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Original Research

The Sustainable One Health Index (SOHI) for Bottom-Up Use: For Countries, Regional Authorities, and Local Communities Based on Sustainable Development Goals

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Note: On August 30, 2024 a column with missing data has been inserted in Table 6a and in Annex I a column on the baseline data for SDG 3.4.1

Abstract

Aim: The United Nations SDG (Sustainable Development Goals) database, inaugurated in 2015, contains extensive and considerable information to follow up on the progress of the SDGs. We shall, therefore, explore in this paper whether the exclusive use of the easily accessible SDG database and a limited selection of 17 suitable indicators, i.e., one indicator per Goal, allows for a stable analysis of progress. We aim to provide a methodology for easy use at the sub-national level on the initiative of non-governmental organizations and communities evaluating their activities towards One Health implementation.

Methods: Seventeen suitable indicators (one per SDG) were selected and determined from the SDG-Database in 2015 and 2019 centering a period of six years from 192017-2022 to project the final success or failure of the target year 2030. To that end, we draw a 10% sample of 19 countries out of the 193 United Nations member states. Negative percent-values of SDGs are recalculated as positive, i.e., as the percentage of a 100% target achievement. Missing percent values, in total 23.5%, were replaced by imputation. A total of 969 values have been identified. We calculated the Sustainable One Health Index (SOHI) based on unweighted and weighted indicators. The weights were derived from a factor analysis of 17 indicators representing all SDGs. The indices were validated against the SDG values published for 2022/3.

Results: The unweighted index resulted in a correlation of 91% ($p<0.001$). Therefore, preference was given to the unweighted approach to facilitate the work of the target group of activists at subnational levels. The corresponding scatterplots for 2015 ($r=0.7057$; $p<0.0007$) and 2019 ($r=0.7470$; $p<0.0002$) show a grouping of high, middle-, and low-income countries. The average delay towards 2030 is 3.37 years for the indicators directly related to One Health (Group A), 3.19 years for the social (Group B), and 4.69 years for the economic (Group C) determinants.

Conclusion: Progress towards the target year 2030 is too slow despite the growing knowledge that most world regions' current economic, social, and environmental trajectories are unsustainable. A new tri- or four-partite global agency which has new representation from civil society could address many of the problems identified by paving the ways for bottom-up commitment, starting from monitoring achievements of the SDGs at the local level. The SOHI-Index can fulfil its intended purpose to support bottom-up commitment, requiring only one measurable indicator per SDG but no experts and no weighting of the selected indicators.

***Keywords**: Bottom-up Initiative, Monitoring, One Health, Sustainable Development Goals, Target Achievement, Imputation.*

Conflict of interests: The authors report no conflicts of interest.

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Introduction

Since the turn of the twenty-first century, there has been growing interest, public pronouncements, and policies supporting a One Health concept and approach to global health (1). Importantly. there is now a generally widely accepted and used definition, one which was created in 2021 by UN technical entities (2):

> *"One Health is an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems. It recognizes the health of humans, domestic and wild animals, plants, and the wider environment (including ecosystems) are closely linked and inter-dependent".*

Further, ***"****The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems, while addressing the collective need for clean water, energy and air, safe and nutritious food, taking action on climate changes and contributing to sustainable development".*

Still insufficiently engaged and structured is the cooperation and exchange between top-down and bottom-up initiatives, i.e. between the governmental level and the multiple Civil Society Organizations or Non-Governmental Organizations (CSOs, NGOs), essential for a broader acceptance and implementation of One Health principles in the population (3, 4). This deficit is aggravated by a lack of effective cooperation at the bottom-up level (5) which remains an obstacle in spite of progressive efforts such as that e.g. of the One Health Commission with its monthly 'One Health Happenings' (6). One Health is a global issue (7, 8).

Recently, attempts to develop indices to measure the state of One Health on the basis of a large set of indicators, derived from multiple databases and weighted by expert groups, have been published for continental areas and respectively countries, (9, 10) and for urban agglomerations (11, 12). The expert-based selection and weighting process of indicators requires a considerable number of resources and may not lead to more valid and especially stable results because expert opinions depend on their selection and naturally change over time.

Since 2015, when the set of Sustainable Development Goals (SDGs) was adopted (13). The United Nations SDG-database contains extensive and relatively complete information on 169 targets and 230 indicators of the 17 Goals (14) for each of the 193 countries in the United Nations system. The Sustainable Development Report 2023 (15) provides extensive calculations of an overall national index for 161 countries and 97 indicators stating that progress towards 2030 has slowed down and even been reverted in some countries for several goals. The lack of progress is confirmed in the subsequent report, published 2024 (16).

While One Health and the SDGs evolved separately, they are intrinsically linked and mutually reinforcing in multiple ways, both in aspiration and execution. Improved methodologies are

needed to gauge One Health's performance in terms of the Sustainable Development Goals and targets.

Often, the complexity of the required analyses is considered an obstacle for to stay against the use by smaller communities and movements for self-determination. Without proper monitoring, all efforts at the local level to develop sustainable interventions for One Health can be misdirected and/or fail. We will, therefore, explore in this paper whether the exclusive use of the easily accessible SDG database and a limited selection of 17 suitable indicators i.e. one indicator per Goal, will allow the calculation of a reliable index, named the Sustainable One Health Index (SOHI), for the 17 SDGs together and for the SDGs specifically related to the One Health concept. This approach would considerably facilitate the self-determination of progress and follow-up at the sub-national and, respectively, community level, for indicators measuring achievements in One Health and related fields. Our main goal is to provide a methodology for easy use at the sub-national level to facilitate initiatives of non-governmental organizations and communities to evaluate their activities towards One Health.

Methods

In order to offer a practical method for local communities to gauge the success and failure in achieving the SDGs, we apply an innovative index-based 'One Indicator per One Goal' analysis for the period between the year of inauguration 2015 and recently published SDG-data as well as a projection towards the target year 2030 (17). We shall validate this approach referring to the national indices published in Part 2 of the Sustainable Development Report 2023 by Sachs et al. (15).

Accordingly, we selected a most appropriate target for each SDG in relation to the One Health concept, its socio-economic conditions, and the availability of a quantifiable indicator. Three public health experts searched for measurable and temporarily complete indicators exclusively in the SDG database, which has 230 indicators for 193 member states of the United Nations system, often listed as the first appropriate target and indicator for each SDG.

As progress towards the One Health criteria depends to a high degree on the respective socio-structural conditions (18-21), we regrouped the SDGs 1-17. Modifying a proposal by Mangukiya et al. (22) we grouped the indicators they listed as environmental (indicators 12-15) with the health-related indicators 3, 6 and 7 as the One Health related group A (see Table 1):

A) SDGs which determine predominantly dimensions of One Health (SDGs 3, 6, 7, 12, 13, 14, and 15)

B) SDGs related to the social conditions influencing One Health (SDGs 1, 2, 4, 5, 11, 16, and 17)

C) SDGs which relate to the economic conditions impacting One Health (SDGs 8, 9, and 10).

Table 1: Overview of the selected SDG Indicators *for each goal* to represent it [*in italics the indicator selected by Sachs et al.* (15)]

Selected SDG indicators	Official description (23)	Value recalculated as proportion of 100% achievement (best)	Classification: A: One Health B: Social setting C: Economic conditions
1.1.1	**Proportion of the population living below the international poverty line.**	Proportion of the population living **above** the international poverty line (>1.25 USD/day).	B
	Poverty headcount ratio at US$2.15/day (https://data.worldbank.org/indicator/SI.POV.NAHC)		
2.1.2	**Prevalence of moderate or severe food insecurity.**	Prevalence of **security** of sufficient food.	B
	Prevalence of undernourishment (2.1.1)		
3.4.1	**Reduce by one third premature mortality rate attributed to cardiovascular disease, cancer, diabetes, or chronic respiratory disease.**	idem	A
	Life expectancy at birth (https://www.who.int/data/gho/indicator-metadata-registry/imr-details/3131)		
4.1.2	**Completion rate, by sex and education level (males, lower secondary education)**	idem	B
	Lower secondary completion rate (4.1.1)		

