The Relative Importance of the SDG Pillars

Lars Carlsen

Abstract

The seventeen United Nations' Sustainable Development Goals (SDGs) comprise social, economic, and environmental aspects of sustainability, and as such they can be grouped into five so-called pillars, i.e., People, Prosperity, Planet, Peace, and Partnership. The present study elucidates the relative importance of these pillars for 193 countries and 12 regions in their attempts to comply with the SDGs as well as the trends towards compliance based on partial order analyses. It is unambiguously demonstrated that the pillar Planet, comprising SDGs 6, 12, 13, 14, and 15, in all cases turns out as the far most important pillar both about the present degree of compliance as well as concerning the development trend. Not surprisingly the OECD region appears as the region with the highest degree of compliance whereas Africa has the least. However, when it comes to the trends the OECD and the high-income countries (HIC) apparently come staggering up when it comes to the pilar planet due to rather low pillar planet values. For the individual countries Finland and Denmark were found on the top ranks. The reason for the importance of the pillar Planet as well as the difference between sustainability goals and sustainability is discussed.

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1. Introduction

In September 2015, the 17 Sustainable Development Goals (SDGs) were unanimously adopted by the United Nations General Assembly and went into force by January 1st, 2016. Thus, we are now virtually midway through the 15-year lifespan of the SDGs. Hence, some reflections on how we are doing appear appropriate.

It is well-known that sustainability is based on three main criteria, i.e., socially equitable decisions, economically viable decisions, and environmentally sound decisions, respectively [1]. Acordingly, the seventeen goals are grouped into five so-called pillars [2][3] (Table 1) each comprising 5 SGDs apart from the last two goals – peace (SDG 16) and partnership (SDG 17), respectively – that constitute separate groups.

Table 1. The 5 P's of the SDGs [2][3]

Pillar	Description	SDGs
People	End poverty in all forms and ensure dignity and equality	1, 2, 3, 4, 5
Planet	Protect our planet's natural resources and climate for future generations	6, 12, 13, 14, 15
Prosperity	Ensure prosperous and fulfilling lives in harmony with nature	7, 8, 9, 10, 11
Peace	Foster a peaceful, just, and inclusive society	16
Partnership	Implement the agenda through a solid global partnership	17

In three previous papers the pillars People[4], Prosperity [5], and Planet [6], respectively have been analyzed individually. The present study takes on a hierarchical approach in analyzing the relative importance of the pillars based on the results obtained in the three previous papers [4][5][6], the method being described in detail by Carlsen[7].

The previous papers [4][5][6] as well as the present study are based on data for 193 countries that are made available through the 2022 version of the "Sustainable Development Report [8] to elucidate the relative importance as well as the development trends of the pillars for the individual countries (denoted by their ISO3 Country code, cf. Appendix A) as well as for twelve groups of countries (cf. Table 2) [8].. The notation for the regions is given in Table 2.

Table 2. Grouping of countries

East and South Asia	E_S_Asia	focus-economics.com/ESA_Sample_Report
Eastern Europe and Central Asia	E_Euro_Asia	ilo.org/moscow/countries/lang--en/index.htm
Latin America and the Caribbean	LAC	worldometers.info/geography/how-many-countries-in-latin-america/
Middle East and North Africa	MENA	en.wikipedia.org/wiki/MENA
Oceania	Oceania	worldometers.info/geography/how-many-countries-in-oceania/
OECD members	OECD	oecd.org/about/
Small Island Developing States	SIDS	un.org/ohrlls/content/list-sids
Sub-Saharan Africa	Africa	https://www.loc.gov/rr/amed/guide/afr-countrylist.html
Low-income Countries	LIC	g2lm-lic.iza.org/call-phase-iv/list-of-lic/
Lower-middle-income Countries	LMIC	worldpopulationreview.com/country-rankings/middle-income-countries
Upper-middle-income Countries	UMIC	worldpopulationreview.com/country-rankings/middle-income-countries
High-income Countries	HIC	worldeconomics.com/Regions/High-Income-Countries/

The basic ranking of the countries and regions has been performed by applying partial ordering methodology that allows simultaneously to take account into account several indicators (here the pillars) without any pretreatment like aggregation.

2. Methods

2.1. Data

Within the data material associated with the Sustainable Development Report[8] the single states are color coded as green, yellow, orange, red, and grey which signalizes 'Goal Achievement', 'Challenges remain', 'Significant challenges', 'Major challenges', and 'Insufficient data', respectively. The trends are visualized by arrows. Thus ↑, ↗, →, and ↓ that refers to 'On track or maintaining achievement', 'Moderately Increasing', 'Stagnating', and 'Decreasing', respectively. In three previous papers [4][5][6], the three pillars, People, Prosperity, and Planet, respectively were studied based on the respective SDGs (cf. Table 1). The present study uses the results obtained from the three pillars to elucidate the relative importance of the pillars in the overall compliance with the SDGs. Thus, the derived average ranks for the People, Prosperity, and Planet pillars [4][5][6] are used as input parameters together with the ranking of SDG 16 and 17 as given in [8] (Appendix B). It should be noted that for a series of countries data for SDG 16 and 17 are not available. Thus, for these countries (Appendix C) the missing data are substituted by a "1" to indicate the lack of data and for further inspiration to make data available. Data for the regions are given in Appendix D and Appendix E, the latter being the data for the development trends for those regions where the data are available, i.e., E_Euro_Asia, LIC, and Oceania (cf. Table 2) have been eliminated.

2.2. Partial ordering methodology

Partial ordering is a relation among the objects to be ordered. In mathematical terms, the only relation is "≤" [4][5][6][9][10][11][12]. The "≤" relation is the basis for a comparison of objects and constitutes a graph, the so-called Hasse diagram [9][13][14][15]. Two objects x and y, both being characterized by a series of indicators $r_j(x)$, j = 1,..., m and $r_j(y)$, j = 1,..., m are connected if and only if the relation "x ≤ y" holds.

$$r_l(x) \leq r_l(y) \text{ for all } l = 1, \ldots, m \qquad (1)$$

Elements that fulfill eq. 1 are denoted as comparable, in contrast to those pairs of elements that do not fulfill the equation. These are denoted incomparable. It should be remembered that eq. 1 sets a rather strict requirement for comparisons as at least one indicator value of object x must be lower (the remaining lower or at least equal) to those of object y.

The procedure applied in the present study using previously derived averaged ranks as input parameters is a so-called hierarchical partial ordering process that has previously been described [7].

