

InsuRisk Assessment Tool – Annex

This annex provides an overview of **indicators**, **datasets** and their **sources** as well as of **key methodological steps** taken in the development of the InsuRisk Assessment Tool (section 2).

1. INDICATORS

The following tables provide an overview of the indicators (incl. data source, year, missing data) for each module of the different components (and modules) of the conceptual framework. Indicators that were not considered in the 2018 version of the InsuRisk Assessment Tool as a result of missing or not sufficient data are highlighted in red. Where available data from 2017 was used to represent the indicators. If data was missing for 2017, data from previous years was used in the analysis.

1.1. Hazard and exposure

Table 1: Hazards (climate-related & other)

Hazard (climate-related)				
Hazard*	Indicator (or proxy)	Source	Year	Missing**
Heavy precipitation	n/a (spatial/modelled data)	n/a	n/a	No data
Heat waves	n/a (spatial/modelled data)	n/a	n/a	No data
Cold waves	n/a (spatial/modelled data)	n/a	n/a	No data
Floods	Return period (RP) 25	UNISDR GAR 2015	RP 25	8 / 84 ***
Droughts	Past events	UNEP PREVIEW	1980-2001	0 / 84
Cyclones / storms	Return period (RP) 50	UNISDR GAR 2015	RP 50	0 / 84
Storm surges	Return period (RP) 25	UNISDR GAR 2015	RP 25	0 / 84
Hazard (other natural)				
Earthquakes	RP 250	UNISDR GAR 2015	RP 250	0 / 84
Volcanic eruptions	n/a	n/a	n/a	No data
Tsunamis	RP 500	UNISDR GAR 2015	RP 500	Not sufficient

* Hazard mentioned in the conceptual framework of the InsuRisk Assessment Tool

** Missing data (for the 84 countries classified as low and low-middle income according to World Bank)

*** No data for: Comoros, Cabo Verde, Egypt, Micronesia, Kiribati, Solomon Islands, Sao Tome and Principe, Vanuatu

For storms and earthquakes, the following intensities were considered in the analysis:

- **Cyclones:** wind speeds of >119 km/h; this corresponds to Saffir-Simpson (SS) Category 1 (and greater); associated damage level of SS Category 1: very dangerous winds will produce some damage
- **Earthquakes:** Peak Ground Acceleration (PGA) > 8.1 cm/s; this corresponds to the Modified Mercalli Scale Intensity VI (and greater); associated damage level MM VI: perceived shaking = strong; resistant structures = light damage; vulnerable structures = moderate damage

Table 2: Exposure

Exposure (people land use & economic production infrastructure)				
Factor	Indicator (or proxy)	Source	Year	Missing
People	% of population exposed to floods, droughts, cyclones, storm surges, earthquakes	GHSL	2015	0 / 84
Agricultural land & production facilities	% of agricultural land exposed to floods, droughts, cyclones, storm surges, earthquakes	ESA CCI	2015	0 / 84
	% of GDP exposed to floods, droughts, cyclones, storm surges, earthquakes	CGER-NIES	2010	0 / 84
Infrastructure (transport, energy)	% transport infrastructure (roads, railways, airports, ports) exposed to floods, cyclones, storm surges, earthquakes	OSM, WFP GeoNode, OurAirports, World Port Index	2016	0 / 84
	% energy infrastructure (power plants, stations, generators) exposed to floods, cyclones, storm surges, earthquakes	OSM	2017	0 / 84
Infrastructure (health care)	% of health care infrastructure (major hospitals, health centres) exposed to floods, cyclones, storm surges, earthquakes	n/a	n/a	No data

1.2. Vulnerability

Table 3: Vulnerability (people | social)

