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Index for Risk Management - INFORM

Concept and Methodology

Version 2016

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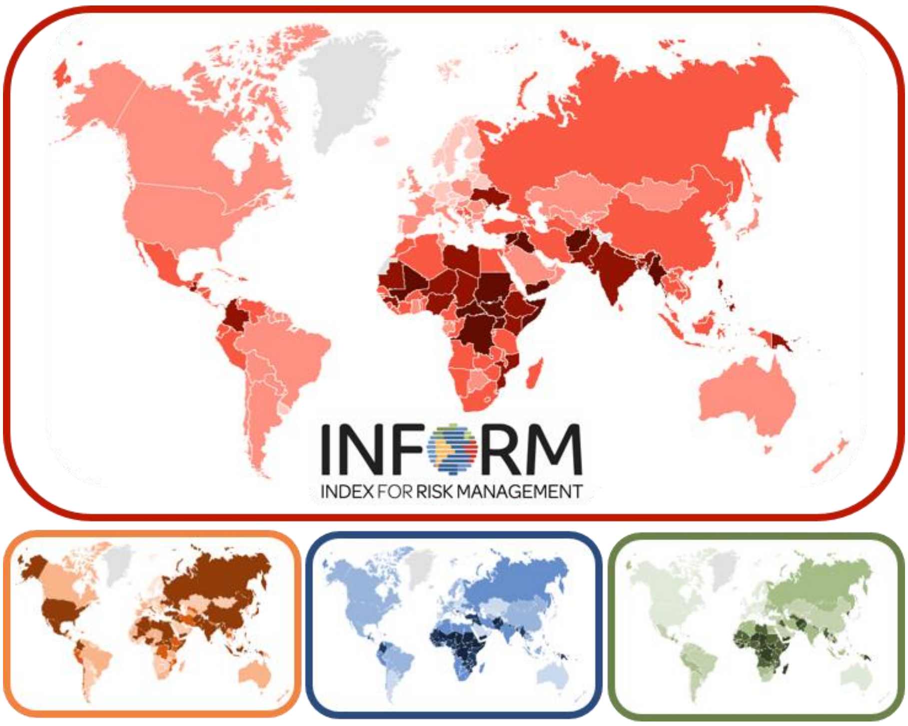

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Abstract

This is already the third report of the revised INFORM's concept and methodology. INFORM is a composite indicator that identifies countries at risk of humanitarian crisis and disaster that would overwhelm national response capacity. The INFORM index supports a proactive crisis and disaster management framework. The INFORM initiative began in 2012 as a convergence of interests of UN agencies, donors, NGOs and research institutions to establish a common evidence-base for global humanitarian risk analysis.
The INFORM model is based on risk concepts published in scientific Literature and envisages three dimensions of risk: Hazards & Exposure, Vulnerability and Lack of Coping Capacity. The INFORM model is split into different Levels to provide a quick overview of the underlying factors leading to humanitarian risk and builds up the picture of risk by 53 core indicators. The INFORM 2016 was mainly changed to incorporate new disaster risk data published by GAR 2015. We introduced the new risk metric in most of natural hazards and improved the way the conflict risk is measured as well as changed data source for the road density indicator. We also introduced five classes of risk with fixed thresholds using hierarchical cluster technique .These changes have been applied also at dimension and category Level and will help us to track risk better. Any changes in the INFORM methodology are always applied at Least five previous years of data to preserve the consistency for the trend analysis.

Version	Date	Description, Modification, Authors
V0.1	30/10/2015	Draft version for core INFORM partners
V1.0	11/11/2015	First version of INFORM 2016 methodology

ABSTRACT

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EXECUTIVE SUMMARY

Policy context

The Index for Risk Management INFORM is a composite indicator developed by JRC as a tool for understanding the risk of humanitarian crisis and disasters. INFORM provides the scientific support to the following EU policy initiatives:

- Communication from the Commission of 23 February 2009 - EU strategy for supporting disaster risk reduction in developing countries, CoM(2009)84.
- Council Regulation No 1257/96 of 20 June 1996 concerning humanitarian aid.
- Key priority of the EU disaster prevention framework (EU Council conclusions, 30 November 2009).
- COM (2009) 82 Community Approach on the prevention of natural and man-made disasters
- SEC (2010) 1626 Risk Assessment and Mapping Guidelines for Disaster Management
- Communication from the Commission of 22 November 2010 - The EU Internal Security Strategy in Action: five steps towards a more secure Europe, CoM(2010)673.
- TFEU (2012), C 326, 26.10.2012, Treaty on the functioning of the european union (consolidated version 2012).
- Communication from the Commission of 16 April 2013 - An EU Strategy on adaptation to climate change, CoM(2013) 216 final.
- REGULATION (EU) No 1291/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2013 establishing Horizon 2020 - the Framework Programme for Research and Innovation (2014-2020) and repealing Decision No 1982/2006/EC.
- Decision 1313/2013/EU of 20 December 2013 on a Union Civil Protection Mechanism.
- Communication from the Commission of 8 April 2014 – The post 2015 Hyogo Framework for Action: Managing risks to achieve resilience.
- Council conclusions on the post 2015 Hyogo Framework for Action: Managing risks to achieve resilience (9884/14, May 2014).
- Council conclusions on Risk Management Capability - Adoption (June 2014, 13375/14 and June 2014)
- Communication from the Commission of 2 September 2015 - Towards the World Humanitarian Summit: A global partnership for principled and effective humanitarian action.

INFORM is a joint initiative of the European Commission and the Inter-Agency Standing Committee Task Team (IASC) for Preparedness and Resilience, in partnership with Office for the Coordination of Humanitarian Affairs (OCHA), UK Department for International Development (DFID), World Bank, the Assessment Capacities Project (ACAPS), UN agencies, and many others. INFORM is also intended to support global policy processes, including

- the Sendai framework for development and disaster risk reduction adopted in March 2016,
- 17 Sustainable Development Goals adopted in UN Summit in September 2015,
- the UN Framework on Climate Change in the Paris Climate Conference in December 2015,
- the 2016 World Humanitarian Summit and

- the resilience ‘agenda’, around which many organisations are focusing their humanitarian and development work.

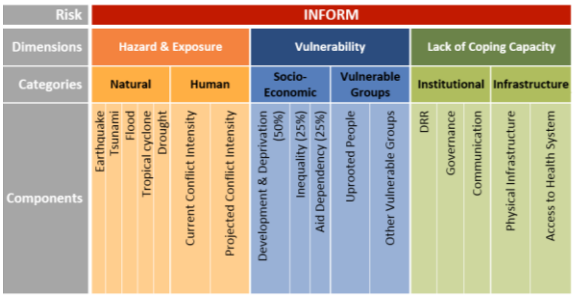
Key conclusions

Most humanitarian crises can be predicted to some extent, and while they cannot always be prevented, the suffering they cause can often be greatly reduced. Understanding crisis risk - the probability of a crisis occurring and its likely impact - is a fundamental step in reducing and managing the risk. Risk analysis is used to identify the people and places most at risk and, therefore, reduce and manage the threat. When all those involved in crisis prevention, preparedness and response - including governments, humanitarian and development agencies and donors - have a common understanding of risk, they can work more effectively together.

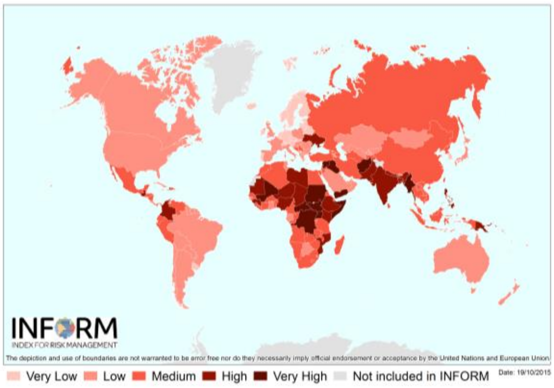
INFORM has been developed to improve the common evidence basis for risk analysis so all governments, development agencies, disaster risk reduction actors and organisations can work together. INFORM is first global, open-source, continuously updated, transparent and reliable tool for understanding risk of humanitarian crises and disasters. It covers 191 countries. All the results and data used data are freely available and the INFORM partnership includes many data source organisations. Methodology is completely transparent and is based on scientific concepts and methods.

The INFORM index supports a proactive crisis and disaster management framework. It will be helpful for an objective allocation of resources for disaster management as well as for coordinated actions focused on anticipating, mitigating, and preparing for humanitarian emergencies. Many organizations are already using INFORM.

Main findings



INFORM summarizes the multitude of factors contributing to the risk for humanitarian crises and disasters into a single index.



INFORM 2016 Risk index map shows risk of humanitarian crises and disaster across the globe

As a composite indicator, INFORM

- ranks countries according to the likelihood of needed international assistance in the near future,
- creates a risk profile for every country which show the level of the individual components of risk,
- allows for trend analysis because the results of INFORM are available for at least 5 years.

Quick guide

The Index for Risk Management - INFORM - is a way to understand and measure the risk of a humanitarian crisis. INFORM is a composite indicator, developed by the JRC, combining 53 indicators into three dimensions of risk: hazards (events that could occur) and exposure to them, vulnerability (the susceptibility of communities to those hazards) and the lack of coping capacity (lack of resources that can alleviate the impact). The index results are published once every year. They give an overall risk score out of 10 for each country, and for each of the dimensions, categories, and components of risk. The purpose of INFORM is to provide an open, transparent, consensus-based methodology for analysing crisis risk at global, regional or national level.

Related and future JRC work

The JRC is actively involved in the further development of INFORM, which includes methodological improvements for more accurate risk assessment as well as introduction of new and better data when become available. The main model is expected to remain stable to guarantee the comparability over the years and trend analysis. INFORM can also be used to measure risk at the sub-national level. The JRC and INFORM partners are working with regional and national counterparts to develop region- and country-specific versions of INFORM.

CONTENT

LIST OF ABBREVIATIONS

ACAPS	Assessment Capacities Project
ASI	Agricultural Stress Index
CRED	Centre for Research on the Epidemiology of Disasters
DFID	United Kingdom government - Department for International Development
DRR	Disaster Risk Reduction
ECHO	European Commission - Humanitarian Aid and Civil Protection
FAO	Food and Agriculture Organization of the United Nations
FCI	Forgotten Crisis Index
GAR	Global Assessment Report
GCRI	Global Conflict Risk Index
GDP	Gross Domestic Product
GFM	Global Focus Model
GNA	Global Needs Assessment
GNI	Gross National Income
GSHAP	Global Seismic Hazard Assessment Program
HDI	Human Development Index
HFA	Hyogo Framework for Action
HIIK	Heidelberg Institute for International Conflict Research
IDMC	Internal Displacement Monitoring Centre
IDP	Internally Displaced Persons
IOM	International Organization for Migration
IQR	Interquartile range
MDG	Millennium Development Goals
MMI	Modified Mercalli Intensity Scale (I-XII)
MPI	Multidimensional Poverty Index
Natech	Natural Hazard Triggering Technological Disasters
NOAA	National Oceanic and Atmospheric Administration, The United States
OCHA	Office for the Coordination of Humanitarian Affairs
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development

PAGER	Prompt Assessment of Global Earthquakes for Response
PPP	Purchasing Power Parity
RP	Return Period
SDG	Sustainable Development Goals
SFDRR	Sendai Framework for Disaster Risk Reduction
SS	Saffir-Simpson Hurricane Scale (Category 1-5)
UNEP	United Nations Environment Programme
UNHCR	United Nations refugee agency
UNICEF	United Nations Children's Fund
UNISDR	United Nations Office for Disaster Risk Reduction
UNODC	United Nations Office on Drugs and Crime
UXO	Unexploded ordnance (i.e. explosive weapons, e.g., bombs, bullets, shells, grenades, land mines, naval mines, etc.).
WFP	United Nations World Food Programme
WHO	World Health Organization
WRI	World Risk Index

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1. INTRODUCTION

2015 was a crucial year for disaster risk management. Three international frameworks of the post-2015 development agenda were signed with clear targets to reduce disasters and humanitarian suffering for the world's population. In the Sendai Framework for Disaster Risk Reduction[1], adopted in March 2015, national governments engage themselves to prevent new and reduce existing disaster risk by reducing hazard exposure and vulnerability and increase preparedness and resilience. In September 2015, 17 Sustainable Development Goals were adopted in a UN Summit and disaster risk is prominent in three of them: end poverty, build resilient cities, and combat climate change. In December, the UN Framework on Climate Change aims to achieve a legally binding agreement in the Paris Climate Conference. All frameworks emphasize the role of science and objective data to monitor progress in risk reduction, and INFORM has been widely promoted at the world conferences.

