	2.20	3.78	3.54	7.86	4.83	5.75	5.12	4.14	6.37
MLT (Eu)	10.00	10.00	10.00	8.74	10.00	2.39	8.19	6.66	8.22	7.42	2.36
MTN (Afr)	9.20	5.00	2.60	5.23	4.57	4.58	5.01	6.16	4.92	3.19	6.37
MEX (Am)	10.00	9.60	8.50	7.91	6.27	6.14	8.09	6.60	1.00	4.60	3.26
MDA (Eu)	10.00	9.60	8.50	6.91	6.38	4.88	6.90	7.08	5.49	4.21	4.51
MGL (As)	7.30	8.20	5.10	6.45	5.19	4.50	8.67	7.14	6.64	4.49	1.30
MNE (Eu)	10.00	9.80	9.00	7.53	5.83	8.36	8.58	7.00	7.95	5.13	3.38
MAR (Afr)	10.00	8.30	7.00	7.09	6.93	6.29	6.04	5.80	4.49	4.36	3.16
MOZ (Afr)	6.20	4.70	1.80	3.77	5.02	4.66	5.89	7.25	2.37	4.49	5.02
MYA (As)	8.40	8.30	7.60	5.11	3.38	4.57	5.74	6.80	1.72	1.51	7.02
NAM (Afr)	8.20	9.30	3.20	5.53	5.41	4.57	6.94	7.18	1.00	5.61	1.00
NEP (As)	8.30	8.90	3.10	5.97	1.80	4.60	5.76	5.89	3.33	3.19	5.52
NED (Eu)	10.00	10.00	10.00	8.89	10.00	7.32	9.94	7.47	8.95	8.30	6.77
NZL (Oc)	10.00	10.00	10.00	8.85	10.00	9.92	10.00	7.81	4.45	8.52	3.92
NCA (Am)	8.10	8.50	5.20	7.42	5.42	4.23	7.01	7.25	1.00	3.66	4.26
NIG (Afr)	8.40	4.90	1.00	4.14	3.64	4.22	3.39	6.20	7.19	3.62	6.37
NGR (Afr)	9.40	5.80	3.10	3.79	2.96	4.48	5.58	6.01	3.07	2.65	6.26
NOR (Eu)	10.00	10.00	10.00	8.89	10.00	9.51	9.80	8.40	9.11	8.39	6.60

