

Addendum B: Water-Energy-Food (WEF) Nexus Index - Indicator selection and weighting

Simpson et al. (2020) provide a detailed account of the indicators reviewed in the development of the WEF Nexus Index. That report includes the assessment of various 'nexus' indicators such as the '*Percent of arable land equipped for irrigation*'. This indicator is a 'nexus' indicator because irrigation is a technology that generally uses energy to convey water to produce food, i.e. it ultimately includes water, energy and food components. There are few 'nexus' indicators, and where there are, there was generally insufficient data to include these indicators in the WEF Nexus Index. A summary of the indicator selection process associated with the 21 indicators that constitute the WEF Nexus Index is presented in this Addendum, which includes **Table B.1** and **Table B.2**.

The WEF Nexus Index consists of the three pillars representing the water, energy and food resource sectors. They are equally weighted in this composite indicator, i.e. 33.3% by three (refer to **Table B.2**). The equal weighting is necessary because of the multi-centric nature of the WEF Nexus framework. Each pillar is comprised of two sub-pillars, one representing 'access' to the resource while the other represents the 'availability' thereof. The weighting of each of the sub-pillars is also equal, i.e. 16.7% by six.

"The establishment of SDG 6, *Ensure availability and sustainable management of water and sanitation for all*, reflects the increased attention on water and sanitation issues in the global political agenda" (UN Water 2018). The **water-access sub-pillar** is, therefore, centred on the sustainable management of water and sanitation *for all*, i.e. equitable access. Guided by the anthropocentric WEF nexus framework (Simpson et al. 2020), the water-access sub-pillar consists of three relevant and available indicators, namely:

- '*Population using at least basic drinking water services*',
- '*Population using at least basic sanitation services*', and
- '*Degree of Integrated Water Resources Management (IWRM) Implementation*'.

In terms of access to freshwater resources, the first two indicators are core to SDG 6 and have sufficient data. The '*Population using at least basic drinking water services*' is an alternative to the official SDG indicator 6.1.1, but it has better data coverage for many nations. The '*Population using at least basic sanitation services*' has excellent data coverage. These two indicators are well correlated (0.88), but not too high such that one would have to be excluded because of 'double accounting' (Simpson et al. 2020).

The indicator '*Degree of IWRM Implementation*' (SDG indicator 6.5.1) is defined as: "the degree to which IWRM is implemented, by assessing the four components of policies, institutions, management tools and financing. It takes into account the various users and uses of water, with the aim of promoting positive social, economic and environmental impacts at all levels, including the transboundary level, where appropriate" (UN Water 2016). As the degree of IWRM implementation increases, so too should the level of access to safe drinking water and safely managed sanitation services. This is indeed true because this indicator has a positive correlation (0.34 and 0.38 respectively) with both the '*Percentage of people using at least basic drinking water services*' and the '*Percentage of people using at least basic sanitation services*' (Simpson et al. 2020). Because this indicator represents the policies, tools and financing associated with water management, it was selected for juxtaposition with the former two indicators in the water-access sub-pillar.

All three indicators constituting this sub-pillar range between 0 and 100, and are therefore already normalised. They also all have positive directions and are equally weighted within the sub-pillar, i.e. 33.3%. In terms of the direction column in **Table B.1**: "A value of 1 means that higher values of the indicator are associated with higher values of the index/concept (e.g. higher values of the indicator "income" indicate higher values of index "quality of life"). A value of -1 means that higher values of the indicator are associated with lower values of the index/concept (e.g. higher values of indicator "deforestation" are associated with lower values of index "environmental performance")" (JRC-COIN 2015).

As noted above, SDG 6 must also aim to "*Ensure [the] availability ... of water ... for all.*" This goal is reflected in the anthropocentric WEF nexus framework (Simpson et al. 2020), wherein resources are obtained, ultimately, from the environment. The **water-availability sub-pillar** consists of four relevant indicators with sufficient data:

- '*Total annual freshwater withdrawals as a percentage of internal resources*' - SDG indicator 6.4.2,
- '*Renewable internal freshwater resources per capita*',
- '*Environmental flow requirements per annum*', and
- '*Average annual precipitation*'.