The partially ordered set may be visualized by a Hasse diagram, where comparable elements (vide supra) are connected by lines in so-called chains, whereas elements that do not fulfill eqn. 1 are denoted incomparable and constitute so-called

antichains. The diagrams are ordered in levels. [9][13][14]. It should be noted that in some cases an element will not be comparable to any other element. Thus, these elements, denoted isolated elements will, by default be located in the top level of the Hasse diagram.

The module mHDCl7_1 of the PyHasse software (vide infra) was used for the basic partial ordering calculations and the associated construction of the Hasse diagrams.

2.2.1. *Sensitivity—indicator importance*

The relative importance of the single indicators in play can be determined through a sensitivity analysis[16]. These analyses are based on the disclosure of which indicator does have the biggest effect on the Hasse diagram, i.e., the ordering. The influence of the single indicators is disclosed by calculating the distance between the original Hasse diagram and the Hasse diagrams derived from datasets where the single indicators one by one have been eliminated. The indicator whose elimination leads to the highest distance has the largest influence on the ranking.

The sensitivity values were calculated by the sensitivity24_5 module[9] of the PyHasse software (vide infra).

2.2.2. *Average ranking*

The Hasse diagram, the level structure provides a first approximation to order, which is rather 'crude' as all elements at the same level will be assigned equal rank. Due to the presence of incomparabilities, partial ordering does not lead to a strict linear ordering as a priori a multitude of linear orders can be derived from the partially ordered dataset. Partial order methodology, however, provides a methodology to calculate an average order of the single objects, which is based on the probabilities for the single elements to have a specific order as, e.g., described by Bruggemann and Carlsen [17] and Bruggemann and Annoni [18]. The average rankings were calculated by applying a local partial order approach by the LPOMext9_1 [17] of the PyHasse software.

2.2.3. *Peculiar elements*

In an overall view the [1] normalized indicator values for the single elements will be found in an ellipsoid centering around a line from (0,0,…,0) to (1,1,…,1) in the n-dimensional space (n being the number of indicators). However, in certain cases where a specific element possesses a surprisingly high or low value for one, or more, indicators such an element will be found outside the ellipsoid. Such elements are denoted 'peculiar' [19].

The so-called peculiar elements were calculated by applying the incompposet9_3[19] of the PyHasse software (vide infra).

2.2.4. *Software*

Partial-order analyses were carried out using the PyHasse software package[20]. PyHasse is programmed using the interpreter language Python (version 2.6) and contains around 140 more or less specialized modules. Selected modules may be acquired from the author.

Preliminary attempts to develop an online version of the PyHasse, presently comprising only few modules, can be found at www.PyHasse.org[1].

3. Results and Discussion

The overall objective of the sent study is to disclose which of the elements, here given by the five pillars, appears to be the focus of the countries as well of the regions in their attempt to comply with the 17 SDGs.

3.1. The regions

Initially, we have a look at the twelve regions (data in Appendix D). In Fig. 1A the partial ordering of the twelve regions is shown based on the compliance data for the three pillars People, Prosperity, and Planet, respectively, visualized by the Hasse diagram. In Fig. 1B the Hasse diagram based on all 5 pillars is depicted. The corresponding average ranking is shown in Table 3.
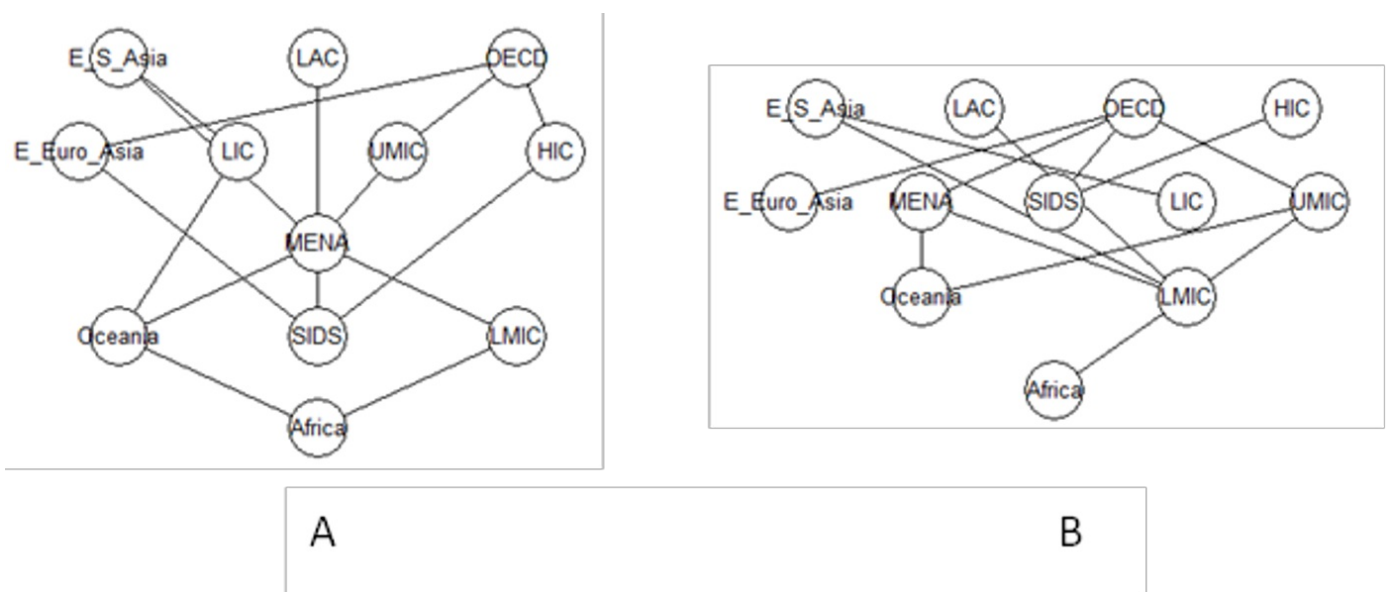

Figure 1. Hasse diagrams visualizing the compliance of the twelve regions based on A: three and B: five pillars.

Table 3. Average ranks for the twelve regions based on A: three and B: five pillars.

