Annex chapter 3: An exploratory analysis of the suitability of indicators to track progress in adaptation.

This annex describes material prepared to support Chapter 3 of the Adaptation Gap Report 2018 (hereafter ARG2018). It was prepared by Ian Noble[1] who should be contacted for further information.

Rationale

The Adaptation Gap Report from 2017 (UNEP, 2017) concluded that "The Paris Agreement's global goal on adaptation provides a new starting point and impetus for assessing progress on adaptation at the global level, but additional information is required for assessing such progress."

This annex takes up the question of whether there are feasible and robust indicators, based on the aggregation of national data, for measuring collective progress to achieve adaptation goals over periods consistent with the Paris Agreement five-year stocktakes. This rationale differs from most other adaptation frameworks and indices in that they have usually focused on ranking countries in terms of needs or capacities rather than tracking progress towards adaptation goals.

The objective here is not to suggest a particular framework for tracking change, nor to select the indicators for that framework. This is the challenge facing the adaptation community as a whole; social, physical, and biological scientists, policy makers, practitioners, the people most affected by climate impacts and ultimately negotiators. As Magnan and Ribera (2016) have suggested, an Intergovernmental Panel on Climate Change-like or a Sustainable Development Goal (SDG) indicators process may be needed to make a significant step forward in this challenge. Here we are in agreement with Tomkins *et al.* (2018) in that this annex focuses on documenting the state of adaptation rather than evaluating adaptation.

To maintain consistency with chapter 3 of the Adaptation Gap Report 2018 this annex uses terminology consistent with the International Panel on Climate Change (IPCC, 2012; 2014) by accepting that most adaptation actions seek to reduce the exposure of people, ecosystems and physical assets to climate related hazards and to reduce their vulnerability to harm if affected by climate related events. Vulnerability is usually seen as being composed of two broad elements, sensitivity to a hazard and the adaptive capacity of those affected. The scope and the dividing line between these two concepts are much debated and here we use the term vulnerability, without these subdivisions. Similarly, some prefer to use the more positive construct of 'increasing resilience' instead of 'reducing vulnerability' when describing the goals of adaption actions, especially when communicating the need for adaptation. While recognizing the subtle but often important differences between resilience and vulnerability (Nelson *et al.,* 2007), in this chapter we will tend to treat the terms 'decreasing vulnerability', 'increasing resilience' and 'increasing adaptive capacity' as synonyms.

Choosing the indicators to be considered

Selection of indicators to track adaptation will be a complex and possibly contentious process. Here we chose to focus on indicators used in adaptation related indices or frameworks that are already well established in the literature. This list includes the indices identified in Leiter (2017); namely GAIN/ND-GAIN (Chen *et al.,* 2018), INForM (Martin-Ferrer *et al.,* 2017), World Risk Report (BEH, 2017), and also a new index by Phillis *et al.* (2018) and a study of indicators suitable for aggregation for longitudinal studies by Moss *et al.* (2001)[2].

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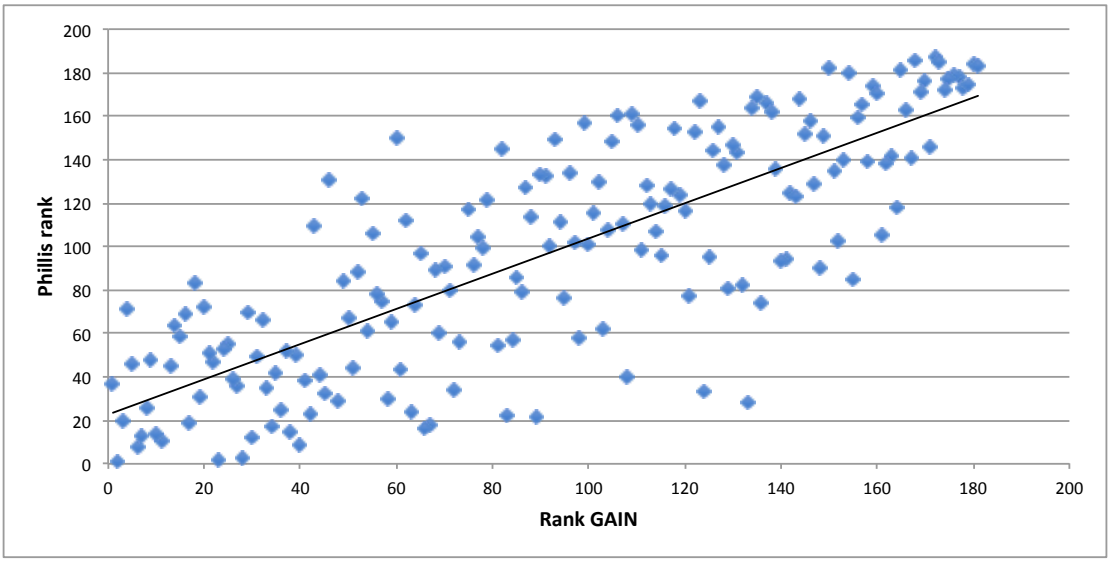
[2] We did not include the Global Climate Risk index (Germanwatch, 2017), as it is an index with a different approach based mostly on the impacts of climate disasters. We also did not consider some indices that are not openly available or are not being updated.