In 2016, the first World Humanitarian Summit[2] will set a new agenda to keep humanitarian action fit for the future. Humanitarian and development stakeholders increasingly recognise the need to transition from a reactive humanitarian crisis response model to a proactive crisis and disaster management framework. Such a framework must be built on a sound understanding of the drivers of humanitarian risk so that actors can work from a common understanding of priorities in order to target their resources in a coordinated and effective manner. This has been the guiding principle in the development of INFORM.

INFORM is a partnership of a group of UN agencies, donors, NGOs and research institutions to develop a comprehensive and flexible, widely-accepted, open and continuously updated, transparent and evidence-based multi-hazard humanitarian risk index with global coverage and regional/subnational scale and seasonal variation. The group is engaged in incorporating the risk index in internal decision making processes and to demonstrate the added value of doing so to other interested organisations.

In 2015, INFORM was successfully integrated in the internal processes of the European Commission's Humanitarian and Civil Protection Office (ECHO). After a transition period, ECHO adopted fully the INFORM index[3] and is promoting its use with partners. OCHA, the Office for Coordination of Humanitarian Affairs, adopted the INFORM index. INFORM is used to support decisions and prioritisation of OCHA's preparedness activities as well as one of the input into the process for deciding on funding allocation from pooled funds. The UK Department for International Development (DFID) is transitioning its risk assessment to incorporate INFORM, while it is also promoting INFORM-inspired thematic risk assessment pilots (e.g. during the Ebola crisis). The World Food Programme is using INFORM to support decisions on prioritisation of emergency preparedness and resilience activities and as a basis for deciding which countries should be focus for further research and analysis for the purpose of early warning. UNICEF has customized INFORM based on consultations with Regional Emergency Advisors and is used to

[1] http://www.preventionweb.net/files/43291_sendaiframeworkfordrren.pdf
[2] https://www.worldhumanitariansummit.org/
[3] http://ec.europa.eu/echo/what/humanitarian-aid/needs-assessments_en

prioritize technical and financial support as well as assign lighter emergency preparedness standards to low risk countries. The U.S. Department of State and U.S. Agency for International Development (USAID) are promoting the use of INFORM-inspired risk analyses to inform annual strategy and budget decision-making.

During 2015, OCHA also coordinated national and regional implementations of the INFORM methodology which resulted in individual risk models for the Sahel, East Africa, Colombia, and Lebanon. These have the same features and benefits as the global model, but are subnational in scale and are tailored to the risk of each country or region.

INFORM is a composite indicator designed to support decisions about prevention, preparedness and response. The INFORM initiative started in a workshop in October 2012 organised at the Joint Research Centre of the European Commission (JRC). The JRC is the main scientific partner in the INFORM process, and has lead the bottom-up process of building a consensus-based new methodology, taking into account the requirements of participating institutions as well as limitations of data availability. INFORM has bi-annual partner conferences where strategic developments are discussed, and frequent teleconferences of the core group and/or thematic groups to discuss implementation of methodological improvements and changes.

In 2015, the INFORM methodology was mainly changed to incorporate new disaster risk data published by the Global Assessment Report 2015. The global multi-hazard probabilistic datasets produced in the Global Risk Assessment are an important new data source that informs better risk assessment. Striking a balance between adopting improved data sources and having a stable index over time, the 2016 methodology incorporates most, but not all, probabilistic hazard datasets of GAR 2015. Other improvements include an upgrade of the Global Conflict Risk Index and the changed data source for the road density indicator. We also introduced five classes of risk with fixed threshold using hierarchical cluster technique instead of previous quartile division. These changes have been applied also at dimension and category level. New interpretation of the scores will help us to track risk better and work with classes of smaller sizes, which give greater ability to monitor, control and even manage risk.

The scope of this publication is to describe the methodology of the global INFORM index in detail. It can be considered as the third version of the methodology, greatly improved by feedback of real use by participating organisations, suggestions of new partners, and availability of new science and data. INFORM will keep evolving when new science and data becomes available, but the main concepts, dimensions and indicators are expected to remain stable to allow for comparability over the years and trends analysis.

For more Information and updated versions of this document, please refer to the INFORM website: http://www.inform-index.org.

2. KEY CONCEPTS OF THE INFORM INDEX

2.1. Objective of the INFORM

INFORM index is a way to simplify a lot of Information about crisis risk so it can be easily used for decision-making. It is a composite indicator that identifies "countries at risk from humanitarian emergencies and disasters that could overwhelm current national response capacity, and therefore lead to a need for international assistance".

INFORM's methodology is designed to answer several questions.

- Which countries are at risk of crisis that will require humanitarian assistance in response to disasters?
- What are the underlying factors that could lead to crisis?
- How does the risk change with time?

The objective of INFORM is to answer those question with a relatively simple framework for quantifying humanitarian crisis risk, which is based on risk concepts published in scientific literature.

2.2. Risk concept

In scientific literature there are many different views how to systematically address disaster risk reflected in various analytical concepts and models of diverse complexity [1]. Those, the most relevant to INFORM methodology, were presented already in [6]. They range from the basic conceptual framework of disaster risk community to identify risk as the interaction of hazard, exposure, vulnerability and capacity measures, [2], [4], to a complex framework for studying the interface and reciprocal interactions that link human to nature known as coupled human-environment system [24]. Among those the features of the pressure and release model (PAR model) [36] and Cardona's holistic perspective of vulnerability and risk [3] had the strongest influence on development of INFORM model. PAR model understands the disaster as the interaction between socio-economic pressures as the underlying factors of vulnerability and physical exposure to the hazardous event. While Cardona's understanding of vulnerability takes into account three aspects, that of physical exposure and physical vulnerability, the fragility of the socio-economic system (prevalent aspects of individual self-protection) and lack of resilience to cope and recover (aspect of collective self-protection). Such perception of the vulnerability has been adopted also in the 2009 UNISDR terminology [30].

Essentially, INFORM risk concept envisages three dimensions of risk:

- Hazards & Exposure (events that could occur and exposure to them)
- Vulnerability (the susceptibility of communities to those hazards)
- Lack of Coping Capacity (lack of resources available that can alleviate the impact)

They are conceptualized in a counterbalancing relationship: the risk of what (natural and human hazard), and the risk to what (population).

The INFORM model balances two major forces (Figure 1) as identified in PAR model: the hazard & exposure dimension on one side, and the vulnerability and the lack of coping capacity dimensions on the other side. Hazard dependent factors are treated in the hazard & exposure dimension, while hazard independent factors are divided among two dimensions: the vulnerability dimension that considers the strength of the individuals and households relative to a crisis situation, and the lack of coping capacity dimension that considers factors of institutional strength.

The INFORM risk concept considers all three aspects of Cardona's vulnerability. The aspects of physical exposure and physical vulnerability are integrated in the hazard & exposure dimension, the aspect of fragility of the socio-economic system becomes INFORM's vulnerability dimension while lack of resilience to cope and recover is treated under the lack of coping capacity dimension. The split of vulnerability in three components is particularly useful for tracking the results of disaster reduction strategies over time. Disaster risk reduction activities are often localized and address particular community-level vulnerabilities and institutional capacities.

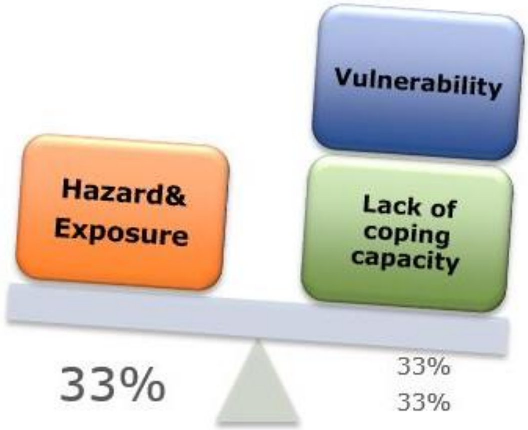


Figure 1: The risk concept of the INFORM

The INFORM score is calculated with a multiplicative equation where each of the dimensions is treated equally:

$$Risk = Hazard\&Exposure^{\frac{1}{3}} \times Vulnerability^{\frac{1}{3}} \times Lack of coping\ capacity^{\frac{1}{3}} \qquad \textbf{Equation 1}$$

In this form the INFORM's score is more susceptible to the Vulnerability and the Lack of Coping Capacity, the internal forces of risk that can be most influenced by the DRR activities.

Equation 1 resembles the risk equation, where all the factors come with the probabilistic notion. While composite indicator methodology can afford to use proxies whenever the probabilistic presentation of the concept's dimension is not available.

For the sake of more straightforward communication higher values in INFORM refer to worse conditions. High values in Vulnerability and Lack of coping capacity lead to worse outcomes in the presence of high values of the Hazard & Exposure. The risk equals zero if one of the three dimensions is zero. Theoretically, in case of tropical cyclones there is no risk if there is no likelihood of a tropical cyclone to occur or/and the hazard zone is not populated or/and if the population is not vulnerable (e.g., all people have high level of education and live in high level of health and livelihood condition as well as they can afford houses built to a high level of wind security) or/and if the resilience of the country to cope and recover is ideal. In practice, only some indicators in the Hazard & Exposure can be zero, when the hazard is truly zero

2.3. INFORM model

INFORM model is a multilayer structure (Table 1) that builds up a score of risk by bringing together 53 different indicators. They measure three **dimensions** of INFORM risk concept.

Each dimension is made up from a two risk **categories**. Categories cannot be fully captured by an individual indicator. They have been chosen to reflect the interest of users of INFORM. For example, UNISDR may follow the institutional category index in the coping capacity dimension while UNICEF and WFP may be more interested in the category of vulnerable groups in the vulnerability dimension. Underlying factors that contribute to the ranking results can be sought down through the levels depending on how narrowly the users intend to target their interventions.

Table 1: INFORM model

Risk	INFORM																
Dimensions	Hazard & Exposure							Vulnerability					Lack of Coping Capacity				
Categories	Natural					Human		Socio-Economic			Vulnerable Groups		Institutional			Infrastructure	
Components	Earthquake	Tsunami	Flood	Tropical cyclone	Drought	Current Conflict Intensity	Projected Conflict Intensity	Development & Deprivation (50%)	Inequality (25%)	Aid Dependency (25%)	Uprooted People	Other Vulnerable Groups	DRR	Governance	Communication	Physical Infrastructure	Access to Health System

Categories comprise a number of **components**. Components are carefully chosen sets of indicators that capture a specific topic of the component, for example earthquake, inequality, or governance. The components of INFORM have been chosen to fulfil the '3 Rs' criteria: relevant, representative, and robust.

Indicators are the individual datasets that make up INFORM, for example the number of people exposed to earthquake of a certain magnitude, the Gender Inequality Index or the Government effectiveness. Indicators may be composite indices themselves. The **source data** of indicator is pre-processed (Chapter 6) before it is used in INFORM. Indicators have been chosen if they are open source and continuous, provide consistent global coverage and are potentially scalable from national to local level, from yearly to seasonal (monthly) scale.

The data used in INFORM comes from international organizations and academic institutes and is considered to be the most reliable available. INFORM works directly with source organizations to ensure quality and appropriate use of the source data in INFORM.

All levels of the INFORM model (from dimensions to indicators) are made available. Therefore users can explore risk at different levels of detail and according to their specific needs and interest. The source data that makes up INFORM is also made available.