A			B		
Region	**LPOMext**	**rank**	**Region**	**LPOMext**	**rank**
OECD	11.475	1	OECD	11.478	1
E_S_Asia	10.714	2	E_S_Asia	9.867	2
LAC	9.967	3	LAC	8.75	3
UMIC	9	4	HIC	8.5	4
LIC	7.117	5	MENA	8.433	5.5
E_Euro_Asia	6.667	6.5	UMIC	8.433	5.5
HIC	6.667	6.5	E_Euro_Asia	5.333	7
MENA	6.429	8	LIC	4.667	8
LMIC	3.905	9	SIDS	3.75	9
Oceania	3.333	10	LMIC	3.507	10
SIDS	1.875	11	Oceania	3.3	11
Africa	1.422	12	Africa	1.754	12

The overall rankings of the regions as well as the mutual possible comparisons are visualized through the Hasse diagram. Fig. 1A displays 34 comparisons and 32 incomparisons. The corresponding figures for Fig. 1B are 20 and 46, respectively. Concerning eqn. 1 it is not surprising the number of incomparisons is increased at the expense of the number of comparisons simply because of the increase in the number of indicators from three to five.

Turning to the average ranking (Table 3) reveals virtually no significant changes. It is not surprising that HIC and OECD are located at the higher end as these countries are generally regarded as well-organized countries. Thus, HIC moves up from rank 6.5 to rank 4 when taking SDG 16 and 17 into account. On the other hand, the decreasing ranks of low-income countries, i.e., LIC (5 to 8), UMIC (4 to 5.5), and LMIC (9 to 10) may not be a surprise taking a subjective approach into account. Africa was in both scenarios found at the lowest rank.

A further, in the present context more interesting result comes from the analysis of the relative importance of the single pillars. In Table 4 the relative importance of the pillars, as derived through sensitivity analyses are summarized.

Table 4. The relative importance of the five pillars for ranking the twelve regions.

Pillar	Relative importance (3 pillars)	Relative importance (5 pillars)
People	0.030	0.000
Prosperity	0.091	0.000
Planet	0.879	0.727
SDG17_score	-	0.121
SDG16_score	-	0.152

It is immediately clear that the pillar Planet, i.e., the pilar comprising the five environment-related SDGs (cf. Table 1) is the absolute dominating pillar relative to the pillars People and Prosperity, the picture being even more pronounced when the SDGs 16 and 17 are brought into play, the former two showing the relative importance of zero. In contrast, the latter shows the importance of 12 and 15%, respectively (Table 4). This demonstrates, at least here on a regional scale the focus on environmental issues apparent at the expense of social and economic issues as well as the governmental issues comprised in SDGs 16 and 17.

To get a piece more detailed information concerning the actual ranking the possible presence of so-called 'peculiar' regions, i.e., regions that have one or more unexpected high or low indicator values, which means that are outside the 'mainstream' regions (for a detailed discussion see [19]). In this context, it is further of interest to disclose the role of the individual indicators, i.e., what indicators account for incomparisons. The latter is advantageously visualized through the so-called tripartite graphs introduced by Bruggemann and Voigt [21].

In the case of the 12 regions (data in Appendix D) we find that the low-income countries (LIC) are surprisingly high in the pillar planet whereas the high-income countries (HIC) and the E_Euro_Asia both are unexpectedly low in the pillar planet indicator. This is for HIC and E_Euro_Asia not surprising as both regions are covered by the OECD, the latter being ranked at the top (cf. Table 3A). A further insight comes from the analysis of incomparisons. From the Hasse diagram (Fig. 1A) it is easily seen that the OECD is incomparable to three other regions, i.e., LIC, LAC, and E_S_Asia, respectively, whereas directly or indirectly comparable to the other eight regions. The underlying reason for this is visualized through the tripartite graph display in Fig. 2A. Here it is clear that for the three regions LIC, LAC, and E_S_Asia the values of the pillar planet indicator are higher than for the OECD, whereas for the remaining eight regions the indicator values for all three indicators are lower than for the OECD. This substantiates that the LIC, LAC, and E_S_Asia regions, on an overall basis, are closer to complying with those SDGs comprising the pillar planet, e.g., 6, 12, 13, 14, and 15.

Including the SDG 16 and 17 in the analyses did not cause major changes. However, it was, not surprisingly noted that the low-income countries (LIC) both turned out as peculiar due to rather low values for all pillars, including SDG 16 and 17, apart from pillar planet.

The above is an indication of the status of the single regions. Another thing is the possible trends, i.e., the process towards an increased compliance degree. In Table 5 the ranking of the trends for 9 out of the 12 regions is shown, noting that trend data for the regions LIC, E_Euro_Asia, and Oceania was not available.

Table 5. Rankings of the nine regions towards compliance.

Objects	LPOMext	Rank
E_S_Asia	7,524	1
LMIC	7,083	2
UMIC	5,1	3
MENA	5,071	4
OECD	4,5	5,5
HIC	4,5	5,5
LAC	3,25	7
SIDS	2	8
Africa	1,476	9

It is immediately noted that developed countries like the HIC and OECD countries are found relatively low on the list indicating a lack of effort which has recently been discussed (Carlsen 4). The calculations further disclosed that again the pillar Planet appears as the dominating indicator for the development. Hence, the relative importance of the three pillars was People: 0.167, Prosperity: 0.125, and Planet: 0.708, respectively, in agreement with the above-reported compliance data. It should be noted that including the two remaining pillars, i.e., SDGs 16 and 17 did not cause any change in the trend ranking.