There is broad agreement between the selected indices, which were designed to explicitly or implicitly rank countries in adaptation preparedness. But this agreement is only in the sense that the OECD countries are the most resilient, whereas small, sub-Saharan African and many Small Island Developing States are the least resilient. A comparison between the two most similar indices (ND-GAIN and Phillis et al., 2015 indices) showed that even though they are statistically significantly correlated, the scatter in ranking of individual countries is so wide between indices as to be contentious (see fig. 3.1).

Figure 3.1: The best correlated are indices are GAIN and Phillis. But even with r^2 of 0.64 ($P << 0.001$) countries can differ by over 100 positions between the two rankings.



We analysed these five studies to identify commonly used indicators. Table 3.1 shows the 80 indicators found in the six studies[3]. On average an indicator appeared in 1.6 of the studies, with only 7 appearing in 4 or 5 of the studies. The most common indicators were used as a starting point to select a small set of indicators for further exploratory analysis.

It is essential to have a baseline for any tracking process. Here we have gone further and sought indicators that already have a significant longitudinal data set; ideally with a time series of data from at least 1996 to 2015, which represents not just a baseline but a tracking of change over the equivalent to four Paris stock-takes. Thus, they provide not only the current state of adaptive capacity, but also the trends over the recent past.

The final selection of indicators to be explored further must always be subjective, but we used a set of inclusion and exclusion criteria to guide the choice. The guiding criteria were:

- Used frequently in the five selected studies.
- Data is available from a well curated and open sources. All the indicators selected here for the exploratory set are included in the World Development Indicators, so they would not impose a burden of extra data collection at the national scale.
- Longitudinal data set, ideally from 1996 to 2015, is available.
- Data is available for most countries and especially the low- and middle-income countries, and data are collected with a frequency that justified interpolation and extrapolation between and beyond reporting dates.

[3] Twenty two very specific indicators of exposure used in INFORM were excluded from the analysis as they appeared in no other studies.

- In, or closely related to, the SDG indicators.

In selecting indicators for the exploratory set, we excluded composite indicators such as Governance Effectiveness and Corruption Perception measures. Composite measures may well be included in an agreed set of indicators, but here we were focusing on directly measurable quantities and on transparency. We also excluded direct measures of national wealth such as GNI/capita as many of the indicators are strongly correlated national wealth, and also a core analysis of the exploratory set in chapter 3 is based on national income groups and we did not want to confound the data. We also excluded measures based on statistics about climate disasters. Even when averaged over 5-year periods and blocks of 30 to 40 countries such statistics are still very volatile, driven by the stochasticity of extreme weather events. These measures can be tracked directly in a separate stream of information.

In making the final selection for the exploratory set for chapter 3 we also sought a mix of indicators to track both near term objectives, such as achieving better health related goals, and longer-term drivers of vulnerability such as urbanization, population shifts and age dependency. Thus, the focus of this chapter is the immediate past and present. Also, in keeping with the theme of this Adaptation Gap Report, we gave priority to health-related measures. The broader set considered is shown in table 3.2, and the final set of 12 indicators in table 3.3.