Table 4 continued

	S. F.	S. D.	S. S.	H. L.	C. A.	C. W.	Ed.	G. E.	I. D.	G. Go.	A. Q.
OMA (As)	9.20	8.90	9.90	7.49	8.85	4.42	7.54	5.87	6.44	5.59	1.79
PAK (As)	7.50	9.20	4.80	5.90	1.88	6.26	4.37	5.58	7.71	2.74	4.12
PAN (Am)	8.50	9.30	6.90	7.88	6.32	9.22	7.83	7.04	1.00	5.18	4.31
PNG (Oc)	6.90	4.00	4.50	6.12	5.08	3.96	3.70	7.10	1.83	3.62	5.96
PAR (Am)	9.00	8.60	7.10	7.39	5.53	5.18	7.05	6.82	1.00	3.68	6.23
PER (Am)	8.40	8.50	7.10	7.89	5.72	8.34	8.29	6.80	1.20	4.52	1.39
PHI (As)	8.70	9.20	7.40	7.06	5.54	8.93	7.88	7.69	3.83	3.87	3.91
POL (Eu)	10.00	10.00	9.00	7.91	10.00	8.16	8.80	7.04	7.16	6.61	2.54
POR (Eu)	10.00	9.90	10.00	8.56	10.00	7.79	9.56	7.14	6.27	6.91	3.77
QAT (As)	10.00	10.00	10.00	7.88	10.00	4.48	5.74	6.23	1.00	6.32	3.27
ROU (Eu)	10.00	8.80	7.20	7.60	6.06	8.15	8.37	6.81	5.67	5.37	2.14
RUS (Eu)	10.00	9.70	7.00	6.83	6.92	8.24	8.53	7.04	4.23	3.51	1.93
RWA (Afr)	6.80	6.50	5.50	3.97	4.00	4.61	6.84	6.80	1.09	4.50	4.77
KSA (As)	10.00	9.10	8.80	7.06	8.63	4.24	8.43	5.75	6.44	4.46	1.88
SEN (Afr)	8.10	7.20	5.20	5.25	2.77	8.36	4.97	6.57	4.77	4.14	4.86
SRB (Eu)	10.00	9.90	9.20	7.54	5.77	8.36	7.85	7.00	8.69	4.72	3.38
SLE (Afr)	6.50	5.50	1.30	2.65	4.74	4.90	4.67	6.20	4.36	3.67	6.37
SVK (Eu)	10.00	10.00	10.00	7.94	10.00	8.92	8.02	6.80	8.56	6.56	3.95
SLO (Eu)	10.00	9.90	10.00	8.56	6.78	9.30	9.42	7.04	9.58	6.83	3.73
RSA (Afr)	10.00	9.10	7.90	4.76	6.28	8.42	7.99	7.48	1.00	5.47	1.20
ESP (Eu)	10.00	10.00	10.00	9.09	10.00	8.31	10.00	7.58	2.80	6.78	3.38
SRI (As)	8.00	9.10	9.20	7.21	5.18	9.17	6.46	7.21	5.33	4.26	3.65
SUD (Afr)	7.80	5.80	2.60	5.08	3.87	6.52	3.86	6.00	1.72	1.74	6.71
SWE (Eu)	10.00	10.00	10.00	9.08	10.00	9.62	9.28	8.04	9.05	8.53	6.61
SUI (Eu)	10.00	10.00	10.00	9.21	10.00	8.69	8.69	7.63	7.60	8.41	7.26
SYR (As)	10.00	9.00	9.50	7.21	8.08	4.50	6.64	5.90	6.64	3.14	2.74

Table 4 continued

	S. F.	S. D.	S. S.	H. L.	C. A.	C. W.	Ed.	G. E.	I. D.	G. Go.	A. Q.
TPE (As)	10.00	10.00	10.00	8.53	10.00	6.26	9.51	6.70	6.19	6.94	5.09
TJK (As)	7.40	6.40	9.40	6.27	4.17	4.51	7.18	6.53	6.98	2.80	3.80
TAN (Afr)	6.60	5.30	1.00	4.40	5.02	8.50	5.66	6.90	5.49	4.33	6.37
THA (As)	8.40	9.60	9.60	7.04	4.03	8.27	7.19	6.89	4.40	4.32	4.29
TOG (Afr)	7.00	6.10	1.30	5.26	4.12	4.42	6.27	6.20	6.84	3.23	7.00
TRI (Am)	8.90	9.40	9.20	7.06	10.00	4.63	6.41	7.37	3.79	5.22	4.45
TUN (Afr)	10.00	9.40	8.50	7.71	10.00	6.30	7.80	6.26	4.32	4.64	2.72
TUR (As)	10.00	10.00	9.00	7.76	6.48	5.79	7.56	5.95	2.87	4.90	3.06
TKM (As)	9.30	9.10	9.80	5.86	9.76	4.50	6.76	6.90	4.40	2.22	1.68
UGA (Afr)	7.80	7.20	3.40	3.86	4.93	3.95	6.85	7.22	3.36	3.81	4.77
UKR (Eu)	10.00	9.80	9.40	6.81	6.92	2.98	9.20	6.86	9.05	3.88	1.88
UAE (As)	10.00	10.00	9.80	8.06	8.29	4.48	6.72	6.45	6.44	5.82	3.25
GBR (Eu)	10.00	10.00	10.00	8.77	10.00	8.16	9.01	7.46	6.24	7.76	5.13
USA (Am)	10.00	9.90	10.00	8.38	10.00	7.75	9.83	7.41	3.20	7.38	3.04
URU (Am)	10.00	10.00	10.00	7.86	7.31	6.34	9.05	6.91	3.75	6.70	5.14
UZB (As)	8.90	8.70	10.00	6.56	3.97	3.80	7.15	6.90	5.60	2.38	3.06
VEN (Am)	9.30	9.10	8.60	7.71	10.00	4.05	8.92	6.86	2.64	2.41	3.94
VIE (As)	8.90	9.50	7.60	7.39	3.10	7.27	6.58	6.73	6.13	3.92	4.38
YEM (As)	7.00	5.50	5.30	5.79	3.47	4.48	5.47	4.87	5.43	2.56	2.80
ZAM (Afr)	5.60	6.10	4.80	3.56	5.12	4.17	5.90	6.30	1.00	4.28	1.00
ZIM (Afr)	7.00	8.00	4.00	3.55	5.25	7.19	5.71	6.61	1.67	1.84	3.64
	B.	**R. W. R.**	**C.**	**R. E.**	**G. Ga.**	**O. F.**	**G. S.**	**GDP**	**Em.**	**P. D.**	
ALB (Eu)	4.21	9.56	6.33	4.16	8.83	1.00	6.57	4.28	3.17	4.86	
ALG (Afr)	3.12	4.74	6.56	1.00	7.22	1.00	9.47	4.11	3.68	9.83	
ANG (Afr)	6.03	9.96	7.35	5.84	9.13	1.00	1.00	3.48	1.00	9.00	