5.5.1.a	**Proportion of seats held by Women in National Parliaments**	Equal seat proportion is set as 1	B
	Share of women parliamentarians (5.5.1.a)		
6.1.1	**Proportion of the population using safely managed drinking water services**	idem	A
	Population using at least basic sanitation services (6.2.1.a)		
7.1.1	**Proportion of the population with access to electricity**	idem	A
	Population with access to electricity (7.1.1)		
8.5.2	**Unemployment Rate**	Employment rate, by Age: 15-24	C
	Unemployment rate (8.5.2)		
9.5.1	**Research and development expenditure as a proportion of GDP (Korea 2020=4.8%=100)**	R. of Korea is set as 100% with a value of **4.8% in 2020**.	C
	Population using the internet (17.8.1?)		
10.2.1	**Proportion of people living below 50 percent of median income**	Proportion of people living **above 50 percent** of median income	C
	GINI coefficient (https://ourworldindata.org/what-is-the-gini-coefficient)		
11.1.1	**Proportion of urban population living in slums**	Proportion of urban population **not living in slums.**	B
	Annual mean concentration of particulate matter of less than 2.5 microns in diameter (11.6.2)		

12.5.2	**Proportion of municipal waste recycled.**	idem	A
	Imported SO2 emissions (https://dashboards.sdgindex.org/map/indicators/so2-emissions-embodied-in-imports)		
13.2.1	**Total greenhouse gas emissions.**	Recalculated for 2019 as percent increase or reduction compared to 2015	A
	CO_2 emissions from fossil fuel combustion and cement production (https://factsonclimate.org/infographics/fossil-fuels-emissions)		
14.5.1	**Average proportion of marine key biodiversity areas covered by protected areas.**	Idem	A
	Ocean Health Index: Clean Water (https://oceanhealthindex.org/)		
15.1.2	**Forest area as proportion of total land area.**	**Target: >30%**	A
	Red List Index of species survival (https://www.iucnredlist.org/assessment/red-list-index)		
16.1.1	**Number of victims of intentional homicide per 100,000 population (males).**	10/100.000 set as zero achievement	B
	Corruption perception index (https://www.transparency.org)		
17.8.1	**Proportion of individuals using the Internet.**	Idem	B

	Statistical Performance Index (https://www.worldbank.org/en/programs/statistical-performance-indicators)		

Of the 19 countries selected by random sampling out of the UN database we replaced Liechtenstein (position 6), Swaziland/Eswatini (position 11) and St. Kitts and Nevis (position 14) because of their small population size below 2 million and partly missing data (also not listed in Sachs et al. (15)) by the next in the sampled row (**Table 2**): *Hungary, Malawi, and Republic of Korea (colloquially South Korea).* In further analyses we use the alphabetical order.

Table 2: 10% Sample of the UN member states (N=19)
Left: Countries selected by random sampling from all 193 UN member states
Middle: Countries sorted alphabetically (*including 3 replacements at positions 5, 7 and 9*)
Right: Countries sorted according to achievement (15, figure 2.3)

Countries as sampled	**Countries alphabetic**	**Countries sorted by achievement (%) (15)**	
Australia	1) Argentina	a) Sweden	86.0
Turkey	2) Australia	b) France	82.0
Somalia	3) France	*c) Hungary*	79.4
Tunisia	4) Honduras	d) Moldova	78.6
Moldova	*5) Hungary*	*e) Republic of Korea*	78.1
Saint Kitts and Nevis	6) Indonesia	f) Lithuania	76.8
Sierra Leone	*7) South Korea*	g) Australia	75.9
Sweden	8) Lithuania	h) Argentina	73.7
Swaziland	*9) Malawi*	i) Tunisia	72.5
Syria	10) Moldova	j) Turkey	70.8
Liechtenstein	11) Niger	k) Indonesia	70.2
Papua New Guinea	12) Papua New Guinea	l) Turkmenistan	68.5
Niger	13) Sierra Leone	m) Honduras	62.9
Indonesia	14) Somalia	n) Republic of Syria	58.2
Argentina	15) Sweden	*o) Malawi*	56.3
Turkmenistan	16) Syria	p) Sierra Leone	55.7
Lithuania	17) Tunisia	q) Papua New Guinea	53.6
France	18) Turkey	r) Niger	48.3
Honduras	19) Turkmenistan	s) Somalia	48.0

The respective recalculations as a percent of achievement are provided for each target specific indicator where appropriate (**Annex I**). To evaluate long-term trends, we projected a baseline value in 2015, through the observed value in 2019 (including a period of +/- three years) to the projected value of 2030 (methodology according to Bjegovic-Mikanovic et al. (17)). Thus, negative percent-values are recalculated as positive i.e. as a percentage of a 100% target achievement. If a baseline-value in 2015 is not available but in earlier years, the available data are accepted if later than 2009 (with a few exceptions due to lack of alternatives).

Missing indicator values can be replaced by imputation, (24) under the assumption that only single values are missing (25), not entire data series as imputation is preferably used for item

non-response. According to Preising et al. (26) several methods are available for imputation. The choice of method depends on the data situation, the failure (in terms of its size and mechanism) and the specific imputation target. In particular, there is not one best method that always achieves the best results for all use cases.

To replace missing values in the SDG-dataset we used imputations for the baseline year 2015 and the observation period 2016-2022 (**Annex I**) with the central observation year 2019 (27). We identified and/or calculated 969 values (19 countries times 17 goal-indicators in 2015, 2019 and 2030). As a method we relied on Chained Random Forest Imputation (28). Handling of missing data for both the basis year and 2019 was performed using R Statistical Software (29) The imputation was carried out with the missRanger package (30), allowing iterative model fitting, and the option of using predictive mean matching. This approach avoids imputation with values not already present in the original data.

An availability of 6 out of 10 indicators or 60% is considered as sufficient, at least 11 out of the sample of N=19 or a maximum of 8 missing values (29). This condition is not met for SDGs 13 and 12 with available values of 52.6 and 31.6%. However, we could not identify suitable alternative indicators from the SDG-database especially for SDG 12 (**Table 3** and **Annex I**).

Table 3: Ranking by missing data (MD) per SDG

Variable	Valid N	%Valid Obs	% MD
3.4.1	19	100.00	0.0
5.5.1.a	19	100.00	0.0
7.1.1	19	100.00	0.0
15.1.2	19	100.00	0.0
17.8.1	19	100.00	0.0
1.1.1	15	78.95	-21.1
2.1.2	15	78.95	-21.1
4.1.2	15	78.95	-21.1
8.5.2	15	78.95	-21.1
10.2.1	14	73.68	-26.3
16.1.1	14	73.68	-26.3
6.1.1	13	68.42	-31.6
9.5.1	12	63.16	-36.8
14.5.1	12	63.16	-36.8
11.1.1	11	57.89	-42.1
13.2.1	10	52.63	-47.4
12.5.2	6	31.58	-68.4
Mean			**-23.5**

Concerning countries, Papua New Guinea, Somalia and the Republic of Syria show levels of completeness of less than 50% (36.8; 36.8; and 31.6%). Based on all 646 observations (19 countries times 17 indicators times indicator values of two years - 2015 and 20219 – on average 23% of data are missing. Imputation is considered the most adequate solution for this situation as feature deletion, i.e. removing variables from data, would reduce the extent of information.

The composition of the index is based on an additive and a weighted aggregation of the various indicators (variables) to ensure that the different importance of individual indicators is taken into account by assigning weights (w).

Calculation of an unweighted SOHI Index:

$SOHI = \frac{\sum_{i=1}^{n} v_i}{n}$; n=17

Calculation of a weighted SOHI Index:

$SOHI = \frac{\sum_{i=1}^{n} w_i * v_i}{n}$; n=17.

These weights are determined by means of a factor analysis. This is a widespread approach. The additive combination of the indicators (31, 32) ensures that the index can still be calculated even if individual indicators have zero values.

In Annex II we provide a detailed user-oriented description of the methods sequential steps for calculating the values of the seventeen selected indicators and the resulting indices.

Results

The weights for the calculation of the SOHI index are derived from the outcomes of a factor analysis (33): Table 4 shows the variables' loadings, which measure their importance as potential indicators.

The cut-off for factor loadings is relative to sample size. This means that the variables 1.1, 2.1, 4.1, 5.5, 6.1 relative to sample size (34). For example, sample sizes of 60 require factor loadings of 70% to be meaningful (35). **The** bold, 7.1, 11.1**,** and 17.8 are the most relevant indicators for a weighted index. The values of the first factor can**, therefore, be used** to construct a one-dimensional weighted index.

When interpreting the data, it should be remembered that information could be lost due to the omission of factor two. It is**,** therefore**,** important to know which positions (values) the countries would hold with regard to both factors. For the year 2015**,** the proportion of the explained variance of the first factor was 44.89%; together with the second factor, it was 63.11%. For the year 2019, it was 44.8%, and together with factor 2, it was 63.15%.