As above a detailed analysis of the single regions based on peculiarities and incomparabilities was carried out to disclose the trends of the single regions towards compliance with the SDGs. The present analysis comprises only nine regions due to the missing data. Compared to the above analyses of compliance the trend analyses show a rather different picture, again using the OECD as an exemplary case. In the case of trend analyses, the OECD is of special interest as it is an isolated element (cf. Fig 1B), i.e., the OECD is not comparable to any other region. It should be emphasized that the following results are equally valid for the high-income countries (HIC) as HIC and OECD are equivalent in the trend analysis (cf. Table 5). Hence, the peculiar element analysis disclosed that the OECD and thus the HIC regions have a surprisingly low value for the pilar planet, which is further substantiated by looking at the tripartite incomparability analysis as displayed in Fig. 2B, where it immediately seen that OECD (and HIC) has indicator values higher than all other regions for pilar people and pillar prosperity, but a lower value for pillar planet compared to all other seven regions, displaying ho the OECD and HIC come staggering up in their attempts to work towards compliance with the environmental goals. An identical result was noted including SDG 16 and 17, i.e., again the OECD and HIC come staggering up when it comes to trend analyses displayed through surprisingly low pillar planet values for these two regions.
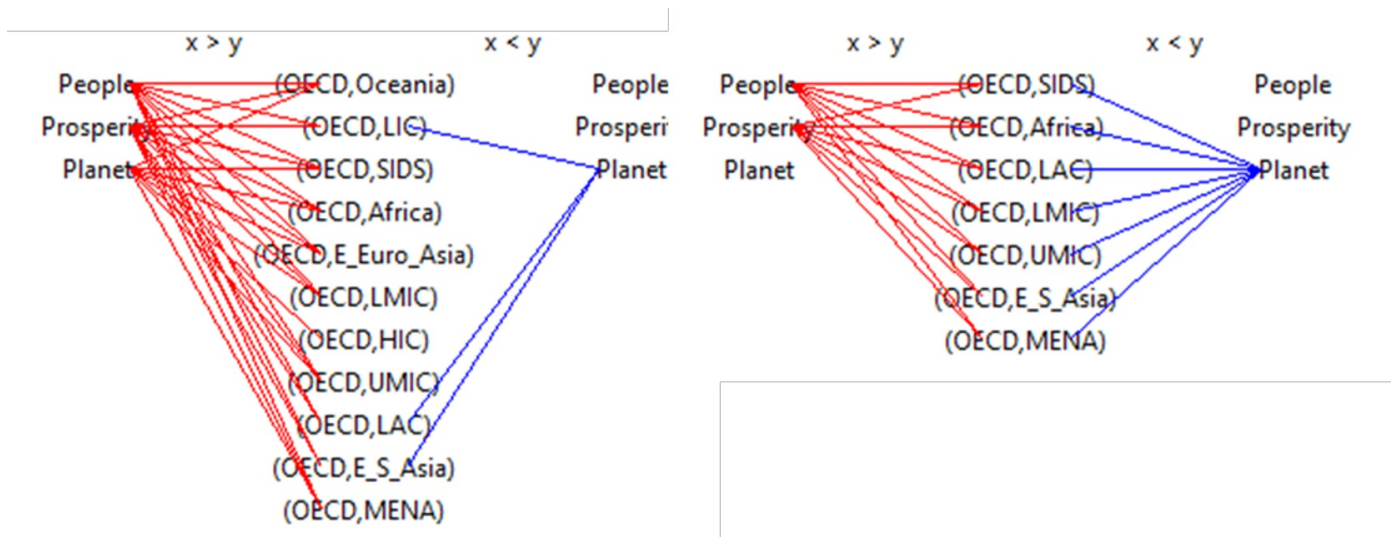
Figure 2. Tripartite graphs visualizing indicator conflicts. A: all 12 regions based on compliance data and B. the 9 regions comprising the trends analysis.

3.2. The countries

Turning to the 193 individual countries comprised in the study an initial analysis based on the three pillars People, prosperity, and Planet resulted in a – not unexpected – rather complicated Hasse diagram (not shown) comprising 16 levels. A deeper analysis disclosed the same overall trend as for the regions, i.e., the pillar Planet is the dominating indicator, the relative importance being 0.652, whereas the relative importance for pillars People and Prosperity were found to be 0.182 and 0,167, respectively. The top 10 countries, i.e., those best, on an overall view, complying with the 3 pillars are shown in Table 6A.

A first attempt to include the two last pillars, i.e., SDGs 16 and 17, caused, due to missing data (cf. Appendix C) a reduction of the countries to be analyzed to 163. The top 10 countries are given in Table 6B, and the relative importance is seen in Table 7A. Assigning a 1 as SDG 16 and 17 data to the countries missing these data resulted in very minor changes in the top ranking (Table 6C) and the relative pillar importance (Table 7B). Some changes in the lowest-ranking area are prevailing due to the very low pillar values for the countries shown in Appendix C, although the interplay with the three other pillars does play a role due to the ranking technique according to eqn. 1. This is not further discussed.

Table 6. Average ranks for the individual countries based on A: three and B: five pillars (with countries with missing data eliminated, and C. five pillar (with assignment of 1 to countries missing SDG 16 and 17 data)

A	B	C
Country ID	*Country ID*	*Country ID*
FIN	DNK	DNK
ROU	FIN	FIN
DNK	GEO	GEO
GBR	BGR	BGR
BGR	POL	POL
POL	ROU	ROU
DOM	BIH	BIH
GEO	DEU	CUB
HRV	CHL	DEU
MDV	CUB	CHL

Table 7. The relative importance of the five pillars. A: countries with missing SDG 16 and 17 data eliminated; B: all countries with missing SDG 16 and 17 data substituted by 1.

	A	B
Pillar	Relative importance	Relative importance
People	0.067	0.087
Prosperity	0.038	0.109
Planet	0.626	0.602
SDG 16	0.090	0.067
SDG 17	0.179	0.134

Turning to the development trends for the individual countries, we face that for only 86 out of the 193 countries (45%) trend data are available for all three pillars (People, Prosperity, Planet), which causes a somewhat axed picture. The top 10 countries, i.e., those displaying the highest trend toward complying with the SDGs appeared to be MDV > DNK > EST > GEO > GBR > HRV > DEU > CHL > MLT > FJI and again the dominance of the pillar Planet was pronounced, the relative importance of the pillars People, Prosperity and Planet were 0,199, 0.203, and 0.598, respectively.

4. Conclusions and Outlook

The 17 Sustainable Development Goals, or global goals, may be subdivided into three main pillars, People, Prosperity, and Planet which comprises the social, economic, and environmental aspect of sustainability and the pillar, comprising only one SDG each, i.e., SDG 16, peace and justice, and SDG 17, collaboration, and partnership. The present study focuses on the relative importance of these pillars both about the actual compliance with the SDGs as well as the trends towards compliance. Based on partial order analyses 193 countries as well as twelve regions were studied.

It is immediately clear from the results of the analyses that the pillar Planet, comprising SDGs 6, 12, 13, 14, and 15 in all aspects appears as the dominating pillar. This may not be surprising that in the media, newspapers, radio, television, and environmental issues, not least the aspects of global warming, for good reasons, receive significantly more attention than the social and economic aspects of sustainability. However, the present study points to the fact that the other pillars, maybe especially SDG16 and 17 to some extents are left out in the cold at the expense of the environmental issues that are generally more easily explained to the general audience. However, it in this connection worthwhile to emphasize that the detailed analyses of the pillar planet show that SDG 6 (clean water and sanitation) for the single countries appears by far to be the most important of the five pillar planet goals by 61.5 %, whereas SDG 13 (Climate action) only comes in on a third place by 13.5 % [6]. In the case of the regions, however, of equal importance of SDG 6 and SDG 13 is noted. Further in the trend analysis it appeared that the OECD and HIC are at the lowest ranks in perfect agreement with the here reported results.