Table 4 continued

	B.	R. W. R.	C.	R. E.	G. Ga.	O. F.	G. S.	GDP	Em.	P. D.
ARG (Am)	2.63	9.60	3.53	1.00	5.79	5.24	8.53	7.17	4.89	7.74
ARM (As)	4.00	6.36	6.27	1.00	8.69	1.00	7.98	3.24	1.50	8.70
AUS (Oc)	6.23	9.54	1.00	1.00	1.00	5.20	8.26	9.50	6.00	9.41
AUT (Eu)	10.00	9.53	2.54	2.68	1.73	9.93	9.01	9.56	6.57	2.29
AZE (As)	3.57	6.53	6.63	1.00	7.27	1.06	7.54	5.20	5.46	9.83
BAN (As)	1.00	9.71	8.31	2.86	9.64	1.00	9.40	1.22	6.07	8.57
BLR (Eu)	3.61	9.25	3.30	1.00	3.12	1.00	9.07	6.61	9.42	6.76
BEL (Eu)	6.58	6.60	1.00	1.00	1.00	5.90	8.95	9.39	4.86	1.00
BEN (Afr)	10.00	9.95	6.49	5.62	9.49	1.00	8.12	1.08	9.32	8.97
BHU (As)	10.00	9.96	1.00	4.76	9.57	1.00	9.67	3.58	6.70	1.27
BOL (Am)	9.25	9.97	2.47	2.69	8.58	1.00	8.09	2.95	5.77	8.87
BIH (Eu)	1.00	9.91	4.75	1.36	4.71	1.00	5.00	4.44	1.00	8.18
BOT (Afr)	10.00	9.84	3.64	2.15	7.71	1.00	9.16	6.84	4.72	9.62
BRA (Am)	10.00	9.93	1.82	4.39	8.01	1.57	7.81	5.71	5.50	3.28
BUL (Eu)	4.43	7.13	3.73	1.00	4.19	1.90	8.57	6.24	2.88	9.63
BUR (Afr)	7.12	9.21	5.11	8.58	9.86	1.00	7.01	1.08	7.19	9.09
BDI (Afr)	2.42	9.77	7.24	8.58	9.86	1.00	1.00	1.00	1.00	8.69
CAM (As)	10.00	9.95	6.94	7.21	9.73	1.00	7.53	1.54	8.44	9.13
CMR (Afr)	4.50	9.97	6.72	6.75	9.74	1.00	7.55	1.56	7.48	9.76
CAN (Am)	3.09	9.84	1.00	1.71	1.00	2.29	7.86	9.51	4.74	1.06
CAF (Afr)	8.87	10.00	5.57	8.58	9.86	1.00	2.84	1.00	4.49	8.15
CHA (Afr)	4.69	9.91	3.73	8.58	9.86	1.00	1.00	1.32	2.42	8.92
CHI (Am)	6.63	9.88	1.65	2.20	5.92	1.00	6.71	7.10	4.90	9.83
CHN (As)	8.02	8.05	6.72	1.16	4.57	1.00	9.56	4.54	6.70	9.28
COL (Am)	10.00	9.94	5.42	2.11	8.69	1.00	7.09	5.22	3.39	8.73
CGO (Afr)	4.84	10.00	6.80	5.42	9.59	1.00	1.00	2.85	2.42	9.44