Table 4: Factor loadings: Correlation between variables and factors for the baseline data in 2015 and for the observed values around 2019

SDG	Factor Loadings (Varimax normalized) (2015) Extraction: Principal components (Marked loadings are >.600000)		Factor Loadings (Varimax normalized) (2019) Extraction: Principal components (Marked loadings are >.600000)	
	Factor (1)	Factor (2)	Factor (1)	Factor (2)
1.1	**0.956587**	-0.037650	**0.910667**	-0.083746
2.1	**0.913505**	0.083927	**0.923632**	0.168903
3.4	0.448978	0.202814	**-0.774787**	-0.166765
4.1	**0.810888**	0.401334	**0.851892**	0.327470
5.5	**0.651774**	-0.054015	0.594926	-0.127163
6.1	**0.919369**	0.252263	**0.917230**	0.155936
7.1	**0.957232**	-0.085378	**0.917671**	-0.180672
8.5	-0.564976	0.197286	-0.425179	0.596402
9.5	0.424552	**0.833078**	0.473618	**0.678866**
10.2	-0.284542	0.547012	-0.166057	0.522683
11.1	**0.943598**	-0.064073	**0.906551**	-0.000660
12.5	0.430779	**0.800218**	0.467052	**0.759738**
13.2	0.119143	0.372428	0.259399	0.165116
14.5	0.501434	0.341931	0.486635	0.374831
15.1	-0.031981	0.457978	0.054439	0.414494
16.1	-0.165186	**0.854263**	0.072813	**0.927841**
17.8	**0.845922**	0.333240	**0.886669**	0.086115
Explained variance	*7.460890*	*3.267302*	*7.616984*	*3.118544*
Proportion of total variance	*0.438876*	*0.192194*	*0.448058*	*0.183444*

Table 5: Index scores by country without and with weighting for 2015 and 2019 (+/-2 years*

SDG INDICES	2015			2019			SDG 2022	SDG 2024
COUNTRIES SAMPLED	Without weighting	Weighted all	Weighted 60%	Without weighting	Weighted All	Weighted 60%	(15)	(16)
1) Argentina	72.75	34.15	71.55	76.39	37.7	64.08	73.7	74.4
2) Australia	101.36	39.73	78.73	103.83	47.58	74.64	75.9	76.9
3) France	99.59	39.87	78.49	101.83	47.04	73.91	82.0	82.8
4) Honduras	56.44	21.79	51.22	59.22	25.46	50.1	62.9	62.0
5) Hungary	68.94	33.94	74.7	73.44	37.44	73.0	79.4	79.5
6) Indonesia	70.79	25.58	58.21	77.37	32.49	59.33	70.2	69.4
7) Lithuania	68.7	35.92	75.56	74.41	38.41	72.58	76.8	78.1
8) Malawi	48.15	**7.81**	**20.37**	57.82	**14.46**	**19.04**	56.3	56.8
9) Niger	**45.51**	10.89	27.42	**44.06**	15.05	25.32	48.3	49.9
10) Papua New Guinea	59.99	10.4	28.11	63.44	15.71	27.59	53.6	52.0
11) R. of Korea	**121.82**	**40.89**	78.02	**122.22**	**50.18**	**75.56**	78.1	77.3
12) R. of Moldova	56.74	30.3	69.4	63.38	32.79	65.53	78.6	78.8
13) R. of Syria	59.17	25.2	57.04	59.51	23.88	41.92	58.2	60.6
14) Sierra Leone	55.18	10.82	25.45	53.63	14.98	24.8	55.7	58.2
15) Somalia	49.65	13.71	33.03	47.16	15.54	27.75	**48.0**	**45.4**
16) Sweden	87.41	39.07	**82.6**	87.12	42.72	75.19	**86.0**	**85.7**
17) Tunisia	65.33	33.02	70.42	67.59	35.34	64.23	72.5	72.5
18) Turkey	85.33	32.25	69.03	90.63	40.22	68.79	70.8	70.5
19) Turkmenistan	71.9	31.7	68.22	69.8	34.06	62.21	68.5	67.1
Average	*70.8*	*27.2*	*70.8*	*73.3*	*31.6*	*55.1*	*68.2*	*68.3*
Range	*76.31*	*33.08*	*62.23*	*78.13*	*35.72*	*56.15*	*38.0*	*40.3*
Correlation with SDG 2022	0.71	0.08	0.06	0.75	0.09	0.10		

* A weighted index is defined as follows: $Index = \frac{\sum_{i=1}^{n} w_i * v_i}{n}$; n=17.

We listed the values of SDG 2022 (15) and 2024 (16) for comparison. The differences between the two reports are less than three percent points.

We used the 2023 report as an external criterion to validate the performance of SOHI. It turned out that, contrary to expectations, it was not the weighted indices (with different significance limits) that showed the best agreement, but the unweighted indices for 2015 and 2019. The correlation between the external criterion and the SOHI indices was $r=0.75$, $p < 0.01$ and 0.71, $p < 0.01$. As an additional option for checking the information value of the SOHI, a comparison was carried out with the standardized unweighted magnitude values of the position vectors (15). It resulted in a correlation of 91% and $p<0.001$. Further, It is remarkable that in **Table 5** all African countries except for Tunisia take the last positions whereas European countries take the top positions regarding the degree of SDG achievement measured by the selected indicators.

Since our objective is to describe an easily useable method, we give preference to the unweighted approach. It does not require additional efforts to determine statistically the weights. As noted above, it is important to review whether information is lost by using the weights from factor 1 alone. For this purpose, the countries were plotted in a two-dimensional space using both country factor scores. **Figure 1** shows the scatterplot with the regression for 2015 and 2019 about SDG 2022. Some countries are grouped together as clusters, indicating a similarity in performance. These clusters are confirmed by k-means clustering of the factor scores and the standardized data. We consider this an indication that the index provides meaningful information. The three indicated groupings relate to the common categorization of countries according to high, middle, and low-income countries and links the analysis to the question of global injustice (37, 38).

The ranking of the countries in our sample according to high-income, middle-income, and low-income countries as in **Figure 1** is even more pronounced if only the key goals of One Health in category A (see Table 1) are considered (**Table 6a below**) and similarly so for categories B and C (**see Tables 6b and c**).

Figure 1: The two scattergrams show the position of the sample of 19 countries about their status in 2015 and 2019 (+-2 years) related to SDG 2022