Table 3.1: The set of indicators found in the six studies. Y indicates inclusion and V the inclusion of a conceptually similar variant. The categories codes are used only to aid the readability of the list.

	CAT	INDICATOR	Moss et al	ND-GAIN	INFORM	WRR	Phillis et al	Count
People of Concern	C	Total Persons of Concern (absolute)			Y			1
	C	Total Persons of Concern (relative)			Y			1
	C	Proportion of population affected by natural disasters (past three years)			Y			1
	C	Hyogo Framework for Action		V	Y			2
	C	Pop living <5m above SL	V	Y	V	V	V	5
	C	Sea level rise impact on population					Y	1
	C	People killed by disasters					Y	1
	C	Economic losses from disasters					Y	1
	C	People affected by disasters (vector, water, & atopic diseases)					Y	1
	C	Frequency of disasters					Y	1
Devel., Poverty, Inequality	D	Human Development Index			Y			1
	D	Multidimensional Poverty Index			Y	V		2
	D	Gini Coefficient	Y	V	Y		V	4
	D	Public Aid per capita			Y			1
	D	Net ODA Received (% of GNI)			Y			1
	D	GDP /cap	Y			Y	Y	3
	D	% Popn in workforce	Y					1
	D	GDP inplicity deflator					Y	1
	D	Central govt debt					Y	1
Educat'n	E	Adult literacy rate	Y	V	Y	Y		4
	E	Gross School Enrolment				Y		1
	E	Teriary Enrolment		Y				1
Food	F	Domestic Food Price Level Index			Y		Y	2
	F	Domestic Food Price Volatility Index			Y			1
	F	Fertilizer use	Y	V				2
	F	Cereal productivity	Y				Y	2
	F	Food Import Dependency		Y				1
	F	Sea level rise impact on rural land					Y	1
	F	Irrigated agricultural land					Y	1
Gender	G	Gender Inequality Index			Y	Y		2
	G	Gender parity in education				Y		1
	G	Female reps in parliamet				Y		1
Health	H	Child Mortality			Y			1
	H	Prevalence of HIV-AIDS above 15years			Y			1
	H	Tuberculosis prevalence			Y			1
	H	Malaria mortality rate			Y			1
	H	Access to Improved water source (% of pop with access)	Y	Y	Y	Y	Y	5
	H	Access to Improved sanitation facilities (% of pop with access)	Y	Y	Y	Y		4
	H	Physicians density		V	Y	Y	Y	4
	H	Health expenditure per capita			Y	V		2
	H	Measles immunization coverage			Y			1
	H	Hospital Beds per 100,000				Y	Y	2
	H	Life expectancy at birth	Y			Y		2
	H	Public & Private health expendiure - separated				Y	V	2
	H	dependency on external resource for health services		Y				1
Infrastructure	I	% energy from renewables					Y	1
	I	Road density (km of road per 100 sq. km of land area)		V	Y			2
	I	Quality trade related infrastructure		Y				1
	I	Dependency on imported energy		Y			Y	2
	I	Enery intensity					Y	1
	I	Energy consumption per cap					Y	1
	I	Access to electricity (% of population)		Y	Y		Y	3
Nutrit'n	N	Children Underweight		V	Y			2
	N	Prevalence of undernourishment			Y	Y	Y	3
	N	Average dietary supply adequacy			Y			1
	N	Animal protein demand	Y					1
Governance	O	Current Subnational Conflict Intensity		V	Y		V	3
	O	Government effectiveness		V	Y		V	3
	O	Corruption Perception Index		V	Y		Y	3
	O	International engagement		Y				1
	O	Political rights					Y	1
Pop'n	P	Dependency Ratio		Y		Y	V	3
	P	Birth rate	Y				V	2
	P	Popn Density	Y					1
Habitat'n	R	% rural population		Y				1
	R	urban concentration		Y				1
	R	slum population		Y				1
	S	Insurance				Y		1
Technol.	T	Internet Users (per 100 people)		V	Y			2
	T	Mobile cellular subscriptions (per 100 people)		V	Y			2
	T	Renewable energy consumption per cap					Y	1
Environment	V	Biodiversity & habitat protection	V	V		Y		3
	V	Forest mgmt				Y	Y	2
	V	% Non-managed Land	Y					1
	V	% Managed Land	Y					1
	V	SO_2 Emissions	Y					1
	V	Natural Capital Dependency		Y				1
	V	Ecological footprint		Y				1
Water	W	Water resources	V	V		Y	Y	4
	W	Dam capacity per capita		Y				1
		Total = 136	19	32	33	22	34	