The first of these indicators has a negative direction, since the lower the degree of total annual freshwater withdrawals as a percentage of internal resources, the more sustainable the freshwater resources will be. The other three indicators within this sub-pillar have positive directions and will be higher for countries that have more significant freshwater resources. These directions, and their combination in this sub-pillar, is confirmed in the WEF Nexus Index since all four indicators have positive correlations with one another, ranging from 0.47 to 0.82 (Simpson et al. 2020). Together these four indicators provide a useful perspective of the water availability in a nation. They are equally weighted with each indicator contributing a quarter to the water-availability sub-pillar.

In accordance with the anthropocentric WEF nexus framework (Simpson et al. 2020), the **energy-access sub-pillar** must be aligned to SDG 7, which is an aspirational goal targetting access to universal, affordable, reliable, sustainable and modern energy. Utilising the indicator '*Access to electricity*' (SDG indicator 7.1.1) would therefore not suffice, on its own, in representing SDG 7. This is because much of the global energy make is not obtained from renewable sources. To address the 'sustainable' and 'modern' components of the energy source the following three indicators have been combined with *Access to electricity* in this sub-pillar, such that together they more closely approximate the intention of SDG 7:

- '*Renewable energy consumption (percentage of total final energy consumption)*' – SDG indicator 7.1.1,
- '*Renewable electricity output (percentage of total electricity output)*', and
- '*CO₂ emissions (metric tons per capita)*'¹.

While the first two of these indicators have positive directions in the WEF Nexus Index, *CO₂ emissions* has a negative direction (since the higher the CO₂ emissions, the lower the degree of transition to a low carbon economy). These three indicators representing the degree of implementation of clean energy are negatively correlated to the indicator *Access to electricity* in the index, with the correlations ranging from -0.22 to -0.73 (Simpson et al. 2020); yet they correlate well with one another (with correlations between 0.33 and 0.60 (Simpson et al. 2020)). The negative correlation between these three indicators and *Access to electricity* is, however, anticipated since much of the energy supply and security in the world is currently still derived from fossil-fuel based generation. The energy-access sub-pillar has been weighted equally between the first indicator (*Access to electricity*) and the average of the subsequent three. This was done to balance the 'access' and 'sustainability' components of SDG 7. The weightings of the four indicators comprising this sub-pillar are presented in **Table B.1** as 50%, 16.7%, 16.7% and 16.7%, respectively.

As presented in the anthropocentric WEF nexus framework (Simpson et al. 2020), energy is obtained, ultimately, from the environment either in a renewable or a non-renewable manner. In terms of the availability of energy, the World Bank (2018) documents sufficient data for '*Electric power consumption (kWh per capita)*'. Another indicator that was considered in the development of the **energy-availability sub-pillar** was '*Energy use (kg of oil equivalent per capita)*'. This indicator has excellent data availability but is highly correlated (0.94) to '*Electric power consumption per capita*' and has, therefore, been excluded from the WEF Nexus Index to avoid double-accounting.

The indicator '*Energy imports, net*' (% of energy use) was considered for inclusion in the WEF Nexus Index since it provides an indication of a nation's independence (and therefore security) in terms of energy supply. Because several nations generate surplus energy and subsequently export that additional capacity, several countries have negative values for this indicator. The indicator, therefore, measures both energy imports and exports. In order to limit this indicator to imports only, the indicator values were truncated at zero. This resultant indicator, *Energy imports, net*, however, has a low, yet negative correlation (-0.27) with '*Electric power consumption*' (Simpson et al. 2020). Becker (2019) notes that the negative correlation is not significant and that it would be expected that these two indicators would not correlate strongly; and states that it makes sense conceptually to include this indicator in this sub-pillar. The two indicators, '*Electric power consumption per capita*' and '*Energy imports, net*' have been weighted equally in this sub-pillar. The former has a positive direction, while the latter has a negative direction, as presented in **Table B.1**. The reason for '*Energy imports, net*' having a negative direction is that if a nation is dependent upon energy imports for its security, then that security is not 'in its own hands.'