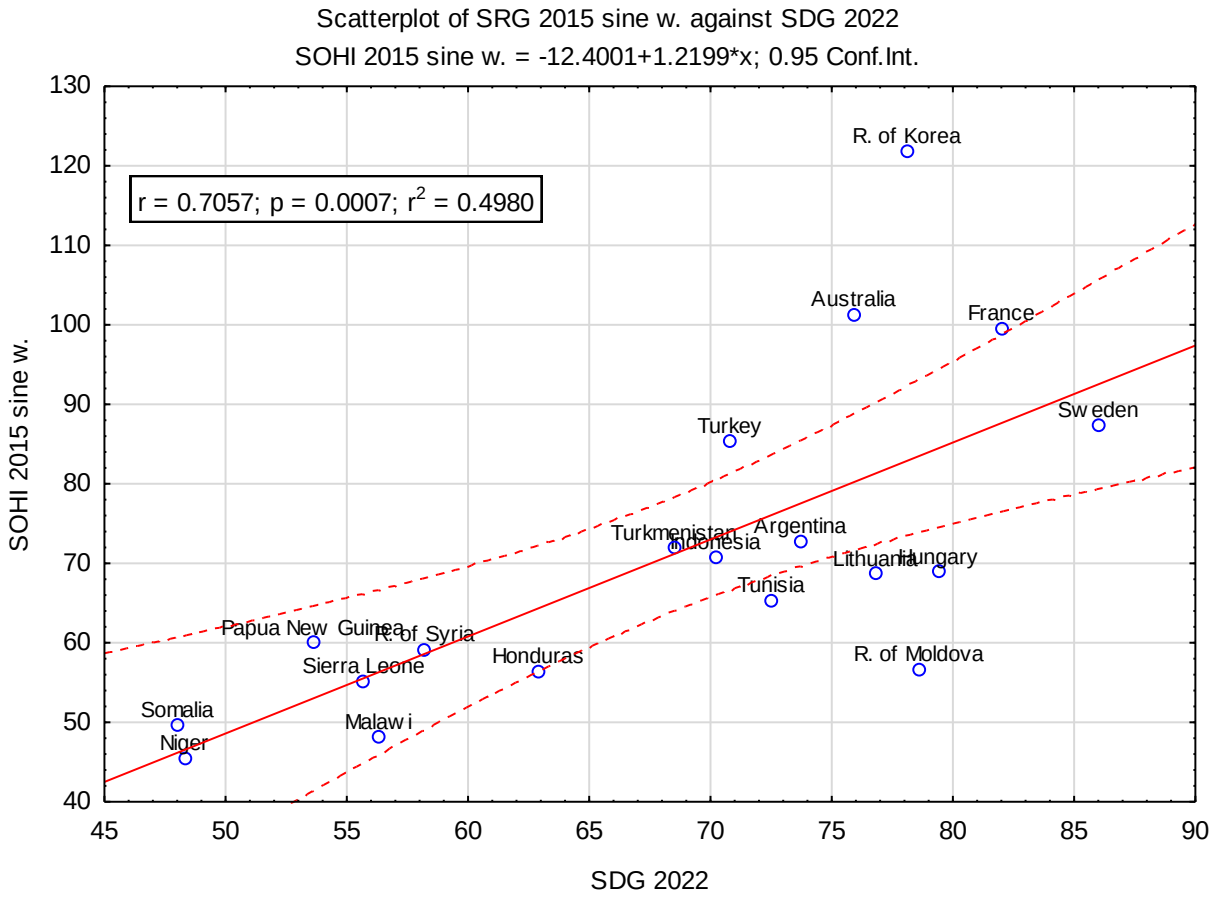

Figure 1a: Distribution of the sample of 19 countries without weighting

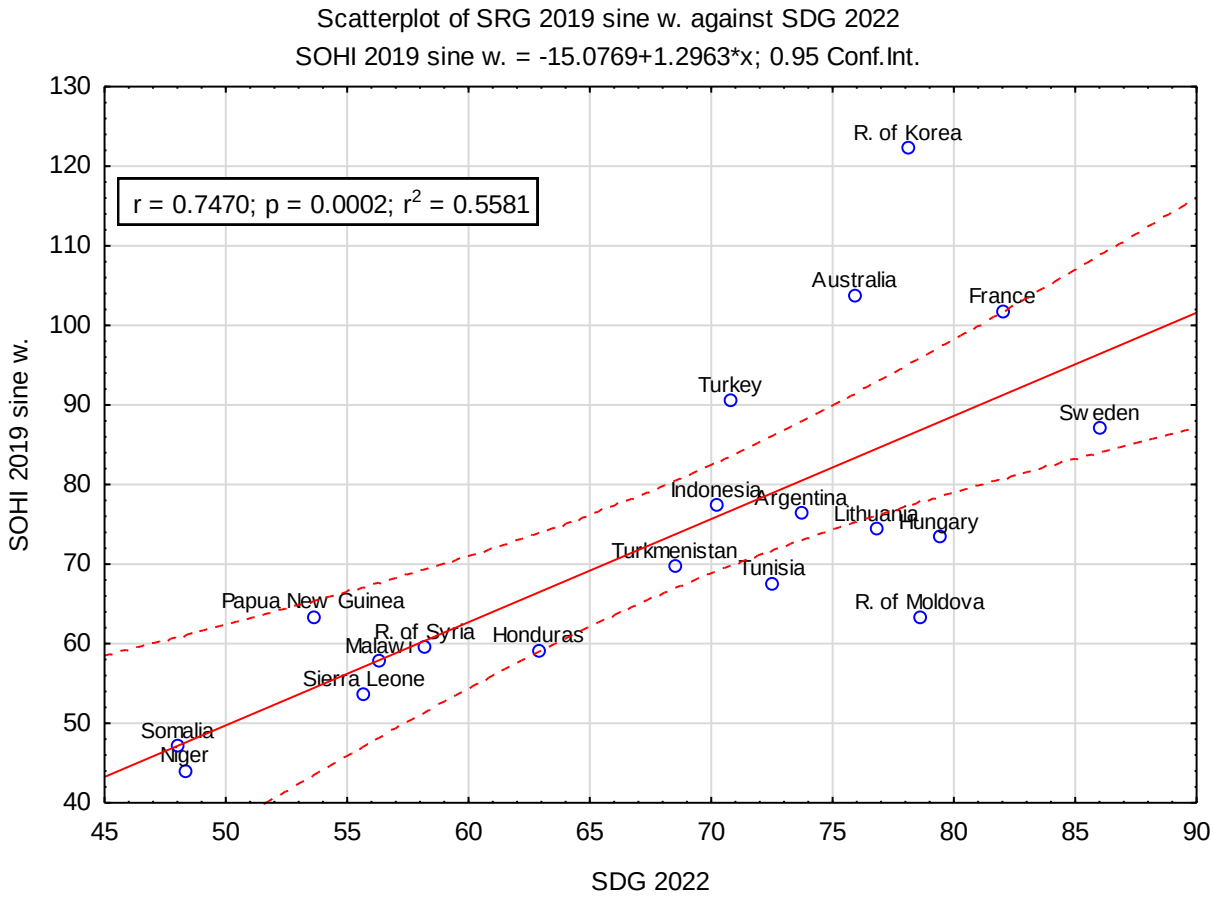

Figure 1b: Distribution of the sample of 19 countries without weighting in 2019 and two adjacent years.

Table 6 a (based on Annex I): Group A: Years of advance/delay of SDG target achievement towards 2030, (imputations bold) as especially relevant for One Health. A delay equal to or higher than 10 years is set in italics.

Sustainable Development Goals Group A	**SDG 3**	**SDG 6**	**SDG 7**	**SDG 12**	**SDG 13**	**SDG 14**	**SDG 15**	**Average horizontal**
Country								
1) Argentina	-1.8	-5.79	9.00	-9.00	-2.60	-6.37	-5.14	-3.10
2) Australia	-0.6	*-17.00*	9.00	**-5.38**	-4.42	-5.39	-4.89	-4.10
3) France	-2.4	4.25	9.00	-5.57	-3.13	-1.77	-17.78	-2.49
4) Honduras	1.2	-5.77	4.79	**-5.82**	0.48	-7.00	-4.47	-2.37
5) Hungary	-1.9	8.00	9.00	-5.40	-2.87	**-4.84**	-5.18	-0.46
6) Indonesia	-2.6	-6.58	4.20	**-5.60**	**-5.74**	-6.00	-3.93	-3.75
7) Lithuania	2	-1.74	9.00	-3.51	-3.98	-3.73	-5.92	-1.13
8) Malawi	-1.4	-6.27	-4.32	**-5.36**	***-18.58***	**-5.91**	-13.35	-7.88
9) Niger	-3.1	**-4.22**	-5.64	**-5.61**	**9.51**	**-4.85**	-5.03	-2.71
10) Papua N.G.	-3.5	**-6.23**	-5.54	**-5.46**	**-2.90**	-7.00	-4.88	-5.07

11) R. Korea	1.9	0.50	9.00	**-6.00**	-1.03	-7.00	-4.76	-1.07
12) R. Moldova	0	-5.68	9.00	**-5.06**	-5.08	**-5.57**	-5.00	-2.48
13) R. of Syria	-4.6	**-8.56**	-7.80	**-6.03**	***-13.14***	**-6.50**	-5.00	-7.38
14) Sierra Leone	-4.2	-6.69	-4.54	**-5.70**	**8.99**	-7.00	-1.75	-2.98
15) Somalia	-2.8	**-6.47**	-6.58	**-5.71**	**7.51**	**-5.65**	-5.43	-5.74
16) Sweden	-0.8	-3.25	9.00	-8.32	-5.01	-5.78	-5.00	-2.74
17) Tunisia	-3.1	-8.33	-6.00	**-5.70**	**-6.73**	-7.00	-4.96	-5.97
18) Turkey	-1.8	**-5.34**	9.00	-1.89	-5.33	-7.00	0.90	-1.64
19) Turkmenistan	-2.7	-0.23	9.00	**-5.32**	**4.67**	**-6.80**	-5.00	-0.91
Average vertical	-1.69	-4.49	3.08	-5.60	-2.60	-5.85	-5.61	-3.37

Group B: Years of advance/delay of SDG target achievement towards 2030 (imputations bold) as especially relevant for Social Conditions: Goals 1, 2, 4, 5, 11, 16, and 17. A delay equal to or higher than 10 years is set in italics.