Vulnerability (people social)				
Factor	Indicator (or proxy)	Source	Year	Missing
Poverty	Poverty headcount ratio at national poverty lines (% of population)	World Bank	2006-2017	3 / 84 (2 after imputation)
Existing social protection	Breadth of social protection: aggregated coverage (% of total population)	ASPIRE	2010-2015	14 / 84
	Depth of social protection: aggregated average per capita transfer amount (% of GDP [per capita])	ASPIRE	2000-2015	22 / 84
Universal health coverage (UHC) – access to essential health services	Tuberculosis treatment success rate for new TB cases (%)	WHO	2015	2 / 84
	Antenatal care coverage – at least 4 visits (%)	WHO	2001-2017	5 / 84 (4 after imputation)
	Births attended by skilled health personnel (%)	WHO	2001-2017	2 / 84
	Diphtheria-tetanus-pertussis (DTP3) immunization coverage among 1-year olds (%)	WHO	2016	2 / 84
	Estimated ARV coverage among people living with HIV (%)	WHO	2017	11 / 84
	Married or in-union women of reproductive age who have their need for family planning satisfied with modern methods (%)	WHO	2007-2017	6 / 84
	Improved water source (% of population with access)	World Bank	2015	2 / 84
	Improved sanitation facilities (% of population with access)	World Bank	2015	2 / 84
Universal health coverage (UHC) –financial protection	General government expenditure on health as a percentage of total government expenditure (%)	WHO	2014	4 / 84
	Out-of-pocket expenditure on health as a percentage of total expenditure on health (%)	WHO	2012-2015	4 / 84
Undernutrition	Prevalence of undernourishment (% of population)	World Bank / FAO	2015	0 / 84
Dependency ratio	Working-age population (%)	World Bank	2017	2 / 84 (1 after imputation)
Remittances	Personal remittances received (% of GDP)	World Bank	2015-2017	6 / 84 (3 after imputation)
Housing quality	Population living in slums (% of urban population)	World Bank	2014	21 / 84 (7 after imputation)
Land titles	% of population with land titles	n/a	n/a	No data
Dependency on primary sector	Agriculture, value added (% of GDP)	World Bank	2015-2017	9 / 84 (1 after imputation)
GINI Index	GINI-Index	World Bank	2003-2016	5 / 84 (3 after imputation)
GDP per capita	GDP per capita, PPP (current international \$)	World Bank	2017	7 / 84 (0 after imputation)

Table 4: Vulnerability (land use & economic production)

Vulnerability (land use & economic production)				
Factor	Indicator (or proxy)	Source	Year	Missing
Soil fertility	Mean soil organic carbon stock (t/ha)	GSOMap (FAO)	n/a	2 / 84 (0 after imputation)
Freshwater scarcity	Freshwater withdrawal rate as % of total renewable water resources	AQUASTAT (FAO)	2000-2016	7 / 84
	Total renewable water resources per capita	AQUASTAT (FAO)	2014	4 / 84
Access to irrigation	% of the cultivated area equipped for irrigation	AQUASTAT (FAO)	2000-2015	20 / 84 (16 after imputation)
Freshwater quality	Water quality of freshwater bodies	n/a	n/a	No data
Economic diversification	Herfindahl-Hirschman index	World Bank	2016	Not sufficient

Table 5: Vulnerability (infrastructure)

Vulnerability (infrastructure)				
Factor	Indicator (or proxy)	Source	Year	Missing
Quality of transport infrastructure	Quality of transport infrastructure (roads, railways, airports, ports)	Global Competitiveness Index	2017-2018	29 / 84
Access to electricity	% of population with access to electricity	World Bank	2016	0 / 84
Access to information (ICT)	% of households with access to one of the following: Radio, TV, mobile phones, internet access (max. value of the four used)	ITU World	2012-2016	46 / 84 (1 after imputation)
	Individuals using the internet (% of population)	World Bank	2016	Used for imputation
	Mobile cellular subscriptions (per 100 people)	World Bank	2016	

1.3. Short-term coping capacity

Table 6: Short-term coping capacity (individual & national level)

Short-term coping capacity (individual level)				
Factor	Indicator (or proxy)	Source	Year	Missing
Financial buffer capacity	Saved any money in the past year, income, poorest 40% (% ages 15+)	World Bank (Global FINDEX)	2017	20 / 84 (11 after imputation)
	Saved for emergencies, income, poorest 40% (% ages 15+)	World Bank (Global FINDEX)	2011	20 / 84
Insurance coverage (micro-schemes)	Total micro-insurance coverage ratio	MunichRe – World Map of Microinsurance	2012-2015	4 / 84
Short-term coping capacity (national level)				
Availability of emergency services	Density of emergency services (police, fire brigades, etc.) per 1,000	OSM	n/a	No data
Access to health care	Number of hospital beds (per 10,000)	WHO	2004-2015	4 / 84 (2 after imputation)
	Density of physicians (total number per 1,000)	WHO	2003-2016	4 / 84 (3 after imputation)
Insurance coverage (macro-schemes)	Membership in the Sovereign Catastrophe Risk Pools CCRIF, ARC, PCRAFI	CCRIF, ARC, PCRAFI	2018	0 / 84
Contingency funds	Contingency funds (% of GDP)	n/a	n/a	No data

1.4. Long-term prevention strategies

Table 7: Long-term prevention strategies

Long-term prevention strategies				
Factor	Indicator (or proxy)	Source	Year	Missing
Availability of DRR strategies	Presence of national DRR strategy (yes/no)	PreventionWeb (UNISDR)	2018	0 / 84
Existence of preparedness plans	Legislative/regulatory provisions made for managing disaster risk (yes/no)	Hyogo Country Reports	2007-2015	Not sufficient
Availability of contingency plans	Disaster risk taken into account in public investment and planning decisions (yes/no)	Hyogo Country Reports	2007-2015	Not sufficient
Availability of NAPs / NAP status	Presence of UNFCCC National Adaptation Plan (NAP) (yes/no)	UNFCCC NAP Registry	2018	0 / 84
	Current NAP status (based on the LEG NAP technical guidelines)	UNFCCC	2016	0 / 84
Availability of NDCs	Presence of NDC (yes/no)	UNFCCC NDC Registry	2018	0 / 84
Spending for DRR and adaptation	National budget -Risk reduction / prevention (%)	Hyogo Country Reports	2009-2015	Not sufficient