SDG 2 is the aspirational goal aimed at ending hunger, achieving food security, improving nutrition and promoting sustainable agriculture. The indicator '*Depth of food deficit*' has good data availability but has a very high correlation with the '*Prevalence of undernourishment*' and has thus been excluded from the final list of indicators selected to constitute the **food-access sub-pillar** to prevent double accounting. The reason for including the '*Prevalence of undernourishment*' in the food-access sub-

¹ Within the index this indicator has a negative direction, i.e. a lower CO₂ emission value will result in an increased index value, with all other indicator's values being held constant.

pillar rather than the *'Depth of food deficit'* is that it is one of the two official indicators for monitoring the state of food insecurity in the world. The other is the *'Proportion of underweight children under five years of age'* (FAO 2015).

Schmidhuber and Tubiello (2007) reason that the FAO's indicator of undernourishment has several advantages over other indicators for quantifying the overall status and distribution of global hunger. These advantages include the fact that (i) it incorporates two dimensions of food security, namely availability and access; (ii) the underlying methodology is straightforward and transparent; and (iii) the parameters and data needed for the FAO indicator is readily available for past estimates and can be derived without significant difficulties in the future (Schmidhuber and Tubiello 2007).

Indicators relating to access to food that have been selected for inclusion in the food-access sub-pillar include the:

- *'Prevalence of undernourishment (percentage of population)'* - SDG indicator 2.1.1,
- *'Prevalence of severe wasting, weight for height (percentage of children under 5)'*,
- *'Prevalence of stunting, height for age (percentage of children under 5)'* - SDG indicator 2.2.1, and
- *'Prevalence of obesity in the adult population (18 years and older)'*.

There is a good correlation between the *'Prevalence of undernourishment'* and the levels of wasting and stunting in children under five years of age; 0.40 and 0.65, respectively (Simpson et al. 2020). There is, however, a negative correlation between these three indicators and the *'Prevalence of obesity in the adult population'*; -0.53, -0.60 and -0.72, respectively (Simpson et al. 2020). This negative association is not unexpected since generally, undernourishment is a challenge in developing nations while obesity occurs in more developed countries.

All four indicators that constitute this sub-pillar have negative directions within the WEF Nexus Index' composition since high values are not desirable in the achievement of SDG 2. Their weighting is such that the *'Prevalence of undernourishment'* (33.3%), the prevalence of wasting and stunting in children under five (33.3%), and the *'Prevalence of obesity in the adult population'* (33.3%) are all weighted equally, i.e. the prevalence of wasting and stunting have been combined to constitute a third of the food-access sub-pillar, as presented in **Table B.2**.

The *'Cereal import dependency ratio'* communicates how much of the available domestic food supply of cereals has been imported and what proportion emanates from the country's domestic production. Negative values indicate that the country is a nett exporter of cereals. This indicator provides a measure of the independence of a country or region in terms of cereal imports. This indicator, even after being truncated at zero to remove exports, was found to have an abysmal level of correlation with all the other food availability-related indicators. It has, therefore, been excluded from the **food-availability sub-pillar**. The indicators *'Agriculture, forestry and fishing, value added (% GDP)'* and *'Value of food imports over total merchandise exports'* also have weak correlations with the other food-availability-related indicators and have also been excluded from the WEF Nexus Index. In terms of the availability of food on a national basis, the following indicators have been selected for incorporation in the food-availability sub-pillar of the WEF Nexus Index:

- *'Average protein supply'*,
- *'Cereal yield'*,
- *'Average dietary energy supply adequacy'*, and
- *'Average value of food production'*.

These four indicators have medium to strong, positive correlations with one another, ranging from 0.42 to 0.63 (Simpson et al. 2020). The fact that together they represent protein supply, cereal yield, dietary energy supply adequacy and the value of food production, with a medium to strong correlation, indicates that this is a strong sub-pillar within the WEF Nexus Index.