Sustainable Development Goals Group B	**SDG 1**	**SDG 2**	**SDG 4**	**SDG 5**	**SDG 11**	**SDG 16**	**SDG 17**	**Average horizontal**
Country								
1) Argentina	*-17.67*	-19.83	-3.84	1.35	-2.10	-1.38	3.00	-5.78
2) Australia	-4.00	-6.83	-6.71	-0.47	**-2.51**	-3.89	5.30	-2.73
3) France	-5.00	-5.56	-4.03	-0.69	**-3.27**	-6.28	-0.48	-3.62
4) Honduras	-3.65	*-11.23*	-7.68	-7.07	-5.23	**0.68**	0.37	-4.83
5) Hungary	0.00	-7.73	-2.63	-6.87	-2.41	2.80	2.71	-2.02
6) Indonesia	3.48	-3.25	-1.46	-5.95	-3.21	**-0.09**	1.70	-1.25
7) Lithuania	3.71	0.67	-9.07	-5.00	**-3.41**	2.60	2.13	-1.20
8) Malawi	-5.00	-6.83	-3.07	-6.20	-4.03	*10.39*	-3.06	-2.54
9) Niger	-2.24	-9.56	**-1.65**	-0.89	-8.03	-4.69	-2.94	-4.29
10) Papua N.G.	**-4.37**	**-7.86**	**1.07**	-8.30	**-4.10**	-5.51	-2.07	-4.45
11) R. Korea	-2.00	-6.56	*-11.91*	-6.75	**-2.68**	-2.96	5.44	-3.92
12) R. Moldova	100.00	-9.26	-4.47	1.14	-0.45	1.48	-1.20	*12.46*
13) R. of Syria	***-25.81***	***-30.74***	**-0.22**	-8.64	***-24.03***	**-0.11**	-3.76	*-13.33*
14) Sierra Leone	-0.81	-3.90	-0.46	-7.76	-1.75	-8.47	-3.13	-3.75
15) Somalia	**-4.32**	-1.27	**-0.31**	-5.56	**-6.04**	**-2.42**	-5.87	-3.68
16) Sweden	0.00	-9.00	-6.39	-1.44	**-2.28**	-5.12	0.02	-3.46
17) Tunisia	*14.00*	*-14.49*	-2.41	*-11.01*	-3.36	-0.41	3.06	-2.09
18) Turkey	*-19.00*	**-5.79**	-3.81	-6.74	-3.67	-4.22	2.97	-5.75
19) Turkmenistan	**-6.99**	**-8.45**	-2.11	-7.97	-4.62	0.63	-1.34	-4.41
Average vertical	-4.41	-8.81	-3.75	-4.99	-4.59	-1.42	0.15	-3.19

Group C: Years of advance/delay of SDG target achievement towards 2030 (imputations bold) as especially relevant for the Economic Conditions: Goals 8, 9, 10. A delay equal to or higher than 10 years is set in italics

Sustainable Development Goals Group C	**SDG 8**	**SDG 9**	**SDG 10**	**Average horizontal**
Country				
1) Argentina	**-10.74**	-5.36	-7.00	-7.70
2) Australia	-3.94	-4.47	-9.72	-6.04
3) France	-2.43	-4.20	-5.42	-4.02
4) Honduras	-14.14	-3.86	-4.69	-7.56
5) Hungary	-2.71	-3.74	-2.00	-2.82
6) Indonesia	-4.44	-4.87	**-1.39**	-3.57
7) Lithuania	-4.16	-4.45	-0.61	-3.07
8) Malawi	7.00	**-2.76**	-5.36	-0.37
9) Niger	*-53.40*	**-4.26**	-3.26	-20.31
10) Papua N.G.	**-6.21**	**-2.99**	**-3.23**	-4.14
11) R. Korea	-2.05	10.00	-2.89	1.69
12) R. Moldova	0.82	-6.29	-3.40	-2.96
13) R. of Syria	**-6.61**	**-3.87**	**-4.68**	-5.05
14) Sierra Leone	5.94	**-3.64**	-5.38	-1.03
15) Somalia	**-11.38**	**-4.03**	**2.64**	-4.26
16) Sweden	-9.24	-1.53	-5.78	-5.52
17) Tunisia	-3.71	-3.38	0.21	-2.29
18) Turkey	-9.32	-4.12	-1.79	-5.08
19) Turkmenistan	**-7.57**	**-4.31**	**-3.08**	-4.99
Average (vertical)	-7.28	-3.27	-3.52	-4.69

Discussion

The SDGs, inaugurated in 2015 by the United Nations, nota bene the World Health Organization (WHO), are not on track, likely due to a lack of political will (39) as commented after the World Health Assembly May-June 2024 (40); progress towards the target year 2030 up to now is too slow (41) despite the growing knowledge that most world regions' current economic, social, and environmental trajectories are unsustainable (42). As a result, there is a demand that the unattainable 2030 deadline be extended, as the poor and vulnerable nations lag far behind which in the authors' opinion would per se not necessarily contribute to a solution of the problem, especially with regard to the poorer developing nations.

Except some European – especially Scandinavian - countries and with regard to a few SDGs, all countries will need at the present pace more time to achieve the target values by 2030. Indeed, only a few countries and targets, altogether 19 or 5.9% out of our sample of 19 countries and 17 indicators need more than 10 additional years **Table 6a, b, c**). On average the country

sample achieves the targets for the One Health indicators in 2030 with a delay of only about 3 years or in 2033. Nevertheless, the rather negative trend between 2015 and 2019 respectively and now in 2024 (16), as well as the high number of missing values requiring imputations (especially SDG 6, 12-14) is disappointing. The outlook is worse for the poorest developing countries, mainly in Sub-Saharan Africa.

The European Commission analyzed its outlook for 2030 and initiated a Regions 2030 Pilot Project (43) to dynamize regional engagement. The technical results published typically address regional governments, the intermediary top-down level, not local initiatives as targeted in this article promoting the SOHI. In analogy e.g. the following is written concluding the executive summary of a report (44) on related developments, even in a highly decentralized country like Indonesia: "Furthermore, both at the national and subnational Government levels, there is room for strengthening legislative accountability and for closer engagement with citizens and citizens' groups". However, citizens are at least mentioned, though well-known is missing mobilization to implement positive changes in legislation at the local level e.g. (45).

The call of the United Nations in Capetown 2023 as well lists rather restrictive principles for the 2025 Comprehensive Review of the SDGs (46):

3rd Principle: There should be space for improvements, while at the same time ensuring that the changes are limited in scope and the size of the framework remains the same.
4th Principle: The focus of the Group's common work should remain on the implementation of the framework in countries for the achievement of the Sustainable Development Goals.

The review rightly insists on the (full) implementation of the SDG-framework in countries (4th Principle) however, the two principles (numbered here 3rd and 4th) may become contradictory if the third principle is used in its restrictive intentions. In the years since 2015 this rather careful than stimulating tendency may have contributed to the slowing down of the SDG development process. Interaction equally footed between well positioned bottom-up initiatives and top-down good governance is considered essential to change the developmental trajectories. The mainly negative trend between 2015 and 2019 (+-2 years) and the high number of missing values that required imputations (especially SDG 6, 12-14) is worrying.

The One Health movement, comprised of many organizations, groups, and individuals from diverse backgrounds and disciplines, has sought to highlight and improve cooperation and coordination globally, subnationally, and especially at the local and community level (5, 47-52). Identifying the most urgent issues at stake and being equipped to evaluate interventions is conditional to proceed effectively. All steps required need data collection and analysis: Observe, Identify, Cooperate, Implement, Evaluate, Communicate (6). To that end we present in this article the SOHI as an attempt to develop and provide a handy instrument enabling subnational units and even local communities to contribute and to monitor own progress in the One Health dimension and beyond.

Subnational units and local communities often possess unique knowledge about their environments, wildlife, and public health challenges. This expertise is invaluable in developing tailored interventions that are culturally and ecologically appropriate. Indigenous communities often have long-standing practices that promote ecological balance. Local engagement fosters trust between people and authorities and makes individuals more likely to participate in and support One Health initiatives. Involved in decision-making processes people feel ownership and responsibility and therefore can adapt to changing circumstances more quickly.

Community engagement supports long-term sustainability and resilience as everybody is directly or indirectly involved. Setting their priorities and involving their resources ensures to a high degree that efforts are not wasted. In summary this may be more cost-effective than generalizing top-down strategies and better embedded in the local culture. Involving community members in data collection can enhance the scope and accuracy of health monitoring efforts. Communities can provide real-time data and observations critical for early detection and response to health threats, improving surveillance systems.