The main result presented in this annex is not the particular selection of indicators, as these were selected with some focus of the health theme and other priorities in the AGR2018. Rather, of the twelve indicators selected for full analysis 10 were assessed to be effective for tracking progress in adaptation. They would provide sufficient changes over Paris stocktakes to assess whether globally we are making progress and provide an indication of which sectors we are doing better or worse. These indicators could be applied at a national scale, but the results would have to be treated with more caution as they will be affected by just when the indicators are updated.

But within the context of the negotiations, despite the fact that adaptation lacks mitigation's greenhouse gas emissions reduction criterion, progress towards an adaptation goal will need to be, and probably can be, tracked based on a small number of agreed indicators.

Table 3.2: Thirty five indicators selected for more detailed assessment.

CAT	INDICATOR	Count	
C	Population living <5m above MSL	5	Included, but infrequently reported
H	Access to Improved water source (% of pop with access)	5	Included
H	Access to Improved sanitation facilities (% of pop with access)	4	Included
H	Physicians per 1000 population	4	Included
N	Adult literacy rate	4	Excluded, weak reporting
W	Burden placed on available water resources	4	Excluded, diversity of measures used
D	Gini Coefficient or Share of income of poorest percentile	4	Included
D	GNI /capita	3	Excluded, see text
N	Prevalence of undernourishment	3	Included, as depth of food deficit
O	Current Subnational Conflict Intensity	3	Excluded, composite measure
O	Government effectiveness	3	Excluded, composite measure
O	Corruption Perception Index	3	Excluded, composite measure
P	Dependency Ratio (ratio <16 or >65 to working age poipulation)	3	Included
I	Access to electricity (% of population)	3	Included
V	Biodiversity & habitat protection	3	Excluded, composite measure
G	Gender Inequality Index	2	Excluded, composite measure
C	Hyogo Framework for Action compliance	2	Excluded, composite measure
D	Multidimensional Poverty Index	2	Excluded, composite measure
F	Domestic Food Price Level Index	2	Not used
F	Fertilizer use	2	Not used
F	Cereal productivity	2	Not used
H	Health expenditure per capita	2	Not used
H	Hospital Beds per 100,000	2	Not used
H	Life expectancy at birth	2	Not used
H	Public & Private health expendiure - separated	2	Not used
N	Children Underweight	2	Not used, child stunting and mortality included
P	Birth rate or population growth rate	2	Incorporated in Population living <5m above MSL
T	Mobile cellular subscriptions (per 100 people)	2	Included
T	Internet Users (per 100 people)	2	Not used, but discussed with mobile phone usage
U	Road density (km of road per 100 sq. km of land area)	2	Not used
U	Dependency on imported energy	2	Not used
V	Forest management quality	2	Excluded, composite measure
H	Immunization, measles (% children aged 12-23 months)	0	Included, health focus
H	Mortality rate, under 5 (per 1,000 live births)	0	Included, health focus
H	Stunting, height for age (% of children under 5)	0	Included, health focus

Table 3.3: An interpretation of each of the 12 indicators in the exploratory analysis.