Table B.1: Description of 21 indicators selected to constitute the WEF Nexus Index

No.	Sector	Indicator	Definition ²	Source	Units	Weight	Direction	Data availability	SDG Indicator? (Y/N)	Reason/motivation for inclusion/exclusion
1	Water (SDG 6)	The percentage of people using at least basic drinking water services	This indicator encompasses both people using basic water services as well as those using safely managed water services. Basic drinking water services are defined as drinking water from an improved source, provided collection time is not more than 30 minutes for a round trip. Improved water sources include piped water, boreholes or tube wells, protected dug wells, protected springs, and packaged or delivered water (FAO.org 2018, Accessed 2019-03-01).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: World Bank: http://data.worldbank.org/indicator/SH.H2O.BASW.ZS . Original source: WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene (washdata.org). Accessed 2019-03-01	%	0.333	1	2015 Very good data coverage. The indicator is utilised in SDG Index for SDG 6	No, but 6.1.1 (Proportion of population using safely managed drinking water services) and 6.3.2 are SDG indices. It is FAO indicator I_4.1	Yes; very good data, and the indicator is relevant to SDG 6. Alternative to official indicator 6.1.1 since it has better data coverage for many nations
2	Water (SDG 6)	Percentage of people using safely managed sanitation services.	The percentage of the population using improved sanitation facilities which are not shared with other households and where excreta are safely disposed in situ or transported and treated off-site (FAO.org 2018, Accessed 2019-03-01).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: World Development Indicators: World Bank: http://data.worldbank.org/indicator/SH.STA.SMSS.ZS . Original source: World Health Organization and United Nations Children's Fund, Joint Measurement Programme (JMP) (http://www.wssinfo.org/). Accessed 2019-03-01	%	0.333	1	2015 Very good data coverage. Data is identical to "Percentage of people using at least basic sanitation services."	Yes, 6.2.1 and it is FAO indicator I_4.4	Yes; very good data coverage and indicator is an official SDG indicator
3	Water (SDG 6)	Degree of integrated water resources management implementation (0-100)	The degree to which IWRM is implemented, by assessing the four components of policies, institutions, management tools and financing. It takes into account the various users and uses of water, with the aim of promoting positive social, economic and environmental impacts at all levels, including the transboundary level, where appropriate (UNWater, 2016).	http://iwrmdataportal.unepdhi.org/data/overview.html	%	0.333	1	Data is available for 2017 for 175 countries.	Yes; indicator 6.5.1	Yes; IWRM implementation provides a good indication of water governance, and has a strong correlation with the implementation of basic drinking water and sanitation facilities.
4	Water (SDG 6)	Annual freshwater withdrawals, total (% of internal resources)	Annual freshwater withdrawals refer to total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from non-renewable aquifers or desalination plants is considerable or where there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services,	https://data.worldbank.org/indicator/ER.H2O.FWTL.ZS?view=chart Source: Food and Agriculture Organization, AQUASTAT data	%	0.25	-1	2002-2014 Limited data coverage. Indicator utilised in SDG Index for SDG 6. Need to use the most recent values from the database	Yes, 6.4.2 C060402	Yes, this is an official SDG indicator, and utilising the most recent values from 2002-2014 a good coverage of data is obtained. This dataset will however require Winsorization in order to remove the distorting effect of outliers, and to avoid too large a space in the dataset. Data could be truncated at 200%, which represents double the available fresh water resources of the country.