Because of their close neighborhood and interrelatedness bottom-up approaches encourage collaboration across different sectors within the community, such as agriculture, education, and health, promoting a holistic approach to One Health. Including farmers, local businesses, and schools, ensures that all aspects of One Health are addressed. Local leaders can champion One Health initiatives, leveraging their influence to garner broader support and drive policy changes, influencing national and international health policies. Bottom-up approaches ensure that marginalized and vulnerable groups are included in health interventions, promoting equity and reducing health disparities. Thus, they effectively promote more comprehensive and equitable health solutions.

The vast potential of context-specific expertise, local ownership and trust, sustainable and resource-effective engagement, local monitoring and surveillance (53), and grassroot-advocacy can significantly enhance bottom-up the effectiveness and sustainability of the One Health initiative. Such a dynamic can be induced only through efforts invested at the level of local initiatives organizing to work together and exchange mutually. Accordingly, the United Nations Universal Health Coverage (UN-UHC) (54) September 2023 promotes a coherent way forward. It recognizes the value of a One Health approach (§ 41) and § 98 enhances cooperation by naming the local level first.

The SOHI can potentially become an instrument facilitating the use at subnational territorial units. It invites to the collection of required data and it addresses engaged groups of activists. Furthermore, our selection of indicators can be modified according to need and interest and always be validated against the official national indices.

We suggest the following operational steps summarizing **Annex II**:

1) Agree with your community to promote the SDGs at the local level.

2) Identify a team to design interventions.

3) Identify a team to evaluate interventions.

4) Define the priorities of intervention.

5) Identify the corresponding measurable indicators in the SDG System.

6) Replace SOHI indicators where necessary.

7) Evaluate the selected indicators against the SOHI indicators.

8) Calculate an appropriate modified SOHI.

9) Compare to the data from Sachs et al. (15).

10) Follow-up every two years.

While the UN framework for SDGs is predominantly country-based, efforts to localize the SDGs are ongoing, recognizing the critical role that subnational entities, regions, municipalities, and local communities play in achieving sustainable development goals.

A shared system to monitor SDGs regionally is necessary to translate them into meaningful local strategies. The initial proposal (55) of the Joint Research Centre (JRC) of the European Commission, comprises a set of 83 indicators for SDG monitoring at regional level and more than 200 indicators; a manageable subset needs to be identified and recommended as we attempted to do in this article.

Conclusions

The intended purpose of this work is to support bottom-up commitment. The SOHI has been profiled for that, requiring only one measurable indicator per SDG but no experts and no weighting of the selected indicators. We offer the SOHI-Index for further development.

A new tri- or four-partite global agency which includes new representation from civil society, devoted to enhance a bottom-up approach and supported by governmental top-down agreement - if not remaining aspirational only (56) - could address many of the problems identified by paving the ways for bottom-up commitment, starting from monitoring defined achievements of the SDGs at the local level. The SOHI-Index can fulfil the purpose to support this bottom-up commitment.

Needed now is new thinking and a new entity to address the problems and opportunities we have described. For many years, the International Labor Organization (ILO) has functioned as a tripartite body representing government, labor, and public interests. This could be the template for a new One Health/Pandemic organization that would provide for proactive community/civil society engagement. If governments, regional and international financial institutions, other donors, and global influencers get behind such an approach, it can happen.

Supplements:

ANNEX I: SDG data recalculated; ZXY GAP 2030 achievement 240714.

ANNEX II: Methodology of the SDG indicator and index analysis for use at local levels.

ANNEX II: METHODOLOGY OF THE SDG INDICATOR AND INDEX ANALYSIS TO DETERMINE PROGRESS AT LOCAL LEVELS.

Motto:

Rudolf Virchow, a leading German physician (1821-1902) stated at his time already, that "Between animal and human medicine there are no dividing lines nor should there be. The object is different but the experience obtained constitutes the basis of all medicine".

Today, under the term One Health, we add the plants, the waters, and the atmosphere, all of which interact with the global population's health (1, 2)

Since the inauguration of the United Nations' Sustainable Development Goals (SDGs) 2015, progress towards the target year 2030 has been too slow to reach the goals in time. To fasten progress, we developed the following methodology structured in three phases: structure the mobilization process bottom-up with the intention of pushing the governmental levels to invest more efforts and accelerate the process.

PHASE I Mobilization process and analysis

PHASE II Interventions to inform, agree and act on identified deficits

PHASE III Determine program

PHASE I Mobilization process and analysis

Step 1) Those concerned about their children's future destiny should identify each other's motivations for joining in targeted action.

Step 2) A small core group of motivated people may define itself as a motor of local action.

Step 3) Inform local or regional authorities about your intentions, based on a short analysis of the present state of affairs and ask for their full support.

Step 4) Inform yourself studying the paper on the Sustainable One Health Index (SOHI) by Laaser, Wenzel, Seifman, Bjegovic-Mikanovic, and Bruce Kaplan, and other related publications as well (e.g. from the references).

5) In the publication mentioned under step 4, one indicator for each of the 17 SDGs has been identified from the available SDG database (e.g., https://unstats.un.org/UNSDWebsite/undatacommons/countries). You can use your country's national indicators as a reference.

5a) Check which information is available in your environment/your community for each of these 17 indicators.

5b) Check in the available SDG database (see 5c), if you prefer alternatives or additional indicators, especially if data on some of these 17 indicators are insufficient/not available locally. Suitable indicators should

- Be well defined (23) and measurable in your environment
- Cover at least the year 2015 (alternatively a year between 2010-2016) as a possible baseline
- Cover at least the year 2019 (alternatively 2017 or later) determining progress by the observed value.

5c) You can choose between:

recommended: https://unstats.un.org/UNSDWebsite/undatacommons/countries

alternatively: https://unstats.un.org/sdgs/dataportal/countryprofiles/

and for general information:

https://unstats.un.org/UNSDWebsite/undatacommons/sdgs/countries

6) Determination and documentation of data:

6a) Identify a value for each of the selected indicators or provide arguments for the es- timate of a missing value to be replaced later by a measurement or a well-argued analysis of the situation to be monitored.

6b) To secure the data identified and work with documented data you may decide to download an Excel sheet (at: https://www.microsoft.com/en-us/microsoft-365/excel) like we did with the Annex I (Laaser et al. in JGPOH).

7) Develop a table with all indicators chosen (see e.g. Table 1 in Laaser et al.) and determine as precise as possible their values:

7a) Scrutinize for plausibility and replace by alternatives if recommendable.

7b) Reformulate where necessary the identified indicator into a value of positive achievement (see e.g. Annex I in the publication by Laaser et al.), e.g.:

If you have identified the indicator 2.1.2 in Annex I:

"2.1.2 Prevalence of moderate or severe food insecurity"

and you found or estimated values of 31% in 2015 and 38% in 2019 (or a later year) you have to recalculate these percentages as percent of the targeted population living in a situation of sufficient food security for tomorrow, which in this example is 69% in 2015 and even diminishing up to 2019 by 7% to a value for food security of 62%. This

procedure is necessary as the target for the SDG achievement up to 2030 is set here as 100% food security in 2030.

8) Calculate the time required to achieve the target value in 2030 as defined for the chosen SDG-Indicators by the data-sets under 5c) and replace indicators if unavailable. You can use the following procedure, best in Excel (17):

Formula and online calculator:

Tr	remaining time
Tn	time needed to achieve the target (in linear progress)
G	time gap (gain or delay in years)
tb	baseline year
tc	year of observation
tt	target year
xb	baseline value of the indicator
xc	observed value of the indicator
xt	target value of the indicator

$$Tr = tt - tc$$

$$T_n := t_t - \left[t_b + \left(t_t - t_b\right) \cdot \frac{\left(x_c - x_b\right)}{\left(x_t - x_b\right)} \right]$$

$$G = Tr - Tn$$

9) We suggest determining the 2015 baseline values in the best possible way and keeping them stable for present and future evaluations.

10) The next step is to calculate the SOHI Index we validated with the data published by Sachs et al (15), see Table 5 in the publication by Laaser et al. mentioned under item 4).

10a) Calculate of the SOHI Index based on 17 indicators with available data or well-argued estimates if not available.

You can use the following formulas:

Calculation of an unweighted SOHI Index:

$$SOHI = \frac{\sum_{i=1}^{n} v_i}{n} \text{ ; n=17}$$

Calculation of a weighted SOHI Index:

$$Index = \frac{\sum_{i=1}^{n} w_i * v_i}{n} \text{ ; n=17.}$$

Value of variable (here SDG) v

Sequential number of SDG n

10b) You can do the same with a limited number of SDG-Indicators (e.g. if you do not want to use estimated instead of unavailable measured indicator-values.