It is at this place also important to stress that we have been dealing with sustainable development and not with sustainability as such. It is satisfying that a major part of the countries and regions have adopted the SDGs and examples where companies are claiming their services or goods to be sustainable are legion, thus greenwashing their activities. It is nevertheless important to stress that we are far away from having a sustainable society. This is unambiguously demonstrated by the Earth Overshoot Day in 2022 was on July 28th [22], i.e., on that day we used all the resources allocated for the day. The only, slightly comforting news is that the overshoot day for the last approx. 10 years have been around Aug. 1st apart from 2020 when it was Aug. 16 – an effect of the Covid-19 pandemic[23] So, it is possible to revert the overconsumption. The overshoot day for individual countries is available [24], showing significant variations. Thus, Qatar's overshoot day was already on February 10th, whereas for Jamaica it was on December 20th. No country managed to come fully through the year before using the "allocated" resources. The figure [24] may serve as inspiration for future work.

Appendix A.

ISO3 country code for the included countries

Country Code ISO3	Country	Country Code ISO3	Country
AFG	Afghanistan	LBR	Liberia
AGO	Angola	LBY	Libya
ALB	Albania	LCA	St. Lucia
AND	Andorra	LIE	Liechtenstein
ARE	United Arab Emirates	LKA	Sri Lanka
ARG	Argentina	LSO	Lesotho
ARM	Armenia	LTU	Lithuania
ATG	Antigua and Barbuda	LUX	Luxembourg

AUS	Australia	LVA	Latvia
AUT	Austria	MAR	Morocco
AZE	Azerbaijan	MCO	Monaco
BDI	Burundi	MDA	Moldova
BEL	Belgium	MDG	Madagascar
BEN	Benin	MDV	Maldives
BFA	Burkina Faso	MEX	Mexico
BGD	Bangladesh	MHL	Marshall Islands
BGR	Bulgaria	MKD	North Macedonia
BHR	Bahrain	MLI	Mali
BHS	Bahamas, The	MLT	Malta
BIH	Bosnia and Herzegovina	MMR	Myanmar
BLR	Belarus	MNE	Montenegro
BLZ	Belize	MNG	Mongolia
BOL	Bolivia	MOZ	Mozambique
BRA	Brazil	MRT	Mauritania
BRB	Barbados	MUS	Mauritius
BRN	Brunei Darussalam	MWI	Malawi
BTN	Bhutan	MYS	Malaysia
BWA	Botswana	NAM	Namibia
CAF	Central African Republic	NER	Niger
CAN	Canada	NGA	Nigeria
CHE	Switzerland	NIC	Nicaragua
CHL	Chile	NLD	Netherlands
CHN	China	NOR	Norway
CIV	Cote d'Ivoire	NPL	Nepal
CMR	Cameroon	NRU	Nauru
COD	Congo, Dem. Rep.	NZL	New Zealand
COG	Congo, Rep.	OMN	Oman
COL	Colombia	PAK	Pakistan
COM	Comoros	PAN	Panama
CPV	Cabo Verde	PER	Peru
CRI	Costa Rica	PHL	Philippines
CUB	Cuba	PLW	Palau
CYP	Cyprus	PNG	Papua New Guinea
CZE	Czech Republic	POL	Poland
DEU	Germany	PRK	Korea, Dem. Rep.
DJI	Djibouti	PRT	Portugal
DMA	Dominica	PRY	Paraguay
DNK	Denmark	QAT	Qatar

DOM	Dominican Republic	ROU	Romania
DZA	Algeria	RUS	Russian Federation
ECU	Ecuador	RWA	Rwanda
EGY	Egypt, Arab Rep.	SAU	Saudi Arabia
ERI	Eritrea	SDN	Sudan
ESP	Spain	SEN	Senegal
EST	Estonia	SGP	Singapore
ETH	Ethiopia	SLB	Solomon Islands
FIN	Finland	SLE	Sierra Leone
FJI	Fiji	SLV	El Salvador
FRA	France	SMR	San Marino
FSM	Micronesia, Fed. Sts.	SOM	Somalia
GAB	Gabon	SRB	Serbia
GBR	United Kingdom	SSD	South Sudan
GEO	Georgia	STP	Sao Tome and Principe
GHA	Ghana	SUR	Suriname
GIN	Guinea	SVK	Slovak Republic
GMB	Gambia, The	SVN	Slovenia
GNB	Guinea-Bissau	SWE	Sweden
GNQ	Equatorial Guinea	SWZ	Eswatini
GRC	Greece	SYC	Seychelles
GRD	Grenada	SYR	Syrian Arab Republic
GTM	Guatemala	TCD	Chad
GUY	Guyana	TGO	Togo
HND	Honduras	THA	Thailand
HRV	Croatia	TJK	Tajikistan
HTI	Haiti	TKM	Turkmenistan
HUN	Hungary	TLS	Timor-Leste
IDN	Indonesia	TON	Tonga
IND	India	TTO	Trinidad and Tobago
IRL	Ireland	TUN	Tunisia
IRN	Iran, Islamic Rep.	TUR	Turkey
IRQ	Iraq	TUV	Tuvalu
ISL	Iceland	TZA	Tanzania
ISR	Israel	UGA	Uganda
ITA	Italy	UKR	Ukraine
JAM	Jamaica	URY	Uruguay
JOR	Jordan	USA	United States
JPN	Japan	UZB	Uzbekistan
KAZ	Kazakhstan	VCT	St. Vincent and the Grenadines
KEN	Kenya	VEN	Venezuela, RB

KGZ	Kyrgyz Republic	VNM	Vietnam
KHM	Cambodia	VUT	Vanuatu
KIR	Kiribati	WSM	Samoa
KNA	St. Kitts and Nevis	YEM	Yemen, Rep.
KOR	Korea, Rep.	ZAF	South Africa
KWT	Kuwait	ZMB	Zambia
LAO	Lao PDR	ZWE	Zimbabwe
LBN	Lebanon		

Appendix B.