3. CHANGES IN INFORM 2016

3.1. Overview

The main changes in INFORM 2016 come from the changes in the underlying data and their pre-processing. Many of them are subjected to ongoing development process of considering new modelling techniques. The latest result will therefore be better in quality and allow to implement better metrics for the underlying factors of humanitarian risk.

Table 2: Changes in INFORM 2016

Position in the INFORM model	INFORM 2015	INFORM 2016	Rationale
Hazard&Exposure Natural Tsunami - **Physical exposure to tsunamis (absolute)** - **Physical exposure to tsunamis (relative)**	Map of annual physical exposure to tsunami based on historical events for the period 1970 - 2011 (GAR 2011)	Tsunami Hazard (Run up) RP 500 years (GAR 2015)	Adopting probabilistic hazard maps to improve the risk metrics to better capture high impact low likelihood events
Hazard&Exposure Natural Flood - **Physical exposure to flood (absolute)** - **Physical exposure to flood (relative)**	Map of annual physical exposure to floods based on historical events for the period 1999 - 2007 (GAR 2009)	Flood hazard map 25, 50, 100, 500, 1000 years RP (GAR 2015)	
Hazard&Exposure Natural Tropical Cyclone Cyclone wind	Map of annual physical exposure to cyclone wind based on historical events for the period 1969 - 2009 (GAR 2011)	Cyclone wind hazard map 50, 100, 250, 500, 1000 years RP (GAR 2015)	

Position in the INFORM model	INFORM 2015	INFORM 2016	Rationale
- **Physical exposure to tropical cyclone of SS1 (absolute) and** - **Physical exposure to tropical cyclone of SS1 (relative)** - **Physical exposure to tropical cyclone of SS3 (absolute) and** - **Physical exposure to tropical cyclone of SS3 (relative)**			
Hazard&Exposure Natural Tropical Cyclone Storm surge - **Physical exposure to surge from tropical cyclone (absolute)** - **Physical exposure to surge from tropical cyclone (relative)**	Map of annual physical exposure surge from tropical cyclone based on historical events for the period 1975-2007 (GAR 2009)	Storm Surge hazard map 10, 25, 50, 100, 250 years RP (GAR 2015)	
Hazard&Exposure Human Projected Conflict Intensity - **GCRI Violent Internal Conflict probability** - **GCRI High Violent Internal Conflict probability**	Global Conflict Risk Index (GCRI)	Updated Global Conflict Risk Index (GCRI)	INFORM employs the latest results of the GRCI working group (GRCI is still in development phase)
Lack of coping capacity Infrastructure Physical Connectivity **Road density**	Road density (km of road per 100 sq. km of land area), World Bank	Road density (km of road per 100 sq. km of land area), Open Street Map	Change of the provider due to private licence issues of Road density indicator from World Bank.

3.2. Probabilistic hazard maps

For the INFORM 2016 it is foreseen:

- to pass from GAR 2009 and GAR 2011 hazard maps based on a deterministic approach to GAR 2015 hazard maps based on probabilistic models.
- the transition from the exposed population [6] used in previous releases to a new metric called annual average exposed population [34] which was enabled with GAR 2015 probabilistic hazard maps for different return periods.

This change affects the score of tsunami, tropical cyclone (cyclone wind and storm surge) and flood components within the natural hazard category. For most hazard types the introduction of new probabilistic hazard maps and new metrics to calculate the score yielded very promising results in terms of ranking and the new approach was endorsed by the INFORM partners.

This was not the case for earthquakes. The new GAR 2015 earthquake hazard maps for 250, 475, 975, 1500 and 2475-year RP provided orders of magnitude of the seismic intensities at global level. They use the approximate seismicity and geometrical models to be used in a probabilistic seismic hazard assessment. However, their coarse-grain assessment is not intended to guide decisions at the national level. With this release thus the earthquake component has not been changed even though GHSAP[4] probabilistic hazard map used so far exists only for the 475-year RP. Momentarily it is possible to calculate the exposed population only for that particular RP which is eventually used as a risk metric for the earthquake component.

In INFORM there is a preference to keep with GAR hazard map as being:

- developed on the basis of a large body of original research contributed to UNISDR by a wide range of independent scientific institutions, think tanks, UN agencies, governments, non-governmental organisations and businesses[5],
- available online including original data, case studies, analysis and survey results,
- supervised by UNISDR as one of the INFORM partners,
- a process that is opening up to the wider scientific community to incorporate the best modelling available.

Hazard maps of GAR 2009 [25] and GAR 2011 [26] were based on a dataset of historical events and their consequences, with the time span up to 40 years depending on the hazard. This time window is too short to include infrequent but severe hazards events that have occurred before or will happen in the future. For these reasons, a probabilistic risk assessment has been under development since late 2011, some results were already published for GAR 2013 [27] and completed for release of GAR 2015 [28]. Probabilistic risk assessment approach followed in GAR 2015 [20] is built on these past events and takes into account as well the events that can physically occur (e.g., vicinity, dynamic and length of the faults) but are not included in the catalogue. For each hazard type, hazard maps for different return periods are available (except for the tsunami).

[4] http://www.seismo.ethz.ch/static/GSHAP/
[5] http://www.preventionweb.net/english/hyogo/gar/2015/en/home/index.html

Therefore new maps of the GAR 2015 provide not only better coverage of the possible events but also improved estimation of the probability of occurrence of each event[6].

Box 1: Quick guide to probabilistic hazard risk methodology

In **probabilistic hazard risk methodology** [7] three sets of data, i.e., **hazard**, **exposure** and the **vulnerability** of the exposed assets at stake, should be available to provide the risk information and each of them presented as the random variable. For example, in the case of the hazardous event one must not only know the magnitude and related impact but also the frequency or probability of its occurrence for any certain time frame. The exposure model provides information on location and characteristics of the assets of interest. When no uncertainties are introduced in the exposure model (and this is usually the case), its data are considered as deterministic values. Vulnerability of the asset is often expressed as the probability that a certain damage level would be exceeded at a certain magnitude of the event. Vulnerability models describe the uncertainty how the exposed asset will react to different magnitudes of the hazardous event and this is strongly related to the hazard type and the characteristics of the concerned asset. So vulnerability models are developed and assigned to each type of the asset. With this setup, it is then possible to calculate the losses with their probability of occurrence related to each of the possible events. The combination of all input data with full probabilistic description is part of the **modelling** which produces also the probabilistic interpretation of the output. For example, the simulation of different events with different probability of occurrence can be run to cover the whole range of possible outcome. The output of probabilistic risk assessment is usually presented as a **loss exceedance curve** relating the certain level of losses with their probability of occurrence in certain time frame. If this time frame is set to one year the area under the loss exceedance curve is known as the **annual average loss** (AAL) describing expected average loss per year considering all the events of the same hazard type that could occur over a long time period. High damage from an extreme event would be multiplied by a very low probability, so that its average annual contribution would be small although the event loss would be very large.

Contrary to GAR and the private sector, INFORM does not look at economic assets but instead at the population at risk. The exposure asset that we look at in INFORM is thus population. The next step within the scope of the probabilistic hazard risk assessment would be to assign a vulnerability model to the population based on the hazard type, age group, gender, etc. Possible outcomes could be number of affected people or number of fatalities. Affected people or fatalities would be a subset of the exposed population. However one of the key concept of the INFORM is that the vulnerability of population is not hazard dependent in order to deal with it in more exhaustive way under the Vulnerability and Lack of Coping Capacity dimensions with the metrics more suitable for the composite indicator methodology.

The full probabilistic setup in INFORM is not yet feasible and for this reason it is out of the scope of the INFORM methodology. In INFORM the **metric for the natural hazard risk** stops at the level of the **physical exposure.** It is introduced in terms of the **Exposed Population (EP)** or **Average Annual Exposed Population (AAEP)** when hazard maps for different return periods are available.

[6] Probability of occurrence of the event for any certain time frame is the inverse of the frequency. Annual probability of occurrence of the event is the probability of occurrence of the event in one-year time frame and equals to inverse of return period.

Exposed population is defined as the expected number of people located within the hazard zone for each type of hazard for each return period per country.

The **hazard zones** are obtained from hazard maps for the specific hazard type and return period and encompass the areas prone to occurrence of an event of at least a minimum intensity level that can trigger significant damage causing a disaster. The choice of the minimum intensity is somewhat arbitrary but equivalent among different types of natural hazards in terms of damage level. In terms of vulnerability of exposed population equivalent damage levels should refer to the similar level of the number of people affected or number of fatalities. Bypassing the vulnerability model of the population such data are not available in the calculations. Instead we reference to the description of similar damage level within relevant intensity scales for different hazard types (Table 3).

Hazard zones are then overlaid with a model of a population distribution[7] in order to derive the total population living in the hazard zone. This is the exposed population of the specific hazard type and return period. Yet, exposed population also assumes the role of the proxy for the physical vulnerability.

New risk metric used within the INFORM methodology is **Annual Average Exposed Population (AAEP).** It goes along the line of the average annual loss (Box 1) for each hazard type, only the loss that is referred to, from now on, is exposed population. If AAL is calculated as the area under the loss exceedance curve also AAEP is calculated as the area under the exposed population exceedance curve. A loss exceedance curve for each hazard type links certain losses with their actual annual probability of occurrence and is the result of the probabilistic risk modelling. On the other side, an **exposed population exceedance curve** for each hazard type in INFORM is simply exposed population obtained from a different return period hazard zones versus inverse return period of the event. The fact is that exposed population is deterministic value. It is one value only per return period without any uncertainty involved and there is no probabilistic distribution of exposed population (i.e., loss) to deal with. In this case the probability of exposed population exceedance equals to the probability of the exceedance of the event causing the exposed population. Furthermore, annual exceedance probability of the event equals to inverse of the return period. For example, for the event of the 50-year of return period the annual probability of exceedance is 2%.

3.2.1. Changes in calculation of the population exposed

For all natural hazard components the population data have been reprocessed using the most recent population density. Furthermore, some improvement have been made also in the GIS processing in order to better assess the small islands states who were underestimated in the previous version of INFORM.

[7] LandScan™ Global developed by Oak Ridge National Laboratory

A more appropriated and detailed mask for selecting the countries has been used for the latest version (Figure 2). The main outcome is a more consistent estimation of small countries, which are represented by few number of pixels in the population density and the error was thus proportionally higher.

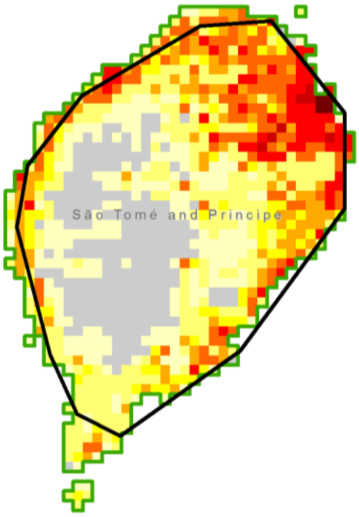


Figure 2: In black is the country mask used in INFORM 2015 and in green is the new one. The background is the population density. The black line doesn't perfectly fit with the data of population as it cuts out many pixels and thus underestimates the population exposed.

The Figure 3 shows the differences between the earthquake score in INFORM 2015 and 2016 (same data source, same methodology, different GIS processing).

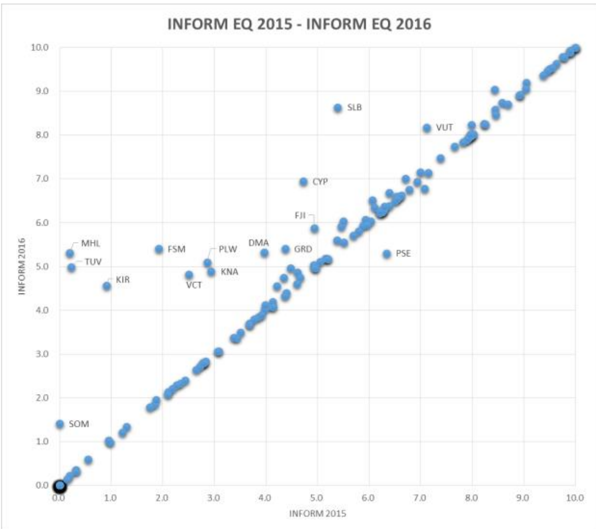


Figure 3: Differences in score between INFORM Earthquake Index in 2015 and 2016 due to improvemeny in GIS processing of the population density.