11) Write the report dated the respective year, naming place and address, and the responsible team.

12) Find some competent but benevolent person to check your report critically.

13) Present your report publicly in a meeting/conference and invite the local/regional administration.

14) Send your report for publication to any acknowledged Journal of your choice or directly to JGPOH, the Executive Editor: Prof. Genc Burazeri, Tirana, Albania, email: gburazeri@yahoo.com

15) Follow a review of your report by the selected journal and return the corrected/adapted version of your report to JGPOH or your journal of choice.

16) Celebrate the publication of your report and invite the greatest possible number of people.

PHASE II Interventions to inform, agree and act on identified deficits

17) Amend your core team with motivated persons focusing on action for improvement.

18) Discuss possible and most promising interventive action with the augmented team to improve the respective indicator values.

19) Test the approachability of the respective target groups

20) Decide on the priority actions to improve the identified deficits.

21) Inform and invite the local authorities.

22) Prepare the local campaign for improvement and determine the period of action.

23) Run the local campaign as planned.

PHASE III Determine progress

24) Re-determine the related indicators and identify achievements and failures.

25) Compare the measured values of your indicators with the corresponding regional and/or national data.

26) Recalculate the SOHI before and after your interventive campaign.

27) Present the results of your campaign in a public meeting.

28) Send the final report to a journal of your choice or JGPOH for publication

29) Identify the next deficit to be dealt with.

30) Celebrate your success in a public party.

References

1) FAO, OiE, WHO, UN System Influenza Coordination, UNICEF, WB. Contributing to One World, One Health. A Strategic framework for Reducing Risks of Infectious Diseases at the Animal-Human-Ecosystems Interface. Consultation Document 2008. At: https://www.preventionweb.net/files/8627_OWOH14Oct08.pdf

2) One Health High-Level Expert Panel (OHHLEP), Adisasmito WB, Almuhairi S, Behravesh CB, Bilivogui P, Bukachi SA, et al. (2022) One Health: A new definition for a sustainable and healthy future. PLoS Pathog 18(6): e1010537. At: https://www.woah.org/en/quadripartite-call-to-action-for-one-health-for-a-safer-world/?fbclid=IwAR0XYjr_6D0iyOgBIEcIO7jNRiSHb-S43ccAOCHC-eM-DZiTtKM

3) Laaser U. A plea for Good Global Governance. Front. Public Health; DOI: 10.3389/fpubh.2015.00046. Available at: http://journal.frontiersin.org/article/10.3389/fpubh.2015.00046/full

4) Laaser U, Dorey S and Nurse J (2016). A plea for Global Health Action bottom-up. Front. Public Health 4:241. doi: 10.3389/fpubh.2016.00241. Available at: http://journal.frontiersin.org/article/10.3389/fpubh.2016.00241/full?&utm_source=Email_to_authors_&utm_medium=Email&utm_content=T1_11.5e1_author&utm_campaign=Email_publication&field=&journalName=Frontiers_in_Public_Health&id=209500

5) Laaser, U., Stroud, C., Bjegovic-Mikanovic, V., Wenzel, H., Seifman, R., Craig, C., Kaplan, B., Kahn, L. and Roopnarine, R. (2022) "Exchange and Coordination: Challenges of the Global One Health Movement", *South Eastern European Journal of Public Health (SEEJPH)*. doi: 10.11576/seejph-6076.

6) One Health Commission (OHC). One Health Happenings. At: https://www.onehealthcommission.org/en/news/global_one_health_happenings_news_notes/

7) Laaser U, Bjegovic-Mikanovic V, Seifman R, Senkubuge F and Stamenkovic Z (2022) Editorial: One health, environmental health, global health, and inclusive governance: What can we do? *Front. Public Health* 10:932922. doi: 10.3389/fpubh.2022.932922. At: https://www.frontiersin.org/articles/10.3389/fpubh.2022.932922/full

8) Bjegovic-Mikanovic, V.; Laaser, U. Challenges and Prospects of Sustainability in the Context of Global Health. Sustainability 2024, 16, 3061. https://doi.org/10.3390/su16073061

9) Zhang XX, Liu JS, Han LF et al. Towards a global One Health index: a potential assessment tool for One Health performance. Infectious Diseases of Poverty 11: 57 (2022). Doi: 10.1186/s40249-022-00979-9;https://idpjournal.biomedcentral.com/articles/10.1186/s40249-022-00979-9

10) Li OY, Wang XC, Yang K et al. The approaching pilot for One Health Governance index. Infectious Diseases of Poverty 2023; 12: 16

11) De Moura RR, de Castro WAC, Farinhas JH et al. One Health Index (OHI) applied to Curitiba, the ninth-largest metropolitan area of Brazil, with concomitant assessment of animal, environmental, and human health indicators. One Health 2022:14:100373. doi: 10.1016/j.onehlt.2022.100373

12) Streifeneder, V. Kienberger, S. Reichel, S. Holbling, D. Socio-Economic Vulnerability Assessment for Supporting a Sustainable Pandemic Management in Austria. Sustainability 2024, 16, 78. https://doi.org/10.3390/su16010078

13) United Nations, Department of Economic and social Affairs: All Sustainable Development Goals. https://unstats.un.org/UNSDWebsite/undatacommons/countries or: https://unstats.un.org/UNSDWebsite/undatacommons/sdgs/countries or: https://unstats.un.org/sdgs/dataportal/countryprofiles/

14) Global Burden of Disease Collaborators. Measuring the health-related Sustainable Development Goals in 188 countries: a baseline analysis from the Global Burden of Disease Study 2015. The Lancet, Volume 388, Issue 10053: 1813-1850, October 08, 2016. DOI: https://doi.org/10.1016/S0140-6736(16)31467-2

15) Sachs, J.D., Lafortune, G., Fuller, G., Drumm, E. (2023). Implementing the SDG Stimulus. Sustainable Development. Report 2023. Paris: SDSN, Dublin: Dublin University Press, 2023. 10.25546/102924 Full report at: https://s3.amazonaws.com/sustainabledevelopment.report/2023/sustainable-development-report-2023.pdf; Part 2: The SDG Index and Dashboards: https://dashboards.sdgindex.org/chapters/part-2-the-sdg-index-and-dashboards

16) Sachs, J.D., Lafortune, G., Fuller, G. Sustainable Development. Report 2024. The SDGs and the UN Summit of the Future. Paris: SDSN, Dublin: Dublin University Press. doi:10.25546/108572. https://s3.amazonaws.com/sustainabledevelopment.report/2024/sustainable-development-

report-2024.pdf and Dashboards: https://dashboards.sdgindex.org/chapters/executive-summary

17) Bjegovic-Mikanovic V, Salem ZA, Wenzel H, Broniatowski R, Nelson C, Vukovic D, Laaser U. A gap analysis of SDG 3 and MDG 4/5 mortality health targets in the six Arabic countries of North Africa: Egypt, Libya, Tunisia, Algeria, Morocco, and Mauritania. Libyan Journal of Medicine 2019: 14/1. Available at: https://doi.org/10.1080/19932820.2019.1607698

18) Haruna Sekabira, Ghislain T. Tepa-Yotto, Manuele Tamò, Rousseau Djouaka, Mustapha Dalaa, Osman Tahidu Damba, Stephen Yeboah et al. Socio-economic determinants for the deployment of Climate-Smart One-Health innovations. A meta-analysis approach prioritizing Ghana and Benin. PLOS March 2023; https://doi.org/10.1371/journal.pstr.0000052

19) Graham H, White PC. Social determinants and lifestyles: integrating environmental and public health perspectives. Public Health. 2016 Dec;141:270-278. doi: 10.1016/j.puhe.2016.09.019.

20) Woldehanna S, Zimicki S. An expanded One Health model: integrating social science and One Health to inform study of the human-animal interface. Soc Sci Med. 2015 Mar;129:87-95. doi: 10.1016/j.socscimed.2014.10.059.