Compliance data for all countries for the five pillars

ID	People	Prosperity	Planet	SDG16	SDG17
AFG	3.670	1.241	38.622	49.205	42.948
AGO	6.850	2.847	71.605	48.973	48.310
ALB	84.444	68.169	105.551	68.660	65.699
AND	54.500	71.579	82.900	1.000	1.000
ARE	99.956	93.580	3.110	77.742	29.564
ARG	104.011	26.017	58.540	65.410	63.193
ARM	65.286	43.090	47.848	77.395	62.545
ATG	59.162	63.525	91.124	1.000	1.000
AUS	81.361	77.719	48.683	83.744	69.629
AUT	101.647	115.691	14.361	91.204	68.700
AZE	79.159	102.868	31.450	72.663	70.985
BDI	6.850	5.682	80.159	52.181	62.064
BEL	96.367	110.874	23.171	85.351	66.857
BEN	6.850	8.646	99.160	52.632	51.367
BFA	6.850	5.682	80.159	54.500	55.025
BGD	62.742	48.117	73.230	53.521	39.180
BGR	96.367	92.020	102.214	73.840	73.164
BHR	31.546	32.185	6.088	71.390	35.308
BHS	33.125	20.450	6.088	1.000	1.000
BIH	81.365	48.117	105.598	70.048	80.638
BLR	105.333	64.040	7.552	74.408	73.843
BLZ	25.008	37.677	32.096	65.247	72.291
BOL	74.518	26.712	8.172	53.055	64.809
BRA	84.444	78.780	89.555	63.890	74.839
BRB	84.444	36.175	44.727	72.472	73.734
BRN	55.686	81.538	6.088	61.963	71.544

BTN	19.028	81.856	72.034	84.142	59.975
BWA	19.645	11.032	31.450	65.334	65.840
CAF	6.850	2.847	94.327	43.793	39.084
CAN	96.032	105.072	74.422	84.585	73.357
CHE	97.030	107.317	8.318	85.089	53.075
CHL	41.195	48.240	101.007	76.751	81.494
CHN	104.457	84.608	76.324	70.269	44.791
CIV	6.850	8.646	83.442	56.016	45.086
CMR	6.850	2.847	71.605	47.280	44.153
COD	6.850	2.847	103.873	41.161	41.699
COG	6.850	2.847	100.116	56.667	49.615
COL	44.625	26.250	18.595	60.543	69.811
COM	6.850	6.852	17.310	1.000	1.000
CPV	32.506	26.017	108.881	1.000	1.000
CRI	43.664	86.919	17.935	71.197	75.202
CUB	75.032	79.675	104.450	64.225	100.000
CYP	105.333	93.626	23.171	80.568	46.757
CZE	75.220	103.710	41.266	83.917	55.819
DEU	96.367	114.082	76.879	84.189	81.973
DJI	9.215	2.847	49.194	56.867	48.698
DMA	20.982	2.484	60.131	1.000	1.000
DNK	98.626	116.927	94.910	93.255	82.273
DOM	85.484	48.447	107.738	58.281	53.703
DZA	60.249	64.040	80.508	72.354	69.309
ECU	64.024	85.991	95.028	59.627	74.564
EGY	25.000	62.563	76.324	76.346	59.261
ERI	7.595	3.816	73.230	1.000	1.000
ESP	91.801	81.856	74.422	83.051	62.105
EST	80.860	90.003	105.209	89.406	53.301
ETH	17.618	5.682	38.622	42.201	44.206
FIN	105.333	115.691	96.074	94.107	72.908
FJI	69.148	81.738	104.450	79.407	60.862
FRA	96.367	110.525	46.922	75.473	73.420
FSM	3.658	2.576	60.131	1.000	1.000
GAB	15.060	24.628	85.598	43.465	41.253
GBR	81.361	107.102	106.780	82.139	52.648
GEO	84.444	99.939	104.672	83.111	66.665
GHA	15.060	24.979	83.442	69.462	46.256
GIN	6.850	17.911	99.160	44.584	49.493
GMB	9.215	16.102	99.160	55.313	46.051
GNB	12.862	8.646	17.310	1.000	1.000

GNB	12.882	6.648	17.316	1.000	1.000
GNQ	3.670	3.816	31.269	1.000	1.000
GRC	82.499	62.563	46.806	76.839	58.008
GRD	88.928	11.615	18.112	1.000	1.000
GTM	15.060	14.276	73.230	51.990	47.477
GUY	74.518	6.226	58.540	63.829	57.067
HND	19.645	14.276	102.698	43.949	61.138
HRV	104.790	107.137	74.633	76.735	50.677
HTI	4.099	2.847	73.230	44.864	43.792
HUN	55.712	93.185	73.020	76.185	52.922
IDN	38.689	48.117	76.324	71.273	49.797
IND	26.108	14.045	73.230	54.347	50.185
IRL	98.626	110.874	71.090	88.518	50.731
IRN	19.028	11.032	34.517	62.623	60.018
IRQ	9.215	26.986	76.324	67.241	69.205
ISL	105.101	112.263	20.938	94.470	72.114
ISR	51.080	96.228	3.110	73.253	61.042
ITA	97.215	71.461	74.374	78.655	65.032
JAM	66.574	27.881	76.324	66.156	67.841
JOR	41.704	43.090	95.028	77.415	58.823
JPN	94.728	112.928	22.539	90.359	72.786
KAZ	81.979	89.844	7.552	68.726	54.516
KEN	19.645	8.646	73.230	57.105	49.871
KGZ	84.444	97.285	72.034	67.526	70.064
KHM	24.464	3.042	73.230	60.075	52.499
KIR	15.018	3.910	27.452	1.000	1.000
KNA	16.753	68.966	18.112	1.000	1.000
KOR	65.120	93.790	25.684	78.493	63.208
KWT	49.957	13.784	3.110	79.945	75.946
LAO	25.000	47.585	72.034	45.703	54.934
LBN	15.274	47.772	58.724	55.565	39.325
LBR	6.850	5.682	90.837	49.593	47.377
LBY	2.255	3.042	20.411	1.000	1.000
LCA	74.917	50.368	49.547	1.000	1.000
LIE	13.469	11.550	8.977	1.000	1.000
LKA	53.694	32.105	53.425	65.947	49.794
LSO	26.947	2.847	80.159	45.198	78.198
LTU	60.249	51.933	90.808	78.003	53.781
LUX	81.050	78.550	3.413	90.262	67.655
LVA	60.249	85.229	90.808	82.359	47.208
MAR	19.028	26.045	102.698	73.639	61.526
MCO	1.000	71.579	78.750	1.000	1.000