3.3. Global Conflict Risk Index

For the Human Hazard category, we profit from a more elaborated model of the Global Conflict Risk Index (GCRI) that offers the **Projected Risk of Conflict** for each individual country. The GCRI is a quantitative model developed by the JRC that uses structural indicators to determine the probability of conflict within the next years. Compared to earlier versions, the GCRI now includes 25 variables such as the country's conflict history, regime type, and ethnic compilation as well as other socio-economic, political, geographic, and security variables that attribute to the outbreak of civil war.[8] Conflict intensity levels as used in the GCRI are provided by the Heidelberg Institute for International Conflict Research (HIIK). As the GCRI as well as the HIIK are purely data-driven and composed of broadly accepted quantitative factors that add up to a comprehensive reflection of risk for and consequences of armed conflict, it allows us to complement our risk assessment with a man-made variable and contributes adequately to the overall predictive abilities of the model.

The two best-performing models for subnational conflict and those over national power were selected to determine the risk for each dimension of conflict as well as the intensity. For **national power** conflicts, we selected a model that includes a country set of all states with more than 500.000 inhabitants that makes use of an interaction between the regime type, the GDP/capita in the country, and the income inequality as determined by the SWIID dataset.[9] For **subnational conflicts**, we chose a model that interacts regime type, GDP/capita as well as income inequality and, in addition, takes into account if the country is an exporter of fuel, such as oil or gas. This model is run without EU Member States to even enhance its performance.

Both models give us predictions for the Projected Risk of Conflict for both violent and highly violent conflicts. Trained on conflicts in both dimensions since 1989 and applied to the most recent data available, the GCRI has a True Positive Rate of 79 percent for conflicts over national power and 74 percent for subnational conflict.

3.4. Road density

Road density (km of road per 100 sq. km of land area) indicator of the International Road Federation is under the private licence[10]. One of the core principles that have guided the INFORM development is to be open source. All data, results as well as underlying data used in INFORM index should be freely available. Therefore the provider of the Road Density indicator was changed to Open Street Map. It is open source and delivers better coverage (100% against the 94%).

[8] The complete methodology of the GCRI is available via http://conflictrisk.jrc.ec.europa.eu/. The GCRI has received further refinement and now includes, beside the SWIID mentioned below, the indicators Youth Bulge, Unemployment, and Corruption.

[9] The Standardized World Income Inequality Dataset uses a custom missing-data algorithm to standardize inequality data from sources such as the United Nations. It covers 174 countries for as many years as possible since the 1960s to the present along with estimates of uncertainty in these statistics. More information on the SWIID is provided in Solt, Frederick. 2009. "Standardizing the World Income Inequality Database." Social Science Quarterly 90(2):231-242.

[10] http://data.worldbank.org/restricted-data#irf-world-road-statistics

4. COMPONENT AND CORE INDICATOR SELECTION

4.1. Introduction

A composite indicator is typically a compromise between a data driven and a user driven model. There are always some components, which existing data cannot describe, especially, if the demands for quality of data are very high.

When selecting the indicators the possible scalability in geographical and temporal scale is always considered as an important property for the future development of the INFORM index.

The following chapters present the component selection for each dimension and explain the aggregation rules within different levels of the INFORM model.

4.2. Dimension: Hazard & Exposure

4.2.1. Overview

The Hazard & Exposure dimension reflects the probability of physical exposure associated with specific hazards. There is no risk if there is no physical exposure, no matter how severe the hazardous event is. Therefore, the hazard and exposure dimensions are merged into Hazard & Exposure dimension. As such it represents the load that the community has to deal with when exposed to a hazardous event.

Box 2: Variations in the subnational models: Hazard & Exposure

An INFORM Subnational model uses the same risk assessment methodology and development process, but is adapted to regional or national level.[11]

Regarding the Natural Hazards dimension, there was a large use of local hazard maps (Lebanon, Colombia, East Africa), a suggestion to include epidemics as natural hazard, in particularly Ebola outbreak (Sahel), an inclusion of land degradation, food security (Sahel), forest fire (Lebanon), landslides (Colombia) as natural hazards.

In the Human Hazards dimension, It should be noticed a large benefit of regional/local data (ACLED[12] in Africa, local sources in Lebanon and Colombia).

[11] INFORM Guidance Note 2016, http://www.inform-index.org/
[12] http://www.acleddata.com/

4.2.1.1. Hazard & Exposure: Categories

The dimension comprises two categories: Natural Hazards and Human Hazards, aggregated with the geometric mean, where both indexes carry equal weight within the dimension.

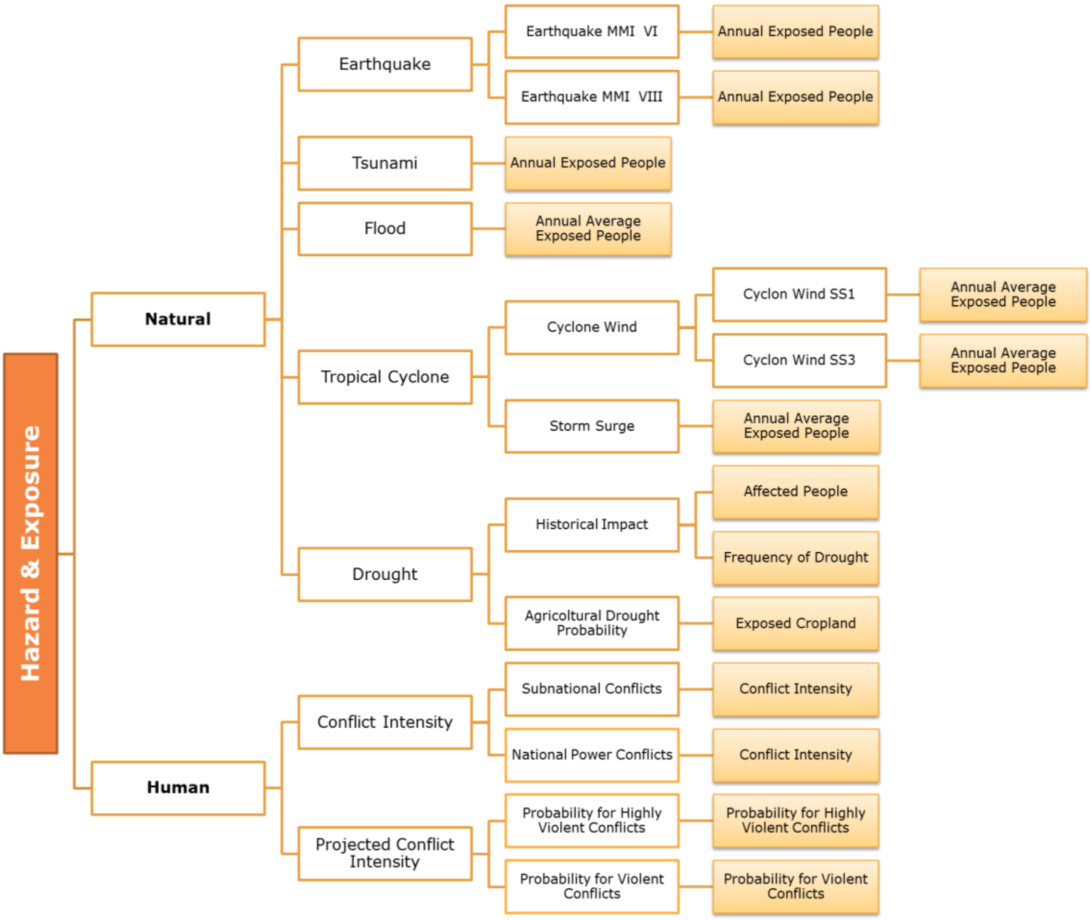


Figure 4: Graphical presentation of the Hazard & Exposure dimension

4.2.2. Category: Natural Hazard

4.2.2.1. Definition

According to the CRED EM-DAT database [36] the death toll of natural hazards during 1900-1999 is caused in the 86.9% cases due to famines, 12.9% due to floods, earthquakes and storms, and less than 0.2% due to volcanic eruptions, landslides and wildfires. On the other hand the rapid on-set hazards with a more limited geographic extent, sometimes labelled as extensive disasters, seldom exceed entry criteria[13] of the EM-DAT database. From that point of view their presence in

[13] Hazardous events have to fulfil at least one of the following criteria, in order to be included in the database (http://www.emdat.be/criteria-and-definition):

- 10 or more people reported killed
- 100 people reported affected

the database is incomplete and the cumulative death toll is higher, while a single event rarely causes a humanitarian crises.

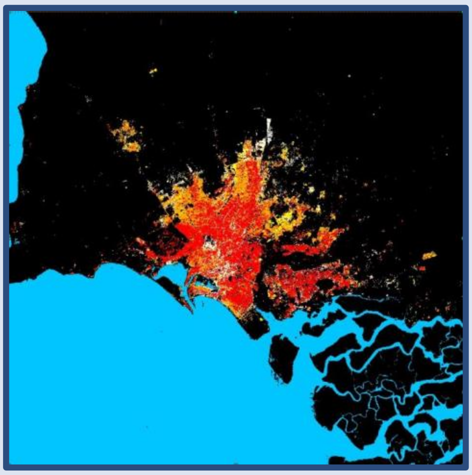
Rapid-onset hazards, i.e., earthquakes, tsunamis, tropical cyclones and floods, are dealt with differently than slow-onset hazard, i.e., droughts. Indicators for each component of rapid-onset hazards are based on the physical exposure to the hazard.

Box 3: A new technique to assess the exposed population

INFORM will consider a number of new data layers that are currently produced at the JRC . For example, the Global Human Settlement Layer (GHSL)[14] is a fine scale global map of the built environment. It includes all human settlement of all sizes and thus provides a snapshot of the current extent of villages, cities and megacities worldwide. The built up information are also use to disaggregate population information typically available in aggregated at the administrative unit level to the grid level. GHSL, both the physical and population layer, are used as proxy variable for exposure, both physical and human in global disaster risk models.

The Global Human Settlement Layer [9] is produced by processing the entire historical archive of Landsat imagery. Landsat is an open source datasets made available by the US government. It extends back in time to the mid 1970's and thus can be used to document the changes in the built environment over the last 40 years. GHSL is produced using a clear defined methodology that relies on information extraction algorithms and no human intervention. The GHSL information is thus reproducible, GHSL methodology generate information that are consistent in space and time. The GHSL processing methodology is suited to process past imagery and imagery that will be generated from future Earth observation mission.

Example of GHSL built up map over Karachi:



- Declaration of a state of emergency
- Call for international assistance

[14]http://ghslsys.jrc.ec.europa.eu/

The **metrics for the natural hazard risk** used in INFORM 2016 are in terms of the

- **Exposed Population (EP)** or
- **Average Annual Exposed Population (AAEP)** when hazard maps for different return periods are available.

They are defined in Chapter 3.2. They are closely related with the definition of the hazard zones (Chapter 3.2).

The hazard zone does not contain information on internal variability of intensity. The population is either in the hazard zone or outside, the people are either exposed or not, respectively. The exposure of the population is thus a binary value, rather than a degree of exposure.

Furthermore, in the case of earthquakes and cyclone winds, the available hazard maps provide information on different intensity level zones. The hazard zones where minimum intensity is set to low intensities inherit also the hazard zones with high intensities but their more detrimental impact is not visible with a simple overlay of the population map. It would be a high intensity events that would more likely cause humanitarian crises.

