

InsuRisk Assessment Tool – Annex

This annex provides an overview of **indicators, datasets and sources** (section 1) 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.

1.1. Hazard and exposure

Table 1: Hazards (climate-related & other)

Hazard (climate-related)				
Factor*	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	0 / 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	Insufficient quality

* Factor 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)

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	2003-2016	3 / 84 (2 after imputation)
Existing social protection	Coverage: all social insurance & assistance (% of population)	ASPIRE	2010-2014	34 / 84 (14 after imputation)
	<i>Total public social expenditure (% of GDP) [to close data gaps in above indicator]</i>	<i>ILO</i>	<i>2003-2012</i>	<i>Used for imputation</i>
Universal health coverage (UHC) – access to essential health services	Tuberculosis treatment success rate for new TB cases (%)	WHO	2014	2 / 84
	Antenatal care coverage – at least 4 visits (%)	WHO	2000-2015	2 / 84
	Births attended by skilled health personnel (%)	WHO	2010-2016	2 / 84
	Diphtheria-tetanus-pertussis (DTP3) immunization coverage among 1-year olds (%)	WHO	1980-2016	2 / 84
	Estimated ARV coverage among people living with HIV (%)	WHO	2016	2 / 84
	Married or in-union women of reproductive age who have their need for family planning satisfied with modern methods (%)	WHO	2005-2016	2 / 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
	General government expenditure on health as a percentage of total government expenditure (%)	WHO	2014	2 / 84
	Out-of-pocket expenditure on health as a percentage of total expenditure on health (%)	WHO	2014	2 / 84
Universal health coverage (UHC) –financial protection				
Undernutrition	Prevalence of undernourishment (% of population)	World Bank / FAO	2015	0 / 84
Dependency ratio	Working-age population (%)	World Bank	2016	2 / 84 (1 after imputation)
Remittances	Personal remittances received (% of GDP)	World Bank	2015	10 / 84 (1 after imputation)
Housing quality	Population living in slums (% of urban population)	World Bank	2014	21 / 84 (8 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	2016	18 / 84 (1 after imputation)
GINI Index	GINI-Index	World Bank	2003-2014	8 / 84 (4 after imputation)
GDP per capita	GDP per capita, PPP (current international \$)	World Bank	2016	8 / 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	Nutrient availability	Harmonized world soil database v1.2 (FAO)	2008	4 / 84
	Nutrient retention capacity	Harmonized world soil database v1.2 (FAO)	2008	4 / 84
Freshwater scarcity	Freshwater withdrawal rate as % of total renewable water resources	AQUASTAT (FAO)	1975-2016	7 / 84 (5 after imputation)
	Total renewable water resources per capita	AQUASTAT (FAO)	2014	4 / 84
Access to irrigation	% of the cultivated area equipped for irrigation	AQUASTAT (FAO)	1987-2015	5 / 84 (2 after imputation)
Freshwater quality	Water quality of freshwater bodies	n/a	n/a	No data
Economic diversification	n/a	n/a	n/a	No data

Table 5: Sources and years for “vulnerability (infrastructure)” indicators

Vulnerability (infrastructure)				
Factor	Indicator (or proxy)	Source	Year	Missing
Quality of transport infrastructure	Quality of transport infrastructure (roads, railways, airports, ports)	Global Competitiveness Index	2016-2017	22 / 84
Access to electricity	% of population with access to electricity	World Bank	2015	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	48 / 84 (0 after imputation)
	Individuals using the internet (% of population)	World Bank	2016	Used for imputation
	Mobile cellular subscriptions (per 100 people)	World Bank	2015-2016	

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)	2014	15 / 84 (>10%)
	Saved for emergencies, income, poorest 40% (% ages 15+)	World Bank (Global FINDEX)	2011	14 / 84 (>10%)
Insurance coverage (micro-schemes)	Total micro-insurance coverage ratio	MunichRe – World Map of Microinsurance	2005-2015	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	2004-2014	7 / 84 (1 after imputation)
	Density of physicians (total number per 1,000)	WHO	1998-2015	3 / 84 (1 after imputation)
Insurance coverage (macro-schemes)	Membership in the Sovereign Catastrophe Risk Pools CCRIF, ARC, PCRAFI	World Bank / GIZ	2016	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)	Sendai Monitor	2017	Not sufficient
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	Country has a UNFCCC National Adaptation Plan (NAP) (yes/no)	UNFCCC NAP Registry	2015-2017	0 / 84
	Current NAP status (submitted/launched = 1; under development/road map developed = 0.5; committed/nothing = 0)	GIZ Climate Change Country Navigator Handbook	2015-2017	0 / 84
Availability of NDCs	Country has a NDC (yes/no)	UNFCCC NDC Registry	2016	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)	2014	15 / 84
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	2016	5 / 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 (%)		2011-2017	0 / 84
Placement by brokers	% of placement	Axco Insurance Information Services	2013-2017	0 / 84
Insurance premium volume	Total (mil. USD) incl. personal accident and health care		2011-2016	0 / 84
Market penetration	Market penetration		2011-2016	0 / 84

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 prototype:

- **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** using linear min-max normalization based on minimum and maximum values of each indicator across the 79 countries considered in the analysis. 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. 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 Cabo Verde, Micronesia, Kiribati, the Democratic People's Republic of Korea (North Korea), and Kosovo, the assessment was conducted for 79 out of the 84 countries currently classified as low and low to middle income countries by the World Bank. Since only indicator scores for these 79 countries were considered in the analysis, the results must be interpreted as a relative assessment within these countries, not taking into account how these countries perform in contrast to e.g. upper-middle or high income countries.

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

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