MCO	1.000	71.379	78.750	1.000	1.000
MDA	99.545	102.245	24.362	72.955	73.879
MDG	12.862	2.847	73.230	43.385	42.187
MDV	78.555	97.644	106.539	72.691	58.202
MEX	46.096	14.276	9.853	54.379	64.518
MHL	3.993	3.250	2.369	1.000	1.000
MKD	65.286	66.093	57.784	77.753	68.588
MLI	6.850	5.682	18.084	56.400	46.419
MLT	91.213	93.185	59.101	79.821	52.300
MMR	33.793	15.424	49.194	59.283	46.937
MNE	60.249	73.190	39.492	75.569	78.013
MNG	69.148	29.105	1.213	63.983	69.307
MOZ	6.850	6.852	71.605	53.337	64.194
MRT	9.215	5.682	53.425	49.917	50.531
MUS	99.545	55.218	39.492	73.034	48.714
MWI	12.862	6.852	80.159	55.462	46.417
MYS	48.247	56.107	40.162	70.540	56.845
NAM	68.421	2.847	103.282	67.954	77.102
NER	6.850	5.682	38.622	55.010	59.887
NGA	6.850	5.682	83.442	41.399	69.050
NIC	57.237	14.276	85.598	58.249	55.638
NLD	98.626	110.874	46.806	85.200	61.979
NOR	104.755	115.310	20.938	90.454	94.643
NPL	38.689	17.911	89.450	60.744	54.085
NRU	10.506	53.104	3.444	1.000	1.000
NZL	105.081	111.579	10.757	89.070	72.492
OMN	24.045	15.182	20.411	79.889	68.089
PAK	9.215	5.682	73.230	51.248	57.165
PAN	24.568	50.368	40.162	67.706	39.913
PER	89.437	50.368	76.324	60.765	60.080
PHL	38.689	14.276	95.755	61.677	55.114
PLW	16.753	30.979	19.492	1.000	1.000
PNG	6.850	6.852	99.160	55.692	39.118
POL	101.647	78.038	103.660	81.485	62.867
PRK	71.393	3.816	102.698	1.000	1.000
PRT	91.801	113.976	51.622	88.262	62.485
PRY	56.459	74.419	51.881	52.942	54.596
QAT	31.546	15.182	8.048	79.876	43.035
ROU	84.444	105.349	106.471	77.479	65.689
RUS	99.545	72.932	25.684	56.560	70.928
RWA	12.862	2.847	18.084	70.855	57.982
SAU	11.100	33.185	6.988	80.435	58.389

SAU	11.190	32.185	6.068	80.435	58.389
SDN	6.850	5.682	53.425	53.089	35.147
SEN	6.850	2.847	73.230	63.926	56.538
SGP	106.861	86.361	3.110	86.936	42.750
SLB	6.850	3.910	17.310	1.000	1.000
SLE	6.850	5.682	73.230	58.926	68.983
SLV	57.237	46.979	105.551	58.453	64.564
SMR	4.045	35.716	37.917	1.000	1.000
SOM	4.099	5.682	73.230	45.254	33.333
SRB	99.545	66.093	16.152	74.656	81.398
SSD	12.862	2.847	18.084	42.241	41.393
STP	25.008	2.847	107.387	74.795	58.914
SUR	44.625	37.677	60.733	78.130	76.466
SVK	55.712	84.667	73.020	80.839	56.486
SVN	98.626	114.912	23.171	86.053	63.275
SWE	100.020	115.691	22.539	86.578	87.214
SWZ	12.862	14.276	21.952	56.644	62.710
SYC	88.928	61.950	100.026	1.000	1.000
SYR	3.670	5.682	92.294	41.918	48.969
TCD	6.850	2.847	45.495	30.527	46.299
TGO	11.715	2.847	107.387	50.936	50.650
THA	63.508	66.093	40.162	70.264	59.231
TJK	32.912	71.461	89.450	72.072	50.886
TKM	22.550	3.042	4.346	73.877	42.893
TLS	6.850	76.051	8.729	1.000	1.000
TON	32.905	28.089	30.522	1.000	1.000
TTO	98.882	9.014	9.765	58.937	55.998
TUN	41.195	24.628	76.324	70.914	73.421
TUR	34.091	26.250	10.757	68.050	74.663
TUV	3.638	42.131	88.167	1.000	1.000
TZA	12.862	2.847	73.230	52.856	44.526
UGA	6.850	2.847	38.622	46.547	47.757
UKR	81.365	102.804	76.324	66.494	73.415
URY	105.333	100.533	39.492	81.390	76.165
USA	51.717	77.329	48.683	71.967	63.071
UZB	91.633	10.132	17.491	70.857	55.954
VCT	80.251	20.450	60.131	1.000	1.000
VEN	19.645	29.328	76.324	33.139	50.195
VNM	89.437	87.516	76.324	66.449	65.673
VUT	11.715	72.932	73.230	1.000	1.000
WSM	19.028	47.490	108.489	1.000	1.000
YEM	3.670	5.682	73.230	43.148	50.074

YEM	3.670	5.682	73.230	42.140	50.974
ZAF	37.030	11.032	58.724	59.050	74.635
ZMB	19.645	2.847	38.622	49.517	55.325
ZWE	14.728	2.847	48.709	48.124	49.881

Appendix C.

Countries for which SDG 16 and SDG 17 data are missing

Country	Country
AND	Andorra
ATG	Antigua and Barbuda
BHS	Bahamas, The
COM	Comoros
CPV	Cabo Verde
DMA	Dominica
ERI	Eritrea
FSM	Micronesia, Fed. Sts.
GNB	Guinea-Bissau
GNQ	Equatorial Guinea
GRD	Grenada
KIR	Kiribati
KNA	St. Kitts and Nevis
LBY	Libya
LCA	St. Lucia
LIE	Liechtenstein
MCO	Monaco
MHL	Marshall Islands
NRU	Nauru
PLW	Palau
PRK	Korea, Dem. Rep.
SLB	Solomon Islands
SMR	San Marino
SYC	Seychelles
TLS	Timor-Leste
TON	Tonga
TUV	Tuvalu
VCT	St. Vincent and the Grenadines
VUT	Vanuatu
WSM	Samoa

Appendix D.

Compliance data for all regions

Objects	People	Prosperity	Planet	SDG 16	SDG 17
E_S_Asia	4.500	8.067	9.565	61.654	50.770
E_Euro_Asia	6.667	9.250	2.683	61.864	65.712
LAC	6.250	7.500	7.848	59.999	66.873
MENA	4.500	6.400	5.750	68.008	63.158
Oceania	1.000	1.986	5.500	62.141	45.242
OECD	9.000	10.708	6.833	76.099	69.983
SIDS	2.750	5.333	2.083	65.250	63.520
Africa	1.000	1.200	4.633	49.565	47.894
LIC	1.000	2.876	7.917	47.193	42.326
LMIC	2.333	5.583	4.633	57.401	50.657
UMIC	8.000	7.917	5.750	69.740	59.109
HIC	9.000	10.708	2.117	79.921	70.889

Appendix E.

Trend data for the regions

Objects	People	Prosperity	Planet
E_S_Asia	5.467	4.167	4.667
LAC	2.667	4.000	2.500
MENA	2.833	4.167	4.667
OECD	7.000	5.800	2.333
SIDS	1.200	1.000	3.500
Africa	1.200	2.583	2.500
LMIC	3.333	4.167	5.250
UMIC	5.417	3.333	4.667
HIC	7.000	5.800	2.333

Footnotes

[1] The further development has presented stopped due the death of dr. Rainer Bruggemann.