To overcome this shortcoming of the hazard zone definition the areas of high intensities within the hazard zone of low intensities were extracted. Their presence was introduced into the model as a parallel indicator at the sub-component level where AAEP was based on the hazard zone with the higher minimum intensity level. We took the advantage of the composite indicator methodology and considered the areas of high intensities as another type of event with the same probability of occurrence. Such indicator pushes up the countries exposed to extreme events as well as pull down those countries where high intensity events are not very likely to happen and/or are spatially very limited. The final hazard component indicator is a geometric average of the normalized AAEP gained from two hazard zone of two distinct levels of minimum intensity, i.e., low as well as extreme one. A high hazard component indicator is the result of high values in both levels of intensities. While low values of the indicator for high intensities will decrease high values of the indicator for low intensities and indirectly suggest that despite the high number of people exposed the share of affected people is expected to be comparatively smaller.

There are different intensity scales for different hazard types, e.g., Modified Mercalli Intensity (MMI) scale for earthquakes and Saffir-Simpson (SS) hurricane scale for cyclone wind. For each hazard type we chose intensity levels equivalent to two distinct damage levels:

- light/moderate potential damage for resistant/vulnerable buildings, respectively and
- moderate/heavy potential damage for resistant/vulnerable buildings, respectively

In the case of the earthquakes MMI VI and VIII, while in the case of the cyclone winds SS 1 an 3 fit the chosen damage levels description (Table 4).

Table 3: Minimum intensity/magnitude levels used for different type of hazards and data source [15]

Hazard type	Intensity levels	Source
Earthquake	Modified Mercalli Intensity scale VI and VIII	GSHAP Seismic hazard intensity map (475-return period, 10% probability of exceedance in 50-year of exposure)
Tsunami	Inundated area	Tsunami Hazard (Run up) RP 500 years (GAR 2015)
Flood	Inundated area	Flood hazard map 25, 50, 100, 500, 1000 years RP (GAR 2015)
Cyclone wind	Saffir-Simpson category 1 and 3	Cyclone wind hazard map 50, 100, 250, 500, 1000 years RP (GAR 2015)
Storm surge	Inundated area	Storm Surge hazard map 10, 25, 50, 100, 250 years RP (GAR 2015)
Drought	Impact (affected people) and frequency of drought disasters	EM-DAT database for the period 1990 - now
	Agricultural drought: 30% of cropland in stress for more than 10 days	Map of annual agricultural drought based on remote sensing (ASI, FAO 2014)

Table 4: Intensity scale levels vs. damage level

Hazard type	Intensity levels	Damage level	Reference
Earthquake	Modified Mercalli scale VI	Perceived shaking: **strong** Resistant structures: **light damage** Vulnerable structures: **moderate damage**	USGS(PAGER)[16]
	Modified Mercalli scale VIII	Perceived shaking: **severe** Resistant structures: **moderate/heavy damage** Vulnerable structures: **heavy damage**	USGS(PAGER)
Cyclone Wind	Saffir-Simpson category 1	Wind speed: 119-153 km/h **Very dangerous winds will produce some damage**: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.	NOAA[17]
	Saffir-Simpson category 3	Wind speed: 178-208 km/h **Devastating damage will occur**: Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes	NOAA

[15] http://preview.grid.unep.ch/index.php?preview=data&lang=eng
[16] http://pubs.usgs.gov/fs/2010/3036/pdf/FS10-3036.pdf
[17] http://www.nhc.noaa.gov/aboutsshws.php

Box 4: Absolute vs. relative physical exposure - correction in favour of small countries

There are two ways to consider population exposed to natural hazards. The absolute value of people exposed will favour more populated countries while the value of population exposed relative to the total population will reverse the problem and favour less populated hazard-prone countries, especially small islands where the entire population may be affected by a single cyclone. To enable a proper comparison between countries, in INFORM the subcomponent indicator is calculated both ways and then aggregated using an arithmetic average.

At the level of core indicators (Table 6) the datasets are rescaled into a range of 0 to 10 in combination with a min-max normalization. Since distribution of the absolute value of exposed people is extremely skewed, the log transformation is applied (Chapter 6).

4.2.2.2. Natural Hazards: components

The Natural Hazard category includes five components aggregated with a geometric average (Table 6):

- Earthquake,
- Tsunami,
- Flood,
- Tropical cyclone (Cyclone wind & Storm surge),
- Drought (Historical Impact & Agricultural Drought Probability).

Table 5: Indicators of the Natural Hazard category

Component	Indicator	Source	MIN - MAX	No. of Missing Values
Earthquake	Physical exposure to MMI VI earthquake (absolute)	GSHAP	Log(10) - Log(10E5)	-
	Physical exposure to MMI VI earthquake (relative)	GSHAP; LandScan	0% - 0.2%	-
	Physical exposure to MMI VIII earthquake (absolute)	GSHAP	Log(10) - Log(10E4)	-
	Physical exposure to MMI VIII earthquake (relative)	GSHAP; LandScan	0% - 0.1%	-
Tsunami	Physical exposure to tsunamis (absolute)	UNISDR GAR 2015	Log(10E-2) - Log(10E3)	-
	Physical exposure to tsunamis (relative)	UNISDR GAR 2015; LandScan	Log(10E-9) - Log(10E-4.5)	-
Flood	Physical exposure to flood (absolute)	UNISDR GAR 2015	Log(100) - Log(10E6)	32/191
	Physical exposure to flood (relative)	UNISDR GAR 2015; LandScan	0% - 1%	32/191

Component	Indicator	Source	MIN - MAX	No. of Missing Values
Tropical Cyclone	Physical exposure to SS-1 tropical cyclone (absolute)	UNISDR GAR 2015	Log(100) - Log(10E6)	-
	Physical exposure to SS-1 tropical cyclone (relative)	UNISDR GAR 2015; LandScan	0% - 2%	-
	Physical exposure to SS-3 tropical cyclone (absolute)	UNISDR GAR 2015	Log(1) - Log(10E6)	-
	Physical exposure to SS-3 tropical cyclone (relative)	UNISDR GAR 2015; LandScan	0% - 0.5%	-
	Physical exposure to Storm Surges (absolute)	UNISDR GAR 2015	Log(10E-2) - Log(10E3)	-
	Physical exposure to Storm Surge (relative)	UNISDR GAR 2015: LandScan	Log(10E-9) - Log(10E-4)	-
Drought	Agriculture drought probability	FAO	0 - 0.3	21/191
	People affected by droughts (absolute)	EM-DAT, CRED	Log(10) - Log(10,000)	-
	People affected by droughts (relative)	EM-DAT, CRED	0% - 0.3%	-
	Frequency of droughts events	EM-DAT, CRED	0 - 0.3	-

Table 6: Aggregation of the Natural Hazards category

Category	Natural Hazard																	
Component	GEOMETRIC AVERAGE																	
	Earthquake				Tsunami		Flood		Tropical Cyclone						Drought			
Aggregation	GEOMETRIC AVERAGE				GEOMETRIC AVERAGE		GEOMETRIC AVERAGE		GEOMETRIC AVERAGE						ARITHMETIC AVERAGE			
	EQ Abs		EQ Rel						Cyclone Abs			Cyclone Rel			Drought impact			
									GEOMETRIC AVERAGE			GEOMETRIC AVERAGE			ARITHMETIC AVERAGE			
									CW Abs			CW Rel			Historical Impact			
	GEOMETRIC AVERAGE		GEOMETRIC AVERAGE						GEOMETRIC AVERAGE			GEOMETRIC AVERAGE			ARITH.AVG			
Core indicator	EQ MMI VI Log(abs)	EQ MMI VIII Log(abs)	EQ MMI VI Relative	EQ MMI VIII Relative	Log(absolute)	Log(relative)	Log(absolute)	Relative	CW SS1 Log(abs)	CW SS3 Log(abs)	CS Log(abs)	CW SS1 Relative	CW SS3 Relative	CS Log(relative)	Log(abs)	Relative	Frequency	Probability of agricultural drought

absolute - absolute value of physical exposure (AAEP)

relative - relative value of physical exposure (AAEP per capita). AAEP is normalized with the country's population.

Scalability: Approach used enables geographical and temporal scalability of physical exposure. Hazard zones and population distribution maps allow extraction of subnational indicators as well as adaptation to mid-term and long-term variability when applying El-Niño scenarios or observed trends in climate changes, and incorporating seasonality of weather related hazard events.

4.2.2.3. Component: Earthquake

Earthquakes can be one of the most destructive natural hazard. The unpredictability of the seismic event can cause several fatalities in areas with high physical vulnerability of the buildings (2010 Haiti, 2015 Nepal).

Data source: As described in the chapter 3.2, in INFORM 2016 GSHAP probabilistic hazard map was used. It is available only for 475-year return period, which only enables to derive the exposed population for that particular return period.

Technical explanation to derive hazard zone: GSHAP seismic hazard map shows different intensity levels of earthquake presented in terms of PGA. In INFORM was used a derived product based on GSHAP dataset, converted to Modified Mercalli Intensity (MMI) using the methodology developed by Wald et al. [33]. This product was compiled by CIESIN (Columbia University) for the Global Assessment Report on Risk Reduction (GAR 2009-2011)[18].

Two hazard zones for each country were extracted using two different minimum intensity levels, i.e., MMI VI and MMI VIII (Table 4). The choice of the minimum intensities is simply based on two distinct damage levels. This is a way to overcome the hazard zone definition that ignores the internal variability of the hazard intensity and it takes the advantage of the composite indicator methodology. We consider a hazard zone with a higher minimum intensity as another event and aggregate the metric derived with the geometric average into earthquake component (Table 6).

4.2.2.4. Component: Tsunami

As earthquakes, the **tsunamis** can be very destructive. Even if the frequency of the events is very low, the humanitarian impact of the most intensive tsunamis is huge (2004 Indian Ocean, 2011 Japan).

Data source: GAR 2015 provides tsunami hazard map for only one return period, i.e. 500-year RP. The score of the Tsunami component is based on the exposed population for 500-year RP only.

Technical explanation to derive hazard zone: The GAR Tsunami hazard map displays binary information on the probable inundated areas. Those areas represent the hazard zones.

4.2.2.5. Component: Flood

Floods are often predictable natural hazards, which can encompass incredible large areas, causing very large impact on population (2010 Pakistan).

Data source: Several sources for global probabilistic flood hazard maps available:

[18] http://preview.grid.unep.ch/index.php?preview=data&events=earthquakes&evcat=5&lang=eng

- GloFAS-JRC global flood hazard maps, developed by Joint Research Centre of European Commission [8]. The maps are based on long term hydrological simulations of the Global Flood Awareness System (GloFAS), coupled with hydrodynamic modelling at 1km resolution.
- The Aqueduct Global Flood Maps[19] are based on GLOFRIS[20] model recently developed by research institute Deltares [35]. It uses hydrological data from 1960 through 1999 for generating flood inundations for 9 return periods, from 2-year flood to 1000-year flood. They are publicly available.
- GAR 2015 flood hazard maps for 25, 50, 100, 200, 500, and 1000-year RP. The hazard maps are developed at 1kmx1km resolution. GAR 2015 flood maps do not take into account flood defences. They are publicly available.

They produce different results and consequently different implications for risk. There is on-going study on comparison of different flood models at the University of Bristol, which will provide more Information on benefits and drawbacks of each. At the moment, the GAR 2015 flood hazard maps are used in INFORM 2016. The score of the Flood component is based on the AAEP risk metrics.

Technical explanation to derive hazard zone: The GAR 2015 flood hazard map displays probable inundated areas related to a specific return period. Inundated areas are not broken down into different water height levels, so only binary information is provided for each point, which is positive if the location is inundated and negative if not. The hazard zones are derived from all inundated areas for each return period.

4.2.2.6. Component: Tropical cyclone

Tropical cyclones (including hurricanes and typhoons) are some of the most damaging events. They occur in yearly cycles and affect coastal population through high **wind speeds** (destroying dwellings and infrastructure), **storm surge** and associated floods (destroying crops) and heavy rainfall sometimes causing riverine floods and landslides. The tropical cyclone component is an aggregation with arithmetic average of the physical exposure for cyclone wind and cyclone surge.

Data source: GAR 2015 provides cyclone wind intensity maps for 50, 100, 250, 500, 1000 years RP. The score of the Cyclone Wind component is based on AAEP risk metrics.