Indicator	Description	Suitability, usage, links to SDGs, and WDI code for the data set
% Population with access to Improved water source and % Population with access to Improved sanitation	These two indicators provide similar information and both show how much the LICs, and to a lesser extent the L-MICs are lagging other countries. When grouped by vulnerability classes, SSA is seen to lag behind other low-income countries including the SIDS especially on improved sanitation services. These remain strong indicators of progress in two areas vulnerable to disruption by climate events and important to maintaining public health.	Effective and widely used in indices. SDG 6.1.1 SH.H2O.BASW.ZS
Number of physicians per 1000 people	Show similar information as the indicators on access to improved water and sanitation. Again, SSA is lagging well behind other LICs, but in this case the SIDs are also lagging. They have almost 4 times the numbers of physicians per population than in SSA, but they still have only half the number that other LICs & MICs do.	Effective and widely used in indices. SDG 6.2.1 SH.STA.BASS.ZS
Immunization, measles (% of children ages 12-23 months)	These data show the value of focused effort to improve health outcomes. Both LICs, MICs and SSA are approaching vaccination levels of HICs. There are signs that the rates of increase are falling and that vaccination rates have tended to stabilize over the past 5 to 10 years. There are similar trends in Hep B and DPT vaccinations. These are important to monitor but they may not be good long-term indicators of progress in adaptive capacity.	Effective, but approaching saturation (i.e. there will remain little room to improve). SDG 3.b.1 SE.MED.PHYS.ZS
Mortality rate, under-5 (per 1,000 live births)	The LICs, MICs and SSA countries are performing similarly in reducing child mortality by 40 to 50% over the past 20 years. But they still have mortality rates of 10 to 20 times that of OECD countries. SSA has mortality rates that are double other developing country groups.	Effective. SDG 3.2.1 SH.IMM.MEAS
Prevalence of stunting, height for age (% of children < 5 years-old)	Similar to the above child mortality indicators, with LICs, MICs and SSA countries reducing the prevalence of stunting by about 20% over the past 20 years. However, countries with poor child health outcomes vary significantly on the two measures.	Effective and commonly used in indices. SDG 2.2.1 SH.DYN.MORT
Depth of the food deficit (kilocalories per person per day)	All groups have reducing the food deficit by about 30% to 50% over 20 years. But the LICs have not reached the average of L-MICs of 20 years ago, and similarly L-MICs have not reached levels of U-MICs. The indicator suggests there is progress but at a rate much slower than desired.	Effective and commonly used in indices. SDG 2.1.2 SH.STA.STNT.ZS
Dependency Ratio (here ratio of 0-	Dependency ratios are falling across all developing countries. This is probably due to lower birth rates and is a positive	Effective and commonly used; a

14yr & over 65 year-olds to 15-65 year-olds)	indication that they are in a better position to support education, and have fewer dependent people needing help in extreme events etc. This indicator is available separately for dependency of young and elderly people and probably a more nuanced assessment could be made.	breakdown into dependent young and older people may increase its value. Not in SDGs SN.ITK.DFCT
Income share held by bottom 10th percentile of income earners	There are small improvements in all developing countries but there remains more inequality than in higher income countries, where inequality has increased slightly. There are different interpretations of how well inequality is measured by such broad-brush economic indicators. The Gini coefficient, which measures across all income groups, is often used to measure inequality. The indicators are strongly correlated (r^2 =0.8)	Widely used but less effective; more socially based indicators of inequality might be better. SDG 10 SP.POP.DPND
% Population with access to electricity	Electricity access is increasing everywhere, although HICs and even U-MIC are close to full coverage. But, in 1996-2000 LICs had 41% fewer people connected than the L-MICs. 15 years later they have more people connected but are still 42% behind U-MICs.	Effective and commonly used. SDG 7.1.1 DI.DST.FRST.10
Mobile phone users (per 100 people)	Low income countries were slow to adopt this technology but over the past decade or so their rate of uptake has been very rapid. They will reach levels equivalent to high income countries within a decade. Internet usage may give a clearer measure of progress and probably better captures access to modern information services. .	Effective and commonly used; likely to saturate over the next decade. SDG 16.6.2
Population living in areas where elevation is below 5 metres (in 1,000s)	A commonly used indicator of an important component of exposure, but not effective for tracking progress as currently collected. Only two estimates have been made over the past 20 years with very little change in terms of the estimated percent of population exposed. The numbers of people exposed has increased along with population increase.	Widely used but less effective due to low granularity and frequency; other indicators might be more useful. SDG 11 EN.POP.EL5M.ZS

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