References

1. [a, b] *Future Learn, The three pillars of sustainability, 2021,*

   https://www.futurelearn.com/info/courses/sustainabilitysociety-and-you/0/steps/4618 (accessed Nov. 2023).

2. [a, b]SEG, 5 pillars of Sustainable Development Goals (SDGs), Social Enterprise Guide, 2021 http://socialenterpriseguide.com/5-pillars-of-sustainable-development-goals-sdgs/ (accessed Nov. 2023).

3. [a, b]Whatcanyoudo, What can you do? The 5p's, 2023, https://whatcanyoudo.earth/selecting-the-sdg-for-youraction/the-5-ps/ (accessed Nov. 2023).

4. [a, b, c, d, e, f]L. Carlsen, The state of the 'People' pillar by 2022 A partial ordering-based analysis of the sustainable development goals 1–5, World Development Sustainability 2 (2023) 100071, DOI: 10.1016/j.wds.2023.100071.

5. [a, b, c, d, e, f]L. Carlsen, The state of the 'Prosperity' pillar by 2022: A partial ordering-based analysis of the sustainable development goals 7–11, Green Finance, 5 (2): 89–101. DOI: 10.3934/GF.2023005.

6. [a, b, c, d, e, f, g]L. Carlsen, The state of the 'Planet' pillar by 2022, A partial ordering-based analysis of the sustainable development goals 6, 12, 13, 14, and 15, submitted for publication.

7. [a, b]L. Carlsen, Hierarchical partial order ranking, Environmental Pollution 155 (2008) 247e253, DOI: Environmental Pollution 155 (2008) 247e253.

8. [a, b, c, d]J.D. Sachs, G. Lafortune, C. Kroll, G. Fuller, F. Woelm, From Crisis to Sustainable Development: the SDGs as Roadmap to 2030 and Beyond. Sustainable Development Report 2022. Cambridge: Cambridge University Press.; DOI: 10.1017/9781009210058.

9. [a, b, c, d]R. Bruggemann, PG. Patil, Ranking and Prioritization for Multi-indicator Systems—Introduction to Partial Order Applications, Springer, New York, 2011, https://link.springer.com/book/10.1007/978-1-4419-8477-7 (Accessed Nov. 2023).

10. [^]L. Carlsen, Happiness as a sustainability factor. The World Happiness Index. A Posetic Based Data Analysis. Sustain Sci 13 (2018) 549–571; DOI: 10.1007/s11625-017-0482-9.

11. [^]L. Carlsen, R. Bruggemann, Partial order methodology a valuable tool in chemometrics. J Chemometrics 28 (2013) 226–234; DOI:: 10.1002/cem.2569.

12. [^]L. Carlsen, R. Bruggemann, Environmental perception in 33 European countries an analysis based on partial order. Environ Dev Sustain 22: (2018) 1873–1896; DOI: 10.1007/s10668-018-0267-z.

13. [a, b]R. Bruggemann, L. Carlsen Partial Order in Environmental Sciences and Chemistry, Springer, Berlin, 2006, Available from: https://www.springer.com/gp/book/9783540339687 (Accessed Nov. 2023).

14. [a, b]R. Bruggemann, L. Carlsen, Introduction to partial order theory exemplified by the evaluation of sampling sites, In R. Bruggemann and L. Carlsen (Eds.), Partial Order in Environmental Sciences and Chemistry, Springer, Berlin, 2006, 61–110. Available from: https://www.springer.com/gp/book/9783540339687 (Accessed Nov. 2023).

15. [^]R. Bruggemann, B. Münzer, A Graph-Theoretical Tool for Priority Setting of Chemicals. Chemosphere 27 (1993) 1729–1736; DOI: 10.1016/0045-6535(93)90153-V.

16. [^]R. Bruggemann, E. Halfon G. Welzl, K. Voigt, C.E.W. Steinberg, Applying the Concept of Partially Ordered Sets on the Ranking of Near-Shore Sediments by a Battery of Tests. J Chem Inf Comp Sci 41 (2001) 918–925; DOI: https://doi.org/10.1021/ci000055k.

17. [a, b]R. Brüggemann, L. Carlsen, An Improved Estimation of Averaged Ranks of Partial Orders. Match Commun. Math. Comput. Chem. 65 (2011) 383-414; https://match.pmf.kg.ac.rs/electronic_versions/Match65/n2/match65n2_383-414.pdf (Accessed Dec. 2023).

18. ^*Bruggemann, R.; Annoni, P. Average heights in partially ordered sets. MATCH Commun. Math. Comput. Chem. 71 (2014), 117–142; http://match.pmf.kg.ac.rs/electronic_versions/Match71/n1/match71n1_117-142.pdf (accessed Dec 2021).*

19. a, b, c*Bruggemann R; Carlsen, L. Incomparable-What now? MATCH Commun.Math.Comput.Chem. 71 (2014) 699-714; https://match.pmf.kg.ac.rs/electronic_versions/Match71/n3/match71n3_699-716.pdf (accessed Dec. 2023)*

20. ^*R. Bruggemann, L. Carlsen, K. Voigt, R. Wieland, PyHasse Software for Partial Order Analysis: Scientific Background and Description of Selected Modules, In R. Bruggemann, L. Carlsen, J. Wittmann (Eds), Multi-indicator Systems and Modelling in Partial Order, Springer, New York, 2014, pp. 389–423; DOI: 10.1007/978-1-4614-8223-9_19.*

21. ^*Bruggemann, R.; Voigt, K. A New Tool to Analyze Partially Ordered Sets - Application, Ranking of Polychlorinated Biphenyls and Alkanes/Alkenes in River main, Germany, MATCH - Commun.Math.Comput.Chem. 66 (2011) 231-251; https://match.pmf.kg.ac.rs/electronic_versions/Match66/n1/match66n1_231-251.pdf (accessed Dec. 2023)*

22. ^*Estimating the Date of Earth Overshoot Day 2022 https://www.overshootday.org/content/uploads/2022/06/Earth-Overshoot-Day-2022-Nowcast-Report.pdf (accessed Dec. 2023).*

23. ^*Earth Overshoot Days 1971 – 2023, https://www.overshootday.org/newsroom/past-earth-overshoot-days/ (accessed Dec. 2023).*

24. a, b*Country overshoot days 2022, https://www.overshootday.org/content/uploads/2022/01/Country_Overshoot_Days_2022.pdf (accessed Dec. 2023).*