Technical explanation to derive hazard zone: GAR 2015 cyclone wind hazard maps display different intensity levels of cyclone wind presented in terms of Saffir-Simpson Hurricane Scale (Category 1-5). Therefore two hazard zones for each country were extracted for the same return period using two different minimum intensity levels, i.e., SS1 and SS3 (Table 4).

Data source: GAR 2015 provides Storm Surge hazard maps for 10, 25, 50, 100, 250 years RP. The score of the Storm Surge component is based on AAEP risk metrics.

Technical explanation to derive hazard zone: GAR 2015 Storm Surge hazard maps are expressed in points along the coast representing the expected storm surge level. In order to derive the hazard

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[19] http://www.wri.org/resources/data-sets/aqueduct-global-flood-risk-maps
[20] Global Flood Risk with IMAGE Scenarios

zone, first the point layer was converted in a raster. Then for each pixel the information of surge level was compared with the terrain elevation[21]. The pixels where the expected surge level is higher or equal than the DEM, define the hazard zone.

4.2.2.7. Component: Drought

Drought is a complex process to model because of the inherent spatial and temporal uncertainty. In general terms, a drought can be understood as a deficiency in precipitation that severely affects a certain region, environment, industry, or people. According to the FAO, droughts are 'the world's most destructive natural hazard' with 'devastating impacts on food security and food production'. The frequency as well as intensity of droughts has increased in the past 20 years due to climate change and it is expected that this trend will intensify in the future.

In INFORM, the impact of drought is measured by a combination of two factors: (1) the risk for drought, calculated as the probability for an agricultural drought (which may or may not result in a drought disaster through reduced food production) and (2) the population affected by droughts in recent years (materialized risk).

For the first factor, we define an agricultural drought as a dry period in a certain region, in which at least 30% of the crop area was in stress for more than 10 days. This is measured using the Agriculture Stress Index (ASI)[22], which is an index based on the integration of the Vegetation Health Index (VHI) in two dimensions that are critical in the assessment of a drought event in agriculture: temporal and spatial [19]. The first step of the ASI calculation is a temporal averaging of the VHI, assessing the intensity and duration of dry periods occurring during the crop cycle at pixel level. The second step determines the spatial extent of drought events by calculating the percentage of pixels in arable areas with a VHI value below 35%.

We consider a country in drought in a particular year if the ASI index indicates drought in one or more crop seasons. While the drought probability is based on the country's frequency of droughts within the last 30 years.

The second factor, historical drought impact, considers the number of affected people per year (both absolute and relative to the country's population size) based on historical events in EM-DAT database for the last 25 years, which is the period when reporting is assumed to be consistent. To emphasize drought-prone countries with frequent and extensive drought (as well as to compensate for uncertainty associated with unique, intensive drought events), we combine the average annual drought affected people with the frequency of drought events in an arithmetic average.

The calculation of drought risk has several limitations, which have to be taken into account. First of all, the ASI model does not consider the impact of drought on pastoralism. Second, due to the coarse resolution of ASI, countries smaller than 1,000 km^2 are not considered. Lastly, the

[21] SRTM digital elevation model.

[22] It is developed by FAO's Global Information and Early Warning System (GIEWS) and the Climate, Energy and Tenure Division.

applicability of historical impact data is limited, as people “affected” by drought are not consistently defined over events (in EM-DAT).

Note that Food Security is a component under the Vulnerable Group category in Vulnerability dimension (Chapter 4.3.4). Food insecurity increases the population’s vulnerability to new shocks.

Scalability: A useful feature of the ASI index is the geographical and temporal scalability, i.e., calculation of subnational indexes with seasonal component based on the historical archive of remote sensing data.

4.2.3. Category: Human Hazard

4.2.3.1. Definition

Human made hazards are either technological (e.g., industrial accidents with environmental impact) or sociological in nature. The latter encompass such divergent phenomena as civil wars, high-intensity crime, civil unrest as well as terrorism. Especially armed internal conflict yields catastrophic results for populations and economies and is almost always accompanied by humanitarian risk on a larger scale, caused by the breakdown of supply lines, absent harvests, refugee flows as well as an overall deterioration of health services.

4.2.3.2. Human Hazard: Components

INFORM includes two quantitative variables on man-made disaster that complement the Hazard & Exposure section with the dimension of violent conflict and the consequences generated by it, such as large refugee flows and overall destruction of infrastructure.

Table 7: Indicators of the Human Hazard category

Component	Indicator	Source	MIN - MAX	No. of Missing values
Conflict Intensity	National Power Conflicts	Conflict Barometer, HIIK	4 – 5	-
	Subnational Power Conflicts	Conflict Barometer, HIIK	4 – 5	-
Projected risk of conflict	Probability for Violent Conflict	Global Conflict Risk Index, JRC	0 – 0.95	-
	Probability for Highly Violent Conflict	Global Conflict Risk Index, JRC	Log(0.01) – Log(0.95)	-

Scalability: Subnational and monthly updates could be supported by the Conflict Barometer but they are not yet available. Data exist, at the moment, only for scientific purposes. The GCRI is planned to be updated in semi-annual intervals.

Table 5: Aggregation of Human Hazard category

Category	Human Hazard			
	MAXIMUM			
Component	Current Conflict Intensity		Projected Conflict Intensity	
Aggregation	MAXIMUM		GEOMETRIC AVERAGE	
Core indicator	Conflict Barometer (Subnational)	Conflict Barometer (National Power)	Global Conflict Risk Index (Probability for Highly Violent Conflict, log)	Global Conflict Risk Index (Probability for Violent Conflict)

4.2.3.3. Component: Conflict intensity

INFORM takes into account the current intensity of conflict in a country or – in case that there is currently no conflict – an estimate of future conflict probability. To determine the **Current Intensity** of a conflict, we use data by the annual *Conflict Barometer* [10] of the Heidelberg Institute for International Conflict Research (HIIK).[23]

Table 8: Adaption of conflict intensity

Type of conflict	HIIK intensity	INFORM conflict intensity
Non-violent conflict	1 (dispute) 2 (non-violent crisis)	0-5
Violent conflict	3 (violent crisis)	5-8
Highly violent conflict	4 (limited war) 5 (war)	9/10

[23] The HIIK approach distinguishes a total of five intensity levels, subdivided in non-violent conflicts (*Disputes* and *Non-violent Crises*) and violent conflicts (*Violent Crises*, *Limited Wars*, and *Wars*). The overall intensity is determined by the number of casualties and refugees caused by conflict, as well as by the number of personnel involved, the weapons that were used, and the destruction that was caused. The basic data is provided by the HIIK's annual Conflict Barometer which includes information about more than 400 political conflicts in the world (see http://hiik.de/en/konfliktbarometer/index.html).

The HIIK defines conflict as a dynamic process made up of a sequence of interlocking conflict episodes. The conflict intensity is determined by two criteria: Instruments on the use of force (use of weapons and use of personnel) and the consequences of the use of force (casualties, refugees, and demolition). Its values (Table 8) range from 1 (dispute) to 5 (war).

For our purpose, we cluster the conflicts observed by the HIIK into three different groups:

- conflicts over national power in a country (National Power),
- over intrastate items apart from national power such as secession (Subnational),
- and interstate conflicts.[24]

We clearly distinguish conflicts over national power from those over subnational items, as they have different causes and drivers that attributes to onset, duration, and escalation of violence.

Table 9: Conflict items, groups, and intensity

HIIK Conflict Item	INFORM conflict groups	HIIK intensity level	INFORM conflict intensity
National power	National Power	5 (war)	10
		4 (limited war)	8
Secession Autonomy Subnational Predominance	Subnational	5 (war)	9
		4 (limited war)	7
Any	Violent conflict with lower intensity	3 (violent crisis)	Not considered
International Power Territory	Interstate	-	Not considered

In INFORM we consider conflicts over National Power to have a graver impact on population, supplies, and long-term development than those over subnational items. First of all, they constrain the overall national production and supply lines and are mostly fought with heavier weapons and more personnel and turns more people into refugees than conflicts over e.g. secession. Second, wars over government usually affect large parts of national territory and oftentimes have the tendency of involving foreign powers. Subnational conflicts are mostly restricted to certain regions of a country and only affect regional production and security. We therefore transfer the HIIK data on conflict intensity into a modified intensity scale: Conflicts with HIIK intensity 5 receive an INFORM intensity of 10 if the object is National Power, and 9 if the object is Subnational. Analogous, conflicts with HIIK intensity 4 (limited wars) are attributed values of 8 (National Power) and 7 (Subnational).

[24] In our model, we only take into consideration the two intrastate dimensions of conflict. This has several reasons: First of all, scientific evidence shows that interstate conflict has become a rather rare phenomenon since the end of the Cold War. Besides, if military confrontations between states occur, they are mostly restricted to remote border regions and tend not to last longer than several weeks or even days, whereby they do not affect the civilian population as much as intrastate conflicts.

4.2.3.4. Component: Projected risk of conflict

If a country does not experience highly violent conflict in the year of observation, INFORM estimates instead the **Projected Risk of Conflict** using the Global Conflict Risk Index (GCRI). The GCRI [5] is a quantitative model developed by the JRC that uses structural indicators to determine a given country's risk for conflict. It uses 26 quantitative variables including, among others, a country's regime type, its conflict history as well as other socio-economic, political, geographic and security variables that attribute to the outbreak of civil war.[25] Intensity levels as used in the GCRI are thereby also provided by the HIIK. INFORM uses the GCRI assessment of the risk for violent conflict within the next four years. The risk for either Violent Conflict (VC) or Highly Violent Conflict (HVC) is calculated using the geometric average of the probability for either type of conflict, with a log transformation of the HVC. A probability of 95% is thereby equivalent to a risk level of 7.

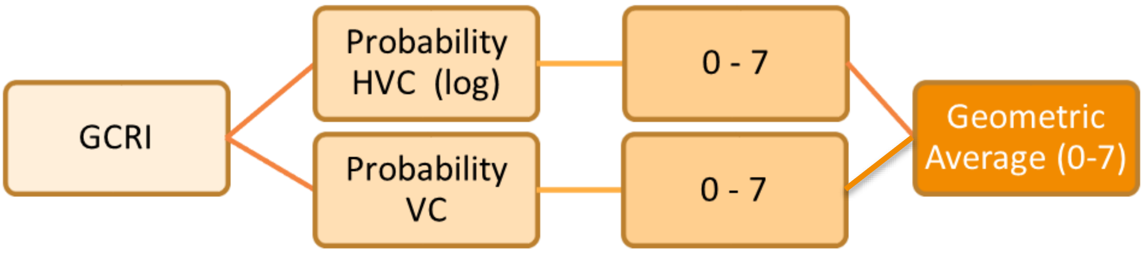

Figure 5: Transformation of GCRI Probability of conflicts to INFORM score

The total risk score for the Human Hazard category is then calculated by using the maximum score of either the actual conflict intensity or the projected intensity. As the GCRI as well as the HIIK are purely data-driven and composed of broadly accepted quantitative factors that add up to a comprehensive reflection of risk for and consequences of armed conflict, it allows us to complement our risk assessment with a man-made variable and contributes adequately to the overall predictive abilities of the model.

4.3. Dimension: Vulnerability

4.3.1. Overview

The main focus of humanitarian organizations is people, which is the element at risk contemplated in the INFORM composite index. The impact of disasters on people in terms of number of people killed, injured, and made homeless is predominantly felt in developing countries while the economic costs of disasters are concentrated in the industrialized world. The Vulnerability dimension addresses the intrinsic predispositions of an exposed population to be affected, or to

[25] The complete methodology of the GCRI is available via http://conflictrisk.gdacs.org/

be susceptible to the damaging effects of a hazard, even though the assessment is made through hazard independent indicators. So, the Vulnerability dimension represents economic, political and social characteristics of the community that can be destabilized in case of a hazardous event. Physical vulnerability, which is a hazard dependent characteristic, is dealt with separately in the Hazard & Exposure dimension.

Box 5: Variations in the subnational models: Vulnerability

An INFORM Subnational model uses the same risk assessment methodology and development process, but is adapted to regional or national level.[26]

Relevant additions were the inclusion of remittances (Sahel), food security (Cadre Harmonisé in Sahel), and malnutrition (Sahel).