Table 4 continued

	B.	R. W. R.	C.	R. E.	G. Ga.	O. F.	G. S.	GDP	Em.	P. D.
COD (Afr)	4.99	10.00	7.56	9.63	9.95	1.00	3.51	1.00	2.42	8.93
CRC (Am)	8.82	9.76	4.68	5.24	8.60	1.43	8.48	5.76	4.36	9.01
CIV (Afr)	10.00	9.83	6.68	7.72	9.71	1.00	7.58	1.15	1.64	1.00
CRO (Eu)	4.77	9.94	2.33	1.33	5.70	3.62	8.80	7.30	2.66	7.55
CUB (Am)	2.67	8.02	6.30	1.17	7.33	1.00	5.00	5.10	6.84	8.72
CYP (As)	2.27	8.16	3.68	1.00	1.01	4.58	6.48	8.79	4.60	2.34
CZE (Eu)	7.53	8.71	2.06	1.00	1.00	9.28	8.70	8.60	5.12	8.09
DEN (Eu)	2.04	8.93	1.00	2.03	1.52	7.83	8.90	9.36	5.42	7.42
DOM (Am)	10.00	8.35	7.42	2.32	8.13	8.80	3.50	4.88	2.32	9.10
ECU (Am)	10.00	9.64	4.18	1.15	7.92	1.93	5.11	4.58	5.49	9.60
EGY (Afr)	3.04	1.00	6.32	1.00	7.81	4.27	6.99	3.77	3.54	1.77
ESA (Am)	1.00	9.45	5.27	5.39	9.05	1.03	6.60	4.21	5.58	6.66
EST (Eu)	10.00	8.60	1.00	1.52	1.00	9.56	9.01	7.70	2.87	9.92
ETH (Afr)	9.20	9.54	6.37	9.47	9.94	1.00	8.13	1.00	1.29	8.52
FIN (Eu)	4.24	9.85	3.14	2.53	1.00	8.42	8.49	9.31	4.60	7.07
FRA (Eu)	8.55	8.50	1.10	1.00	4.48	5.37	8.31	9.25	3.80	1.00
GAB (Afr)	7.29	9.99	3.95	5.62	8.24	1.00	5.98	6.88	1.22	9.51
GAM (Afr)	1.00	9.91	5.97	8.58	9.86	1.00	7.95	1.37	1.85	2.82
GEO (As)	1.69	9.71	6.82	3.88	8.89	1.00	5.42	3.29	2.25	8.79
GER (Eu)	10.00	7.90	3.08	1.00	1.00	7.73	8.85	9.40	5.50	1.31
GHA (Afr)	6.98	9.82	4.90	7.03	9.61	1.00	8.33	2.04	1.64	7.85
GRE (Eu)	4.95	8.73	2.02	1.00	2.55	6.08	2.04	8.51	1.77	1.00
GUA (Am)	10.00	9.74	5.63	6.70	9.28	1.00	6.91	3.09	6.64	9.36
GUI (Afr)	3.21	9.93	4.62	8.58	9.86	1.00	1.41	1.00	1.64	2.30
GBS (Afr)	10.00	9.94	6.56	8.58	9.86	1.00	8.83	1.00	1.64	7.60
GUY (Am)	2.38	9.93	3.90	1.28	5.04	1.00	6.04	4.17	3.33	4.21