1.5. Readiness for insurance solutions

Table 8: Readiness for insurance solutions (individual / enabling environment / insurance industry)

Readiness for insurance solutions (individual)				
Factor	Indicator (or proxy)	Source	Year	Missing
Financial literacy	Access to account or mobile money service with secondary education or more (% ages 15+)	World Bank (Global FINDEX)	2017	21 / 84 (12 after imputation)
Trust in insurance	n/a	n/a	n/a	No data
Risk awareness	Number of catastrophic events in last ten years (#)	EM-DAT database	n/a	Not sufficient
Readiness for insurance solutions (enabling environment)				
Functioning of government	Functioning of government	Economist Intelligence Unit	2017	8 / 84
Readiness for insurance solutions (insurance industry)				
Number of primary non-life insurers	Number of competitors (non-life)		2013-2017	0 / 84
Market concentration	Market concentration of up to top 5 (%)	Axco Insurance	2011-2017	0 / 84
Placement by brokers	% of placement	Information Services & Social Impact	2013-2017	0 / 84
Insurance premium volume	Total (mil. USD) incl. personal accident and health care	Partners (SIP)	2011-2016	0 / 84
Market penetration	Market penetration		2011-2016	8 / 84

1.6. Updates in the 2018 version (indicators)

For the 2018 version of the InsuRisk Assessment Tool, data for 32 out of the total 53 indicators (60%) was updated. In addition, five indicators were newly included in the analysis compared to the 2017 version of the tool:

- Newly added vulnerability indicators:
 - Breadth of social protection: aggregated coverage (% of total population)
 - Depth of social protection: aggregated average per capita transfer amount (% of GDP [per capita])
 - Mean soil organic carbon stock (t/ha)
- Newly added long-term prevention indicators:
 - Presence of national DRR strategy (yes/no)
 - Current NAP status (based on the LEG NAP technical guidelines)

As shown in table 9, no updates were carried out for the hazard & exposure element of the tool. In contrast, newly available data for the elements of vulnerability, short-term-capacity and readiness was available for more than three quarter of the considered indicators.

Apart from the increased number of indicators, the data available for those indicators was also increased. Consequently, the 2018 version now also covers Cabo Verde and Kiribati – two countries that were not included in the 2017 version. In consequence, the number of target countries with ‘no data’ has been reduced from five to three (Micronesia, the Democratic People's Republic of Korea, and Kosovo).

Table 9: Updates (indicators)

Elements of the InsuRisk Assessment tool framework	Updates (factors & indicators)				
	Factor	Indicator (or proxy)			
	Updates in 2018	Updates in %	Updates in 2018	Updates in % (tool calculation)	Updates in % (overall)
Hazard & exposure	0	0 %	0	0 %	0 %
Vulnerability	14 (2 new)	70 %	20 (3 new)	77 %	67 %
Short-term coping capacity	4	67 %	5	83 %	63 %
Long-term prevention strategies	3 (2 new)	50 %	4 (2 new)	100 %	57 %
Readiness	7	78 %	7	100 %	78 %

2. KEY METHODOLOGICAL STEPS

The InsuRisk Assessment Tool builds on a modular design, where the different indicators are aggregated into their respective modules (e.g. social vulnerability, economic vulnerability, infrastructure vulnerability) and components (e.g. disaster risk, readiness) using an index-based approach. The results are index scores for each module (e.g. social vulnerability, infrastructure vulnerability, etc.) and each component (e.g. climate and disaster risk, readiness for insurance solutions, etc.). The modules can be combined in multiple ways. This enables users such as governments, insurers and researchers to select and access the required information based on their respective interests.

Index scores for each module and component were derived pursuing a composite indicator approach comprising the following key steps: (1) definition of the conceptual framework; (2) identification of potential indicators for each component of the framework based on a systematic review of literature, expert consultations, and selection criteria (e.g. relevance, validity, etc.), (3) acquisition of data for each of the identified indicators, (4) data transformation (e.g. absolute into relative values), (5) analysis and imputation of missing data, (6) outlier detection and treatment, (7) assessment and reduction of potential multicollinearities, (8) normalization, and (9) weighting and aggregation of indicators.