4.3.2. Vulnerability: Categories

There are two categories aggregated through the geometric average: Socio-Economic Vulnerability and Vulnerable Groups. The indicators used in each category are different in time variability and the social groups considered in each category are the target of different humanitarian organizations. If the Socio-Economic Vulnerability category refers more to the demography of a country in general, the Vulnerable Group category captures social groups with limited access to social and health care systems.

[26] INFORM Guidance Note 2016, http://www.inform-index.org/

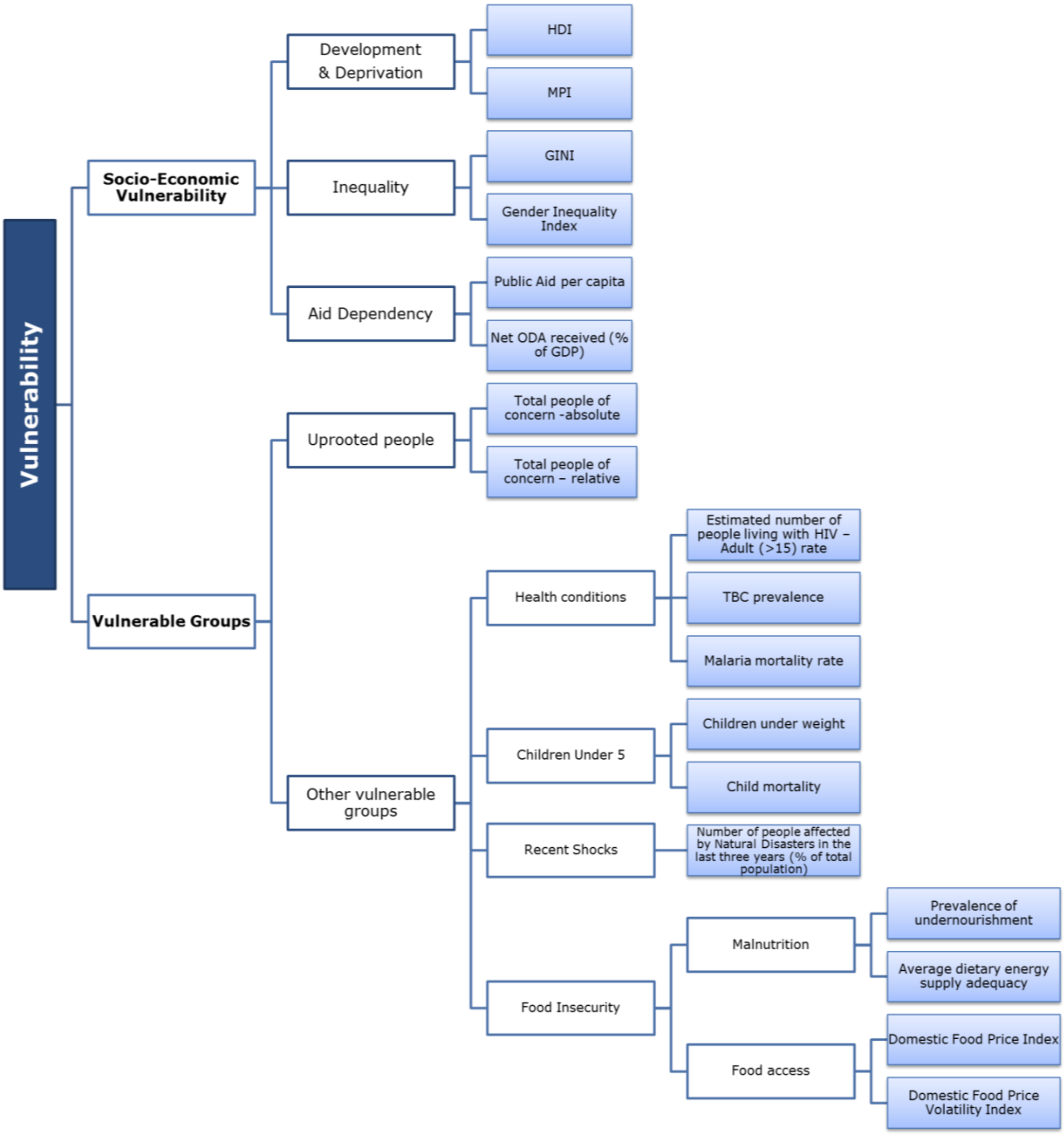

Figure 6: Graphical presentation of the Vulnerability dimension

4.3.3. Category: Socio-Economic Vulnerability

4.3.3.1. Definition

The question is what makes a population vulnerable when faced by a hazardous event. In most cases vulnerability has a negative relationship with the provision of basic needs. In such cases vulnerability is closely related to the level of self-protection mechanisms. Therefore the Socio-Economic Vulnerability category tries to measure the (in)ability of individuals or households to afford safe and resilient livelihood conditions and well-being. These in turn dictate whether people can live in safe houses and locations as well as maintain an adequate health in terms of nutrition and preventive medicine to be resistant to increased health risk and reduced food intake in the case of disasters. Socio-Economic Vulnerability depends only in part on adequate income. Other deficiencies can be corrected with adequate development level that strengthens those cultural processes, which raise level of awareness and knowledge.

4.3.3.2. Socio-Economic Vulnerability: Components

INFORM describes population performance with the weighted arithmetic average of three components (Table 11).

Table 10: Indicators of the Socio-Economic Vulnerability category

Component	Indicator	Source	MIN - MAX	No.of Missing values
Development & Deprivation	Human Development Index	Human Development Report, UNDP	0.3 – 0.95	6/191
	Multidimensional Poverty Index	Human Development Report, UNDP	0.05 – 0.5	100/191
Inequality	GINI index	World Bank	25 – 65	56/191
	Gender Inequality Distribution	Human Development Report, UNDP	0 – 0.75	39/191
Aid Dependency	Total ODA in the last two years per capita	OECD	0 - 500	-
	Global Humanitarian Funding per capita	Financial Tracking System, UNOCHA		-
	Net ODA Received in percentage of GDP	World Bank	0% – 15%	-

Scalability: All core indicators (Table 10) of Socio-Economic Vulnerability are published annually. The data for indicators of Development & Deprivation and Inequality component are available on subnational level, while the unit of analysis for the indicators of the Aid Dependency component is country.

Table 11: Aggregation of the Socio-Economic Vulnerability category

Category	Socio-Economic Vulnerability						
Aggregation	ARITHMETIC AVERAGE 50/25/25						
	50%		25%		25%		
Component	Development & Deprivation		Inequality		Aid Dependency		
Core Indicator	ARITHMETIC AVERAGE		ARITHMETIC AVERAGE		ARITHMETIC AVERAGE		
					Public Aid per capita		
					SUM		
	Human Development Index	Multidimensional Poverty Index	GINI index	Gender Inequality Distribution	Total ODA in the last 2years per capita	Total Humanitarian Funding in the last 2year per capita	Net ODA Received (% of GNI)

4.3.3.3. Component: Development & deprivation

The **development & deprivation** component describes how a population is doing on average. It comprises two well recognized composite indices by UNDP: the Human Development Index (HDI) and the Multidimensional Poverty Index (MPI). The Human Development Index covers both social and economic development and combines factors of life expectancy, educational attainment, and income. While the Multidimensional Poverty Index identifies overlapping deprivations at the household level across the same three dimensions as the Human Development Index (living standards, health, and education), it also includes the average number of poor people and deprivations, with which poor households contend. Even though dealing with similar dimensions, there is no double counting. If HDI measures capabilities in the corresponding dimension, MPI reflects the prevalence of multidimensional deprivation and its intensity in terms of how many deprivations people experience at the same time. However both indexes have a transparent methodology [11] with a justified choice of indicators and should be considered as a whole. This component is weighted 50% to fairly convey the contribution of both aspects, development as well as deprivation.

4.3.3.4. Component: Inequality

The **Inequality** component introduces the dispersion of conditions within population presented in Development & Deprivation component with two proxy measures: the Gini index by the World

Bank and Gender Inequality Index by UNDP. The Gini index (named after Italian statistician and sociologist Corrado Gini) measures how evenly distributed resident's income is among a country's population while the Gender Inequality Index exposes differences in the distribution of achievements between men and women. Income inequalities are linked to and can reinforce other inequalities such as education and health inequality [29]. There is a relationship between high inequality and weak growth in developing countries, where a large part of population is trapped in poverty. Furthermore the data show [11] that countries with unequal distribution of human development within the nation also experience high inequality between women and men. So, the Inequality and Development & Deprivation components together help point out how the average person is doing and overcome the assumption that if the whole is growing, everyone must be doing better.

4.3.3.5. Component: Aid dependency

With the **Aid Dependency** component the methodology points out the countries that lack sustainability in development growth due to economic instability and humanitarian crisis. It is comprised of two indicators: Public Aid per capita and Net Official Development Assistance (ODA) Received in percentage of Gross National Income (GNI) by the World Bank.

Public Aid per capita is obtained as a sum of total Official Development Assistance in the last two years per capita published by OECD and Global Humanitarian Funding per capita published by UN OCHA.

Official development assistance[27] has the promotion of economic development and welfare as its main objective. The effects of the economic instability are the main source of growth regression [29] because it decreases the ability of governments to predict budget revenue and thus expenditure, but also has an impact on income in dependent households. And once progress on human development is reversed, the damage can have multiplier effects and be lasting. For instance, deteriorating health and education today can lead to higher mortality rates tomorrow. Lower investments can hamper future progress in sanitation and water supply. The presence of fewer children in school can lead to lower completion rates in later years. And household incomes that fall far below the poverty line can delay escapes from poverty.

In a very simplistic view, the poorest regions on the world receive the highest volume of development aid relative to other regions [29]. These are the countries of sub-Saharan Africa and other least developed countries based on HDI ranking. So, development aid flows can cause developing countries to maintain government spending.

Parallel to the Aid Dependency component other aspects of economic dependency were considered as well, such as export dependency (the ratio of the international trade to GDP), export concentration (a degree to which a country's export is concentrated on a small number of products or a small number of trading partners) and personal remittances received (in % of GDP). They would address economic vulnerability in a country as a risk to have its development

[27] http://www.oecd.org/dac/stats/officialdevelopmentassistancedefinitionandcoverage.htm

hampered by financial shocks triggered by different events on the foreign markets. Finally they were not adopted due to a weak causal link with the humanitarian risk.

4.3.4. Category: Vulnerable Groups

4.3.4.1. Definition

The Vulnerable Group category refers to the population within a country that has specific characteristics that make it at a higher risk of needing humanitarian assistance than others or being excluded from financial and social services. In a crisis situation such groups would need extra assistance, which appeals for additional measures, i.e., extra capacity, as a part of the emergency phase of disaster management.

Why are certain groups of people more vulnerable than others? At a conceptual level two fundamental reasons of increased vulnerability can be identified:

- Intrinsic due to internal qualities of individual themselves:
    - Special disabilities,
    - Disease and
    - Limitations imposed by stages of human life.
- Extrinsic as a result of external circumstances:
    - Social: ethnic, religious minorities, indigenous peoples,
    - Political: people affected by conflicts; refugees and IDPs,
    - Environmental: people recently exposed to frequent natural hazardous events or living in areas difficult to access, like mountainous regions or extremely rural areas.

It is often the case that a particular vulnerable group is prone to several weaknesses as one characteristic of increased vulnerability develops circumstances for another one to take place. Those specific characteristics bear also a higher risk than others for a need of humanitarian assistance in the crisis situation.

For example, a study of rural communities in North Eastern India [18] shows that frequent exposure to floods is associated with long-term malnutrition of children under five. The underlying cause is the adverse impacts of flooding on crop productivity. Crop yield variation is one of the leading mechanisms to limited access to food. In such situation children are the first to suffer because of their greater sensitivity to certain exposure and dependence on care givers.