Table 4 continued

	B.	R. W. R.	C.	R. E.	G. Ga.	O. F.	G. S.	GDP	Em.	P. D.
HAI (Am)	1.00	9.14	8.30	7.05	9.79	1.00	8.98	1.00	1.00	9.82
HON (Am)	6.93	9.88	5.81	4.86	9.04	1.30	8.41	2.72	6.44	9.16
HUN (Eu)	2.57	9.46	3.47	1.00	5.11	5.30	8.82	7.56	3.35	1.39
ISL (Eu)	6.59	9.99	1.00	8.25	3.96	1.00	2.03	9.40	4.76	1.00
IND (As)	2.41	6.61	8.15	2.63	8.61	1.03	9.28	2.38	3.75	2.94
INA (As)	3.21	9.44	6.99	3.45	8.29	1.00	9.17	2.89	5.19	9.32
IRI (As)	3.44	3.23	7.05	1.00	3.12	1.00	7.52	6.09	2.22	9.76
IRQ (As)	1.00	1.27	8.47	1.00	6.77	1.00	5.00	2.48	2.23	1.00
IRL (Eu)	1.00	9.76	1.77	1.00	1.36	2.51	6.93	9.48	2.37	1.00
ISR (As)	7.54	1.00	4.57	1.00	1.07	3.43	8.56	8.96	5.70	2.02
ITA (Eu)	7.93	7.63	2.89	1.06	3.41	8.87	8.12	8.91	4.33	1.00
JAM (Am)	3.67	9.38	6.37	1.52	7.06	1.00	7.68	4.78	2.78	1.00
JPN (As)	5.46	7.91	5.54	1.00	1.03	1.00	8.77	9.22	6.35	1.00
JOR (As)	1.00	1.00	5.35	1.00	6.92	1.00	6.22	3.48	2.75	2.65
KAZ (As)	1.26	7.11	6.01	1.00	1.00	1.00	3.61	6.08	5.83	9.81
KEN (Afr)	5.86	9.11	7.20	8.07	9.73	1.00	8.84	1.25	1.00	7.00
PRK (As)	1.00	8.88	8.15	1.20	7.41	1.00	5.00	1.28	3.36	9.05
KOR (As)	2.50	6.35	4.36	1.00	1.00	1.89	9.29	9.01	7.11	8.77
KUW (As)	1.00	1.00	3.25	1.00	1.00	1.00	8.97	9.56	8.13	9.89
KGZ (As)	3.47	7.94	7.08	3.06	8.70	1.00	8.45	1.63	4.53	6.33
LAO (As)	8.31	9.87	5.92	4.76	9.57	1.00	6.66	1.80	7.79	5.23
LAT (Eu)	8.19	9.88	1.76	3.56	6.40	9.04	8.59	6.76	2.09	8.47
LIB (As)	1.00	8.14	4.94	1.00	5.60	1.00	5.72	6.73	4.54	1.00
LBR (Afr)	1.00	9.99	6.14	8.58	9.86	1.00	1.09	1.00	6.91	9.73
LBA (Afr)	1.00	1.00	5.46	1.00	1.88	1.00	5.00	3.43	1.00	9.95
LTU (Eu)	7.20	9.05	1.00	1.54	5.98	7.42	8.57	7.43	2.12	8.36