² Definitions from websites listed in "Source" column of table

			commercial establishments, and homes (<i>World Bank 2019-03-01</i>)							
5	Water (SDG 6)	Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country. Renewable internal freshwater resources per capita are calculated using the World Bank's population estimates (<i>World Bank 2019-03-01</i>).	Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country. Renewable internal freshwater resources per capita are calculated using the World Bank's population estimates (<i>World Bank 2019-03-01</i>).	https://data.worldbank.org/indicator/ER.H2O.INTR.PC?view=chart Source: Food and Agriculture Organization, AQUASTAT data	m ³ /capita	0.25	1	2014 Very good data coverage	No	Yes , very good data coverage, and the “per capita” unit provides a helpful measure between countries with an indicator of relative scarcity. Good correlation with annual fresh water resources, but not too high to warrant exclusion (0.78)
6	Water (SDG 6)	Environmental flow requirements	The quantity and timing of freshwater flows and levels necessary to sustain aquatic ecosystems which, in turn, support human cultures, economies, sustainable livelihoods, and wellbeing” (Adapted from Arthington, A.H., et al. 2018).	http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en Source: Food and Agriculture Organization, AQUASTAT data	10 ⁹ m ³ /year	0.25	1	Data available from 1962-2017 with many missing data per year. Most data are available for 2017 for 154 countries.	No	Yes, it is important that water's contribution required for sustaining the environment is taken into account. Good correlation with renewable internal fresh water resources (0.58)
7	Water (SDG 6)	Average precipitation in depth (mm per year)	Average precipitation is the long-term average in depth (over space and time) of annual precipitation in the country. Precipitation is defined as any kind of water that falls from clouds as a liquid or a solid (<i>World Bank 2019-03-04</i>).	https://data.worldbank.org/indicator/AG.LND.PRPC.MM Source: Food and Agriculture Organization, electronic files and website	mm/year	0.25	1	2014 Very good data coverage	No	Yes ; this data is widely available and provides a good indication of available fresh water. This indicator directly influences food production and energy generation. Good correlation with annual freshwater withdrawals
8	Energy (SDG 7)	Access to electricity (% of the population)	Access to electricity is the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources (<i>World Bank 2019-03-04</i>)	https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?view=chart Source: World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program.	%	0.5	1	2016 Very good data coverage. Indicator utilised in SDG Index for SDG 7	Yes, Indicator 7.1.1 (C070101)	Yes ; essential indicator for SDG 7 with good data coverage.
9	Energy (SDG 7)	Renewable energy consumption (% of total final energy consumption)	Renewable energy consumption is the share of renewables energy in total final energy consumption (<i>World Bank 2019-03-04</i>).	https://data.worldbank.org/indicator/EG.FEC.RNEW.ZS Source: World Bank, Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework led jointly by the World Bank, International Energy Agency, and the Energy Sector Management Assistance Program.	%	0.167	1	2015 Very good data coverage. Indicator utilised in SDG Index for SDG 7	Yes, Indicator 7.2.1 (C070201)	Yes ; essential indicator for SDG 7 with good data coverage.
10	Energy (SDG 7)	Renewable electricity output (% of	Renewable electricity is the share of electricity generated by renewable power plants in total electricity generated by all types of plants (<i>World Bank 2019-03-04</i>).	https://data.worldbank.org/indicator/EG.ELC.RNEW.ZS?view=chart	%	0.167	1	2015 Very good data coverage	No	Yes ; since “Renewable energy consumption” refers to energy, while this indicator considers