21) John Frank. Thomas Abel, Stefano Campostrini, Sarah Cook, Vivian K. Lin, David V. McQueen. The Social Determinants of Health: Time to Re-Think? *Int. J. Environ. Res. Public Health* 2020, *17*(16), 5856; https://doi.org/10.3390/ijerph17165856

22) Mangukiya Rupal D, Sklarew Dann M. Analyzing three pillars of sustainable development goals at sub-national scales within the USA. Science Direct 2023. https://doi.org/10.1016/j.wds.2023.100058

23) United Nations. Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development. 2024: https://unstats.un.org/sdgs/indicators/Global-Indicator-Framework-after-2024-refinement-English.pdf

24) Gelitz C. Imputation: Der Umgang mit fehlenden Werten. *Spektrum.de* (2019 Apr 02)

25) GitHub. *How to treat missing values in your data* (2024) [cited 2024 Apr 16]. Available from: https://gist.github.com/farrajota/eb64e1b9b327bb4698fc97982a4a33c1

26) Preising M, Lange K, Dumpert F. Imputation zur maschinellen Behandlung fehlender und unplausibler Werte in der amtlichen Statistik - imputation-maschinelle-behandlung-

052021.pdf [cited 2024 Apr 12]. Available from: https://www.econstor.eu/handle/10419/244708

27) Bruch C. *Varianzschätzung unter Imputation und bei komplexen Stichprobendesigns* (2016).

28) Wright, Mar Wright, Marvin N.; Ziegler, Andreas (2017): ranger : A Fast Implementation of Random Forests for High Dimensional Data in C++ and R. In *J. Stat. Soft.* 77 (1). DOI: 10.18637/jss.v077.i01

29) R Core Team (2024): R: A language and environment for statistical computing. R version 4.4.1 (2024-06-14 ucrt). R Foundation for Statistical Computing. Vienna, Austria. Available online at https://www.R-project.org/.

30) Mayer, Michael (2023): Fast Imputation of Missing Values. Available online at https://CRAN.R-project.org/package=missRanger, updated on 2023.

31) Metge C, Chateau D, Prior H, Soodeen R. De Coster C, Barré L. (2009): Composite Measures/Indices of Health and Health System Performance. Winnipeg, MB. Available online at http://mchp-appserv.cpe.umanitoba.ca/reference/Chip.pdf#page=33&View=Fit, checked on 4/22/2024.

32) Guillaume Lafortune, Grayson Fuller, Jorge Moreno, Guido Schmidt-Traub, Christian Kroll (2018): SDG Index and Dashboards - Detailed Methodological paper. Available online at https://raw.githubusercontent.com/sdsna/2018GlobalIndex/master/2018GlobalIndexMethodology.pdf, checked on 5/19/2024.

33) TIBCO Software Inc. (2017): Statistica (data analysis software system). Version 13: TIBCO Software Inc. Available online at https://www.tibco.com/.

34) Samuels, Peter: Advice on Exploratory Factor Analysis. DOI: 10.13140/RG.2.1.5013.9766

35) Hair Jr, Joseph F.; Black, William C.; Babin, Barry J.; Anderson, Rolph E. (2010): Multivariate data analysis. A global perspective. 7th ed., global edition. Upper Saddle River, NJ: Pearson.

36) Grace-Martin K. *How To Calculate an Index Score from a Factor Analysis - The Analysis Factor* (2016) [cited 2024 Apr 22]. Available from: https://www.theanalysisfactor.com/index-score-factor-analysis/

37) Prah Ruger. Global Health Justice. Public Health Ethics 2009, Vol 2/3. 261-275

38) Otto, Friederike. Klimaungerechtigkeit. Was die klimakatastrophe mit Kapitalismus Rassismus und Sexismus zu tun hat (Klima-Injustice. How the clima-catastrophy is linked to capitalism, racism and sexism. Ullstein336 pages.

39) Deen Th. UN's Development Goals: Rich Nations Lead While World's Poor Lag Far Behind. IPS News 2024. https://www.ipsnews.net/2024/06/uns-development-goals-rich-nations-lead-worlds-poor-lag-far-behind/?s

40) World Health Organisation: 77th World Health Assembly. https://www.who.int/about/governance/world-health-assembly/seventy-seventh

41) Richard Seifman. Dealing With Future Pandemics: Do You Feel Safer Coping With Another Pandemic Today? Impakter 2024. https://impakter.com/dealing-with-future-pandemics-do-you-feel-safer-coping-with-another-pandemic-today/-

42) Yehia Abed, Madhumita Dobe, Eliudi Eliakimu, Rusmir Goletic, Tomiko Hokama, Ulrich Laaser, George Lueddeke, Linda Mans, Veronica Ormea, & Monalisha Sahu. (2023). Special Volume No. 1, 2021: The Global One Health Environment. *South Eastern European Journal of Public Health*. https://doi.org/10.56801/seejph.vi.182

43) Lella L, Osés-Eraso N, Stamos I, Manfredi R. (editors). Monitoring the SDGs at regional level in EU. REGIONS2030 pilot project Final Report, Stamos, I. and Manfredi, R. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/989319, JRC135594. file:///C:/Users/laase/OneDrive/Desktop/JRC135594_01-1.pdf

44) Asian Development Bank. SNAPSHOT OF SUSTAINABLE DEVELOPMENT GOALS AT THE SUBNATIONAL GOVERNMENT LEVEL IN INDONESIA. 2023. ISBN 978-92-9270-356-1 (print); https://www.adb.org/sites/default/files/publication/928536/snapshot-sdgs-subnational-government-indonesia.pdf

45) Tomaž Deželan, Alem Maksuti & Matjaž Uršič. Capacity of Local Development Planning in Slovenia: Strengths and Weaknesses of Local Sustainable Development Strategies. Lex Localis - Journal of Local Self-Government Vol. 12, No. 3, pp. 547 - 573, July 2014

46) Inter-Agency and Expert Group on Sustainable Development Goal Indicators (IAEG-SDGs). https://unstats.un.org/sdgs/iaeg-sdgs/2025-comprehensive-review)

47) Khan MS, Rothman-Ostrow P, Spencer J, Nadeem H, Sabirovic M, Rahman-Shepherd A, Shaikh N, Heyman DL, Dar O. The growth and strategic functioning of One Health networks: a systematic analysis. The Lancet 2;6: E264-E273, 2018. Doi: 10.1016/S2542-5196(18)30084-6

48) Streichert LC, Sepe LP, Jokelainen P, Stroud CM, Berezowski J, Del Rio Vilas VJ. Participation in One Health Networks and Involvement in the COVID-19 Pandemic

Response: A Global Study. Frontiers in Public 24 February 2022. https://doi.org/10.3389/fpubh.2022.830893 at: https://www.frontiersin.org/articles/10.3389/fpubh.2022.830893/full

49) Mwatondo A, Rahman-Shepherd A, Hollmann L, Chiossi S, Maina J, Kurup KK, Hassan OA, Coates B, Khan M, Spencer J, Mutono N, Thumbi SM, Muturi M, Mutunga M, Arruda LB, Akhbari M, Ettehad D, Ntoumi F, Scott TP, Nel LH, Ellis-Iversen J, Sönksen UW, Onyango D, Ismail Z, Simachew K, Wolking D, Kazwala R, Sijali Z, Bett B, Heymann D,

50) Kock R, Zumla A, Dar O. A global analysis of One Health Networks and the proliferation of One Health collaborations. Lancet. 2023 Feb 18;401(10376):605-616. doi: 10.1016/S0140-6736(22)01596-3.

51) Claudia Cataldo , Maria Bellenghi , Roberta Masella , Luca Busani. One Health challenges and actions: Integration of gender considerations to reduce risks at the human-animal-environmental interface. One Health Vol.16, June 2023; doi: 10.1016/j.onehlt.2023.100530; PMID: 37089529; https://www.sciencedirect.com/science/article/pii/S2352771423000502?via%3Dihub

52) Paula Cristina Pungartnik, Ariane Abreu, Cleber Vinicius Brito dos Santos, Jo˜ao Roberto Cavalcante, Eduardo Faerstein, Guilherme Loureiro Werneck. The interfaces between One Health and Global Health: A scoping review. One Health, Vol. 16, June 2023, Elsevier.

53) 'Citizen Science': https://www.nps.gov/subjects/citizenscience/get-involved.htm

54) UN-UHC: Universal health coverage : moving together to build a healthier world. https://www.un.org>2023/09>UHC-Final-Text

55) Joint Research Centre (European Commission), Stamos I, Lella L, Osés-Eraso N, Manfredi R. Regional Policy and Regional Economies. ISBN 978-92-68-09051-0; DOI 10.2760/02404. Website: https://publications.jrc.ec.europa.eu/repository/handle/JRC135594

56) Pannenborg O, Seifman R. Re-Treating Pandemics. JGPOH 2024. Posted: DATE: 17/04/2024, DOI: 10.61034/JGPOH-2024-10

57) UN Habitat: *https://unhabitat.org/guidelines-for-voluntary-local-reviews-volume-2-towards-a-new-generation-of-vlrs-exploring-the-local-national link]*