Table 4 continued

	B.	R. W. R.	C.	R. E.	G. Ga.	O. F.	G. S.	GDP	Em.	P. D.
LUX (Eu)	10.00	9.81	1.00	1.00	1.00	5.09	8.41	10.00	5.47	9.49
MKD (Eu)	2.44	8.39	5.02	1.48	6.01	5.60	8.71	5.26	1.00	9.16
MAD (Afr)	1.27	9.56	6.36	8.58	9.86	1.00	6.83	1.00	7.71	9.93
MAW (Afr)	7.51	9.44	7.59	8.58	9.86	1.00	8.12	1.00	1.00	7.97
MAS (As)	6.84	9.77	3.73	1.00	3.49	1.00	9.16	6.74	7.26	6.30
MLI (Afr)	1.22	9.35	4.10	8.58	9.86	1.00	8.11	1.00	1.64	9.01
MLT (Eu)	1.00	2.87	3.89	1.00	4.01	1.00	5.25	8.41	5.27	2.47
MTN (Afr)	1.00	8.60	1.45	8.58	9.86	1.00	5.75	1.51	1.00	1.00
MEX (Am)	5.93	8.26	4.66	1.00	6.15	3.21	8.64	6.50	5.93	7.80
MDA (Eu)	1.00	8.36	5.58	1.00	8.28	2.77	8.74	2.20	5.12	9.39
MGL (As)	6.69	9.85	1.00	1.00	5.69	1.00	1.20	2.93	7.41	6.69
MNE (Eu)	5.74	9.75	5.93	3.18	6.69	1.59	4.07	5.64	3.17	7.51
MAR (Afr)	1.00	5.66	6.81	1.00	8.56	1.00	9.35	3.08	4.07	5.91
MOZ (Afr)	7.40	9.97	7.66	9.56	9.89	1.00	7.04	1.00	1.22	8.84
MYA (As)	2.61	9.72	3.80	7.84	9.83	1.00	5.00	1.00	6.69	7.73
NAM (Afr)	7.34	9.83	4.48	1.97	8.54	1.00	9.48	4.13	1.00	9.45
NEP (As)	8.50	9.53	7.69	8.78	9.88	1.00	9.46	1.00	1.00	8.78
NED (Eu)	7.58	8.83	1.00	1.00	1.00	4.51	8.82	9.58	6.38	3.27
NZL (Oc)	10.00	9.85	1.00	3.90	2.96	2.37	8.31	8.66	5.21	8.54
NCA (Am)	10.00	9.93	5.91	5.53	9.23	1.51	7.45	2.11	4.57	2.32
NIG (Afr)	3.53	9.30	1.50	8.58	9.86	1.00	8.99	1.00	1.64	9.57
NGR (Afr)	6.29	9.64	5.70	8.44	9.71	1.00	9.34	1.75	1.00	9.60
NOR (Eu)	5.43	9.92	1.00	3.61	1.99	7.49	9.06	9.86	7.20	6.88
OMA (As)	4.66	1.61	1.95	1.00	1.00	1.00	1.69	8.54	2.23	9.94
PAK (As)	4.91	2.57	8.28	3.73	9.22	1.00	8.45	1.87	5.52	4.58
PAN (Am)	5.75	9.97	3.30	2.23	7.61	1.00	8.57	6.37	6.57	8.46

Table 4 continued

	B.	R. W. R.	C.	R. E.	G. Ga.	O. F.	G. S.	GDP	Em.	P. D.
PNG (Oc)	1.00	10.00	3.86	3.67	9.57	1.00	5.00	1.72	8.27	9.44
PAR (Am)	2.72	9.99	1.63	10.00	9.27	1.00	8.98	3.25	5.71	9.73
PER (Am)	6.54	9.90	4.23	2.52	8.56	2.23	7.77	5.16	4.72	9.46
PHI (As)	2.52	8.30	6.72	3.98	9.18	1.54	9.10	2.58	4.95	8.20
POL (Eu)	10.00	8.06	3.59	1.00	2.01	5.70	8.10	7.69	3.81	5.68
POR (Eu)	3.06	8.77	2.96	2.33	5.47	7.65	3.25	8.15	2.80	1.00
QAT (As)	1.00	1.00	1.00	1.00	1.00	1.00	5.00	10.00	9.61	8.96
ROU (Eu)	3.88	9.68	4.64	1.67	6.48	2.83	9.05	5.92	4.86	8.86
RUS (Eu)	4.60	9.85	3.84	1.00	1.00	1.00	7.32	7.00	5.22	9.84
RWA (Afr)	4.99	9.84	7.80	8.58	9.86	1.00	8.16	1.00	1.00	9.39
KSA (As)	10.00	1.00	4.83	1.00	1.00	1.00	3.01	8.27	3.68	9.89
SEN (Afr)	10.00	9.43	5.60	4.70	9.56	1.00	8.88	1.33	1.00	8.18
SRB (Eu)	2.98	9.75	5.61	1.32	3.69	1.00	4.07	5.35	1.00	7.18
SLE (Afr)	2.15	9.97	6.43	8.58	9.86	3.80	7.63	1.00	1.64	4.62
SVK (Eu)	10.00	9.86	2.06	1.00	3.55	8.95	8.57	8.14	2.62	7.68
SLO (Eu)	6.53	9.70	3.35	1.48	2.52	7.92	8.85	8.75	4.46	7.28
RSA (Afr)	3.44	7.50	6.59	1.07	3.06	1.00	5.97	5.46	1.00	8.37
ESP (Eu)	3.82	7.10	2.16	1.18	4.18	7.68	8.42	8.93	1.15	2.87
SRI (As)	7.48	7.55	6.94	5.61	9.36	3.42	9.03	3.38	6.13	1.57
SUD (Afr)	2.09	4.24	4.86	7.07	9.69	1.00	3.00	1.84	3.00	2.17
SWE (Eu)	5.01	9.85	1.00	3.39	4.93	9.70	9.09	9.51	4.74	8.50
SUI (Eu)	10.00	9.51	4.15	1.90	4.37	9.42	9.37	9.62	7.33	7.05
SYR (As)	1.00	1.36	7.53	1.00	7.18	1.00	2.55	2.95	4.32	8.75
TPE (As)	2.45	7.42	2.37	1.00	1.00	1.00	5.00	9.39	6.45	8.16
TJK (As)	2.07	2.52	7.69	5.90	9.60	1.00	2.75	1.45	8.03	8.68
TAN (Afr)	10.00	9.46	6.30	8.95	9.87	1.00	8.76	1.11	1.00	7.72