		total electricity output)		Source: IEA Statistics © OECD/IEA 2018 (http://www.iea.org/stats/index.asp)						electricity only. Correlation with Renewable energy consumption is good, but not too high
11	Energy (SDG 7)	CO ₂ emissions (metric tons per capita)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (<i>World Bank 2019-03-05</i>).	https://data.worldbank.org/indicator/EN.ATM.CO2E.PC Source: Carbon Dioxide Information Analysis Centre, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States. https://data.worldbank.org/indicator/EN.ATM.CO2E.PC	metric tons per capita	0.167	-1	2014 Very good data coverage. Similar indicator utilised in SDG Index for SDG 7	No	Yes; this data provides an indication of fossil fuel-related power generation. The per capita rating takes cognisance of the size of the impact relative to the population
12	Energy (SDG 7)	Electric power consumption (kWh per capita)	Electric power consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants (<i>World Bank 2019-03-05</i>).	https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?view=chart Source: IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp)	kWh per capita	0.5	1	2014 Very good data coverage	No	Yes; very good data coverage and very relevant, since it provides a helpful indication of a nation's generation capacity.
13	Energy (SDG 7)	Energy imports, net (% of energy use)	Net energy imports are estimated as energy use less production, both measured in oil equivalents. A negative value indicates that the country is a net exporter. Energy use refers to use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport (<i>World Bank 2019-03-05</i>).	https://data.worldbank.org/indicator/EG.IMP.CON.SZS?view=chart Source: IEA Statistics © OECD/IEA 2014 (http://www.iea.org/stats/index.asp)	%	0.5	-1	2015,2014,2013 Good data coverage, although will need to utilise latest data since very limited data for 2015.	No	Yes; this indicator provides a helpful indication of national energy security. But this indicator will be truncated at zero to exclude exports, since the primary concern is energy security and the indicator is essentially measuring imports and exports.
14	Food (SDG 2)	Prevalence of undernourishment ³	The prevalence of undernourishment expresses the probability that a randomly selected individual from the population consumes a number of calories that is insufficient to cover her/his energy requirement for an active and healthy life. The indicator is computed by comparing a probability distribution of habitual daily dietary energy consumption with a threshold level called the minimum dietary energy Requirement. Both are based on the notion of an average individual in the reference population (<i>FAO 2019-03-05</i>).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: FAOSTAT and ESS calculations:	%	0.333	-1	2015-2017 Very good data coverage. Indicator utilised in SDG Index for SDG 2	Yes, 2.1.1 (C020101). Could consider a health indicator such as 3.2.1 "Under-5 mortality rate" as an additional indicator of 'healthy' food?	Yes; it was the official Millennium Development Goal indicator for Goal 1, Target 1.9, and is now an SDG indicator
15	Food (SDG 2)	Percentage of children under 5 years of age affected by wasting ^{4 5}	Wasting prevalence is the proportion of children under five whose weight for height is more than two standard deviations below the median for the international reference population ages 0-59 months (<i>FAO 2019-03-05</i>).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: World Development Indicators: http://data.worldbank.org/indicator/SH.STA.WAST.ZS	%	0.167	-1	2016 Limited data. Need to utilise latest since coverage for the final year alone	No	Yes; if there is a strong correlation of data with SDG indicator 2.2.1's data, one of the two indicators will be used to avoid noise in the dataset. However

³ "This is the traditional FAO hunger indicator, adopted as official Millennium Development Goal indicator for Goal 1, Target 1.9." (<http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk>).

⁴ "Child growth is the most widely used indicator of nutritional status in a community and is internationally recognized as an important public-health indicator for monitoring health in populations. In addition, children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have a greater risk of suffering illness and death." (<http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk>)

⁵ The "two official indicators for the hunger target [are] the prevalence of undernourishment and the proportion of underweight children under 5 years of age" (<http://www.fao.org/3/a-i4671e.pdf>)

				+ UNICEF et al. (2016) report an average prevalence of wasting in high-income countries of 0.75% , which has been assumed for high-income countries with missing data. The classification as a high-income country is based on the World Bank's listing of high-income countries: https://data.worldbank.org/income-level/high-income				is scarce. Indicator utilised in SDG Index for SDG 2		the correlation is good, but not too high. Both indicators can therefore be retained.
16	Food (SDG 2)	Percentage of children under 5 years of age who are stunted ⁶	Percentage of stunting (height-for-age less than -2 standard deviations of the WHO Child Growth Standards median) among children aged 0-59 months (FAO 2019-03-05).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: World Development Indicators: http://data.worldbank.org/indicator/SH.STA.WAST.ZS + UNICEF et al. (2016) report an average prevalence of wasting in high income countries of 2.58% , which has been assumed for high-income countries with missing data. The classification as a high-income country is based on the World Bank's listing of high-income countries: https://data.worldbank.org/income-level/high-income	%	0.167	-1	2016 Limited data. Need to utilise most recent coverage for the final year alone is scarce. Indicator utilised in SDG Index for SDG 2	Yes, 2.2.1 (C020201)	Yes; this is an SDG indicator with sufficient data available for 153 countries.
17	Food (SDG 2)	Prevalence of obesity in the adult population (18 years and older)	Prevalence of obesity in the adult population is the percentage of adults ages 18 and over whose Body Mass Index (BMI) is more than 30 kg/m ² . Body Mass Index (BMI) is a simple index of weight-for-height or the weight in kilograms divided by the square of the height in meters (FAO 2019-05-06).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: World Health Organization Global Health Observatory (GHO) http://apps.who.int/gho/data/node.main.A900A?lang=en	%	0.333	-1	2016 Very good data coverage. Indicator utilised in SDG Index for SDG 2	No, but it is FAO Indicator I_4.8	Yes; since it is utilised within the SDG Index. Although it has a negative correlation with the levels of undernourishment, stunting and wasting, it measures a different portion of the population, i.e. adults >18 years old vs children <5 years old. It is viewed as being a key indicator of access to food despite the negative correlation with the other indicators listed in the access to food sub-index
18	Food (SDG 2)	Average protein supply ⁷	National average protein supply (expressed in grams per caput per day) (FAO 2019-03-06)	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: FAOSTAT	gr/caput/day	0.25	1	2011-2013 Very good data coverage	No, but it is FAO Indicator I_1.4	Yes; very good data availability and provides an indication of a healthy, varied diet