For the InsuRisk Assessment tool:

- **Indicators** were identified through a review of literature and through expert consultations
- **Data** was acquired from reliable and publically available sources (open source) focusing on datasets with global coverage
- Potential **outliers** in the data were analysed using box plots based on the inter-quartile range (IQR), i.e. data outside 1.5 x IQR were classified as potential outliers. Following the statistical analysis, each outlier was examined in detail using scatter plots and by going back to the raw data. Identified outliers were treated using a winsorization approach, i.e. by an iterative replacement of the highest/lowest with the second highest/lowest indicator scores
- Potential **multicollinearities** (or redundancies) in the data were analysed using Spearman's correlation coefficient (with $r > 0.9$ indicating multicollinearity)

- Data was **normalized** only for those indicators not representing percentages (between 0 and 100%). For other indicators (i.e., GDP per capita PPP; mean soil organic carbon stock (t/ha); total renewable water resources per capita; age dependency ratio; freshwater withdrawal rate as % of total renewable water resources) data was normalized using linear min-max normalization based on global minimum and maximum values. This approach allows for changes in the selection of the target countries while ensuring that the index scores of the individual countries do not change. The outcome are re-scaled indicator scores in the range between zero and one [0-1]. Where necessary, the direction of the indicator was adjusted during the normalization process to ensure that all indicators 'point' into the same direction (e.g. high indicator scores always contribute to increased vulnerability)
- **Equal weights** were applied when aggregating the indicators into modules (e.g. social vulnerability) and when aggregating modules into components (e.g. climate and disaster risk, short-term coping capacity, long-term preventive strategies, readiness for insurance solutions).
- The following **aggregation methods** were used:
 - Weighted arithmetic aggregation (note: equal weights were used) was applied when aggregating indicators into modules (e.g. social vulnerability, etc.)
 - Weighted arithmetic aggregation was applied when aggregating modules into overall vulnerability and overall readiness for insurance solutions
 - Weighted multiplicative aggregation was applied to combine 'hazard exposure' and vulnerability into climate and disaster risk (*risk = hazard exposure x vulnerability*)
 - Weighted multiplicative aggregation was applied when calculating residual risk (*residual risk = (1-coping capacity x climate and disaster risk)*)
- **Exposure** was determined by calculating the percentage of (i) people, (ii) agricultural land and downscaled GDP grids, and (iii) infrastructure located in potentially hazard-prone areas using Geographic Information Systems (GIS). Considering that each element of the system in a country (e.g. people, agricultural land, infrastructure, etc.) can be exposure to multiple hazards, multi-hazard exposure was calculated by summing up the percentages of single hazard exposure for these elements. Since this can result in values greater than 100 %, 100 % was defined as the cut-off value representing the maximum exposure of a country.
- A metric representing a country's **insurance market development** status was calculated by a multistage, iterative process. All five factors for "readiness for insurance solutions (insurance industry)" were weighted separately to reflect their individual importance. The weighting factors were additionally adjusted by continents (Africa, Asia, Latin America and Eastern Europe) to take continental characteristics into account. Finally all results were verified by insurance experts with specific market expertise.

Since data was missing for several countries, including Micronesia, the Democratic People's Republic of Korea (North Korea), and Kosovo, the assessment was conducted for 81 out of the 84 countries currently classified as low and low to middle income countries by the World Bank.

2.1. Updates in the 2018 version (methodology)

The 2017 version of the tool used minimum and maximum indicator scores in the normalization process, resulting in relative indicator and index scores for these 84 countries. For the 2018 version, global minimum and maximum values were used for those indicators not representing percentages (see section 2), thus allowing for changes in the selection of target countries in the future while ensuring that the index scores of the individual countries do not change.

3. ABBREVIATIONS

ARC	African Risk Capacity
AQUASTAT	FAO's global water information system
ASPIRE	The Atlas of Social Protection Indicators of Resilience and Equity
CCRIF	Caribbean Catastrophe Risk Insurance Facility
DRR	Disaster Risk Reduction
EM-DAT	The International Disaster Database
ESA	European Space Agency
ESA CCI	ESA Climate Change Initiative
FAO	Food and Agriculture Organization of the United Nations
FINDEX	Global Financial Inclusion Database
GAR	Global Assessment Report
GDP	Gross Domestic Product
GDP PPP	GDP Purchasing Power Parity
GHSL	Global Human Settlements Layer
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
ICT	Information and communications technology
ILO	International Labour Organization
IQR	Inter-quartile range
ITU	International Telecommunication Union
PGA	Peak Ground Acceleration
MMI	Modified Mercalli Intensity Scale
NAP	National Adaptation Plan
NDC	Nationally Determined Contributions
OSM	OpenStreetMap
PCRAFI	Pacific Catastrophe Risk Assessment and Financing Initiative
RP	Return period
UNEP	United Nations Environment Programme (now: UN Environment)
UNEP PREVIEW	UNEP PREVIEW Global Risk Data Platform
UNISRD	The United Nations Office for Disaster Risk Reduction
WHO	World Health Organization