Table 4 continued

	B.	R. W. R.	C.	R. E.	G. Ga.	O. F.	G. S.	GDP	Em.	P. D.
THA (As)	8.67	8.69	4.94	1.97	6.41	1.00	9.27	4.92	9.34	8.06
TOG (Afr)	5.52	9.89	6.99	8.30	9.81	1.00	1.31	1.00	1.64	9.00
TRI (Am)	4.80	9.40	5.01	1.00	1.00	1.00	1.00	7.64	5.60	8.90
TUN (Afr)	1.00	3.87	6.31	1.42	7.92	3.61	8.56	4.95	1.51	7.97
TUR (As)	1.00	8.17	5.39	1.11	6.35	3.26	6.60	6.48	3.72	8.31
TKM (As)	1.49	1.00	4.64	1.00	1.00	1.00	9.38	4.33	1.00	9.68
UGA (Afr)	5.13	9.95	4.97	8.58	9.86	3.36	8.44	1.00	6.57	9.10
UKR (Eu)	1.80	7.24	4.96	1.00	4.19	1.51	8.11	4.07	4.41	8.58
UAE (As)	2.35	1.00	1.76	1.00	1.00	1.00	9.49	9.76	6.70	9.63
GBR (Eu)	9.03	9.12	3.12	1.00	2.22	6.62	6.11	9.30	4.49	1.23
USA (Am)	6.83	8.44	2.28	1.00	1.00	1.40	5.26	9.76	4.09	1.00
URU (Am)	1.00	9.74	1.00	4.90	8.08	7.92	7.28	6.63	5.43	5.95
UZB (As)	1.13	1.00	7.58	1.00	6.44	1.00	1.00	2.16	9.80	9.85
VEN (Am)	10.00	9.93	4.32	1.00	3.65	1.00	8.54	5.95	4.45	7.56
VIE (As)	2.29	9.07	6.81	2.88	8.50	1.00	9.02	2.20	6.37	8.45
YEM (As)	1.00	1.00	8.18	1.00	9.10	1.00	1.30	1.59	2.32	7.96
ZAM (Afr)	10.00	9.83	7.52	9.22	9.85	1.00	3.37	1.17	2.47	9.27
ZIM (Afr)	10.00	7.90	6.94	6.88	9.28	1.00	1.41	1.00	1.00	2.57

S. F. sufficient food, *S. D.* sufficient to drink, *S. S.* safe sanitation, *H. L.* healthy life, *C. A.* clean air, *C. W.* clean water, *Ed.* education, *G. E.* gender equality, *I. D.* income distribution, *G. Go.* good governance, *A. Q.* air quality, *B.* biodiversity, *R. W. R.* renewable water resources, *C.* consumption, *R. E.* renewable energy, *G. Ga.* greenhouse gases, *O. F.* organic farming, *G. S.* genuine savings, *GDP* gross domestic product, *Em.* employment, *P. D.* public debt

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