⁶ "This indicator belongs to a set of indicators whose purpose is to measure nutritional imbalance and malnutrition resulting in undernutrition (assessed by underweight, stunting and wasting) and overweight. Child growth is the most widely used indicator of nutritional status in a community and is internationally recognized as an important public-health indicator for monitoring health in populations. In addition, children who suffer from growth retardation as a result of poor diets and/or recurrent infections tend to have a greater risk of suffering illness and death." (<http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk>)

⁷ "This indicator provides information on the quality of the diet" (<http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk>)

19	Food (SDG 2)	Cereal yield	Cereal yield, measured as kilograms per hectare of harvested land, includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Production data on cereals relate to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded. The FAO allocates production data to the calendar year in which the bulk of the harvest took place. Most of a crop harvested near the end of a year will be used in the following year (<i>World Bank 2019-03-06</i>).	https://data.worldbank.org/indicator/AG.YLD.CREL.KG?view=chart Source: World Bank	kg per hectare	0.25	1	2016 Very good data coverage. Indicator utilised in SDG Index for SDG 2	No	Yes ; good data availability and the indicator is relevant to food security
20	Food (SDG 2)	Average dietary energy supply adequacy ⁸	The indicator expresses the Dietary Energy Supply (DES) as a percentage of the Average Dietary Energy Requirement (ADER). Each country's or region's average supply of calories for food consumption is normalised by the average dietary energy requirement estimated for its population to provide an index of adequacy of the food supply in terms of calories (<i>FAO 2019-05-06</i>).	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk Source: FAOSTAT and ESS calculations	%	0.25	1	2015-2017 Very good data coverage	No, but it is FAO Indicator I_1.1	Yes ; less than 10% missing data
21	Food (SDG 2)	Average value of food production	The indicator expresses the food net production value (in constant 2004-06 international dollars), as estimated by FAO and published by FAOSTAT, in per capita terms (FAO 2019-03-06)	http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.Xlix_8t7lhG	I\$ per caput	0.25	1	Data available from 1999-2014 for 201 countries.	No, but it is FAO indicator I_1.2	Yes ; very good data coverage that includes data from 201 countries. The data can be used to infer priorities in terms of resource allocation in the WEF nexus.

⁸ “Analysed together with the prevalence of undernourishment, it allows discerning whether undernourishment is mainly due to insufficiency of the food supply or to particularly bad distribution.” (<http://www.fao.org/economic/ess/ess-fs/ess-fadata/en/#.WDmBh9V96Uk>)

Table B.2: Contribution of indicators, sub-pillars and pillars to the final index, from Simpson et al. (2020)

Indicator	Indicator weight in the index	Sub-pillar	Sub-pillar weight in the index	Pillar	Pillar wieght in the index
1	0.056	Water- access	$\frac{1}{6}$	Water	$\frac{1}{3}$
2	0.056				
3	0.056				
4	0.042	Water- availability	$\frac{1}{6}$		
5	0.042				
6	0.042				
7	0.042				
8	0.083	Energy- access	$\frac{1}{6}$	Energy	$\frac{1}{3}$
9	0.028				
10	0.028				
11	0.028	Energy- availability	$\frac{1}{6}$		
12	0.083				
13	0.083				
14	0.056	Food- access	$\frac{1}{6}$	Food	$\frac{1}{3}$
15	0.028				
16	0.028				
17	0.056				
18	0.042	Food- availability	$\frac{1}{6}$		
19	0.042				
20	0.042				
21	0.042				

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