The vulnerable groups are a weak part of the society also in highly-developed countries. The Kobe earthquake of M 7.2 in 1997 revealed [36] a particularly vulnerable minority of Korean-Japanese workers and foreign illegal and legal workers. They were subjected to official neglect and economic deprivation. Within the most severely affected wards of Kobe City there were 130,000 foreign and migrant workers. Most were paid low wages in small businesses that were damaged or destroyed by the earthquake, which made their recovery even more difficult. However they failed to surface in official reporting by government as well as in most NGO reports.

Furthermore children, elderly and women in general are more vulnerable part of the society. Their presence is a demographic characteristic of the country (and in case of gender not even country specific), which is why we do not consider them as a special vulnerable group. The aim is to address special issues related to them. Children Underweight extract the group of children that are in a weak health condition, while together with Child Mortality it reflects also efficiency of the country's health system and food access problems. Gender inequality is taken into account under the Inequality component in the Socio-Economic Vulnerability. Regarding older people, they are also affected by inadequate health service and lack of protection, issues common to older ages. Declining health as well as social (e.g. isolation) and economic marginalization makes them even more vulnerable in disasters and conflicts [12]. Physical or mental impairment impede the ability to evacuate or specific health problems need adequate health care and medicines or isolation due to forgotten responsibilities of relatives and community results in poor nutritional status and poor livelihood conditions in general. Globally, the proportion of older people is increasing faster than any other group but the number of old people alone or old-age dependency ratio alone is not reflecting their weaknesses. Namely, old-age dependency ratio is higher in higher income countries but there basic insurance providing basic health care and old age pension makes their situation better. Altogether it is the matter of the Lack of Coping Capacity dimension, partially related with the quality of the social and health system, but mainly it is about strategies to protect older people during emergencies, which are not momentarily directly covered by any available indicators.

However, effective monitoring and related indicators exist only for some of the identified vulnerable groups.

4.3.4.2. Vulnerable Groups: Components

The Vulnerable Group category (Table 13) is split in two: **Uprooted People** and **Other Vulnerable Groups**. Uprooted People are effectively weighted more because they are not a part of the society as well as the social system, only partially supported by the community and often trigger the humanitarian intervention.

Table 12: Indicators of the Vulnerable Groups category

Component / Sub-component	Indicator	Source	MIN - MAX	No. of Missing values
Uprooted People	Number of refugees, returned refugees, Internally Displaced Persons (absolute)	UNHCR, IDMC	Log(1,000) – Log(1,000,000)	-
	Number of refugees, returned refugees, Internally Displaced Persons (relative)	UNCHR, IDMC, World Bank	0.005% - 10%	-
Other Vulnerable Groups / Health Conditions	Prevalence of HIV-AIDS above 15 years	WHO	0% - 5%	34/191
	Tuberculosis prevalence	WHO	0 – 550	2/191
	Malaria Mortality Rate	WHO	0 - 120	90/191
Other Vulnerable Groups / Children under-5	Children Underweight	UNICEF, WHO	0% – 45%	60/191
	Child Mortality	UNICEF, WHO	0 – 130	1/191

Component / Sub-component	Indicator	Source	MIN - MAX	No. of Missing values
Other Vulnerable Groups / Recent Shocks	Relative number of affected population by natural disasters in the last three years	EM-DAT, CRED	0% - 10%	-
Other Vulnerable Groups / Food Security	Prevalence of Undernourishment	FAO	5% - 35%	29/191
	Average Dietary Energy Supply Adequacy	FAO	75% – 150%	31/191
	Domestic Food Price Level Index	FAO	1 – 2.5	45/191
	Domestic Food Price Volatility Index	FAO	0 – 20	54/191

Table 13: Aggregation of the Vulnerable groups category

<table>
<tr><th>Category</th><th colspan="13">Vulnerable Groups</th></tr>
<tr><td rowspan="2">Component</td><td colspan="13">GEOMETRIC AVERAGE</td></tr>
<tr><td colspan="3">Uprooted People</td><td colspan="10">Other Vulnerable Groups</td></tr>
<tr><td rowspan="7">Aggregation</td><td colspan="3">ARITHMETIC AVERAGE</td><td colspan="10">GEOMETRIC AVERAGE</td></tr>
<tr><td rowspan="5">Log(absolute)</td><td colspan="2" rowspan="5">Relative</td><td colspan="3">Health Conditions</td><td colspan="2">Children under-5</td><td>Recent Shocks</td><td colspan="4">Food Security</td></tr>
<tr><td colspan="3">ARITHMETIC AVERAGE</td><td colspan="2">ARITHMETIC AVERAGE</td><td></td><td colspan="4">ARITHMETIC AVERAGE</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td><td></td><td>Utilization</td><td>Availability</td><td colspan="2">Access</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td><td></td><td></td><td></td><td colspan="2">ARITHMETIC AVERAGE 80/20</td></tr>
<tr><td colspan="3"></td><td colspan="2"></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="3">SUM</td><td colspan="3"></td><td colspan="2"></td><td></td><td></td><td></td><td>80%</td><td>20%</td></tr>
<tr><td colspan="13"></td></tr>
<tr><td>Core Indicator</td><td>Number of refugees</td><td>Number of returned refugees</td><td>Number of IDPs</td><td>Prevalence of HIV-AIDS (>15years)</td><td>Tuberculosis Prevalence</td><td>Malaria Mortality Rate</td><td>Children Underweight</td><td>Child Mortality</td><td>Relative number of affected population by natural disasters in the last three years</td><td>Prevalence of Undernourishment</td><td>Average Dietary Energy Supply Adequacy</td><td>Domestic Food Price Index</td><td>Domestic Food Price Volatility Index</td></tr>
</table>

absolute - absolute value of uprooted people
relative - uprooted people relative to total population

The Vulnerable Groups category should be always fed with the most recent data available (e.g., uprooted people, people affected by recent shocks,…).

Scalability: The indicators for the Uprooted People component are foreseen to be updated as soon as data are available on subnational scale. The indicators of the Health Conditions and the Children under 5 sub-component are updated annually and could be potentially provided sub-nationally if the data would exist. The data for the Recent Shock sub- component are limited to national scale and provided every three months. In case of Food Security indicators the data are available annually on national scale but other options considered in Box 6, not available at the moment on global scope, would allow geographical and temporal disaggregation.

4.3.4.3. Component: Uprooted people

The total number of uprooted people is the sum of the highest figures from the selected sources for each uprooted group. The **Uprooted People** component is the arithmetic average of the absolute and relative value of uprooted people. The absolute value is presented using the log transformation while the uprooted people relative to the total population are transformed into indicator using the GNA criteria and then normalized into range from 0 to 10 (Table 14).

Table 14: Transformation criteria for the relative value of uprooted people

% of total population	Level of Vulnerability	Uprooted people (relative subcomponent)
> 10%	high	10.0
> 3% AND < 10%		8.3
> 1% AND < 3%	medium	6.7
> 0.5% AND < 1%		5.0
> 0.1% AND < 0.5%	low	3.3
> 0.005% AND < 0.1%		1.7
< 0.005%	no vulnerability	0.0

4.3.4.4. Component: Other vulnerability groups / Health condition

A **Health Condition** subcomponent refers to people in a weak health conditions. It is calculated as the arithmetic average of the indicators for three deadly infectious diseases, AIDS, tuberculosis and malaria, which are considered as pandemics of low- and middle-income countries. The combat to these three diseases is one of the 2015 Millennium Development Goals[28]. Similarly, the Global Fund[29] is an international financing institution that fights AIDS, tuberculosis and malaria.

[28] http://www.undp.org/content/undp/en/home/mdgoverview/
[29] http://www.theglobalfund.org/en/about/diseases/

4.3.4.5. Component: Other vulnerability groups / Children under-5

A **Children under-5** subcomponent captures the health condition of children. It is referred to with two indicators, malnutrition and mortality of children under-5. Children Underweight extracts the group of children that are in a weak health condition mainly due to hunger. The Child Mortality shows general health condition of the children and is closely linked to maternal health since more than one third of children deaths occur within the first month of life and to how well the country tackles major childhood diseases (e.g. proper nutrition, vaccinations, monitoring system, family care practice, health system access, sanitation and water resources). Therefore decrease of underweight children and the child deaths are one of the MDG by 2015 as well.

4.3.4.6. Component: Other vulnerability groups / Recent shocks

Recent Shocks subcomponent accounts for increased vulnerability during the recovery period after a disaster and considers people affected by natural disasters in the past 3 years. The affected people from the most recent year are considered fully while affected people from the previous years are scaled down with the factor 0.5 and 0.25 for the second and third year, respectively, assuming that recovery decreases vulnerability progressively. This way the smoothness of the INFORM index in time series is assured.

4.3.4.7. Component: Other vulnerability groups / Food security

The FAO definition of **food security** is: “A situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.”[30] For our model, we therefore suggest that the Food Security subcomponent is dependent on Food Access, Food Availability, and Food Utilization. This concept serves as a set of proxy measures for the number of people lacking secure access to food. Leaning on definitions provided by the Integrated Phased Food Security Classification (IPC), we determine **Food Availability** on the fact if food is actually or potentially physically present regarding production, wild foods, food reserves, markets, and transportation. **Food Access** assesses whether or not households have sufficient access to that food, taking into account physical (distance, infrastructure), financial (purchasing power) and social (ethnicity, religion, political affiliation, etc.) aspects. Finally, **Food Utilization** covers the question whether or not households are sufficiently utilizing food in terms of food preferences, preparation, feeding practices, storage and access to improved water sources.

The combination of lack of food, lack of means to actually make it available, and lacking quality of food may lead to famine and hunger for poor populations. Therefore, the three components are aggregated with an arithmetic average. All components are the arithmetic average of the raw

[30] http://www.fao.org/3/a-i4030e.pdf, p.50. The complementary definition for food insecurity is: “A situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life. It may be caused by the unavailability of food, insufficient purchasing power, inappropriate distribution or inadequate use of food at the household level. Food insecurity, poor conditions of health and sanitation and inappropriate care and feeding practices are the major causes of poor nutritional status. Food insecurity may be chronic, seasonal or transitory” (ibid.).

indicators. In the Food Access component more weight is given to the price index (absolute) versus price volatility, 80% versus 20%, respectively. For example, there are some situations of countries with high but stable prices that seem better off than countries with average prices and average volatility.

Box 6: Other options for food insecurity sub-component

For the Food Security sub-component some other options were considered, which seem more adequate but their coverage was too sparse:

- The IPC (Integrated Food Security Phase Classification) classifies the severity of food security and humanitarian situations into five phases based on a widely accepted set of indicators. The phase classification describes the current situation for a given area, while also communicating the likelihood and severity of further deterioration of the situation.
- The FEWSNet[31] methodology used by a famine early warning systems network. It uses scenarios to forecast the most likely outcomes based on continuous monitoring of weather, climate, agriculture, production, prices, trade, and other factors, considered together with an understanding of local livelihoods.

These options may be integrated in the INFORM methodology in the future, when data coverage increases.

4.4. Dimension: Lack of Coping Capacity

4.4.1. Overview

For the Lack of Coping Capacity dimension, the question is, which issues the government has addressed to increase the resilience of the society and how successful their implementation is. The Lack of Coping Capacity dimension measures the ability of a country to cope with disasters in terms of formal, organized activities and the effort of the country's government as well as the existing infrastructure, which contribute to the reduction of disaster risk.

Box 7: Variations in the subnational models: Lack of coping Capacity

An INFORM Subnational model uses the same risk assessment methodology and development process, but is adapted to regional or national level.[32]

The most important changes in Lack of Coping Capacity dimension include the addition of Financial & economic system (East Africa), International Investments in risk reduction (Sahel, East Africa).

4.4.2. Lack of Coping Capacity: categories

It is aggregated by a geometric mean of two categories: Institutional and Infrastructure. The difference between the categories is in the stages of the disaster management cycle that they are

[31] http://www.fews.net
[32] INFORM Guidance Note 2016, http://www.inform-index.org/

focusing on. If the Institutional category covers the existence of DRR programmes, which address mostly mitigation and preparedness/early warning phase, then the Infrastructure category measures the capacity for emergency response and recovery.

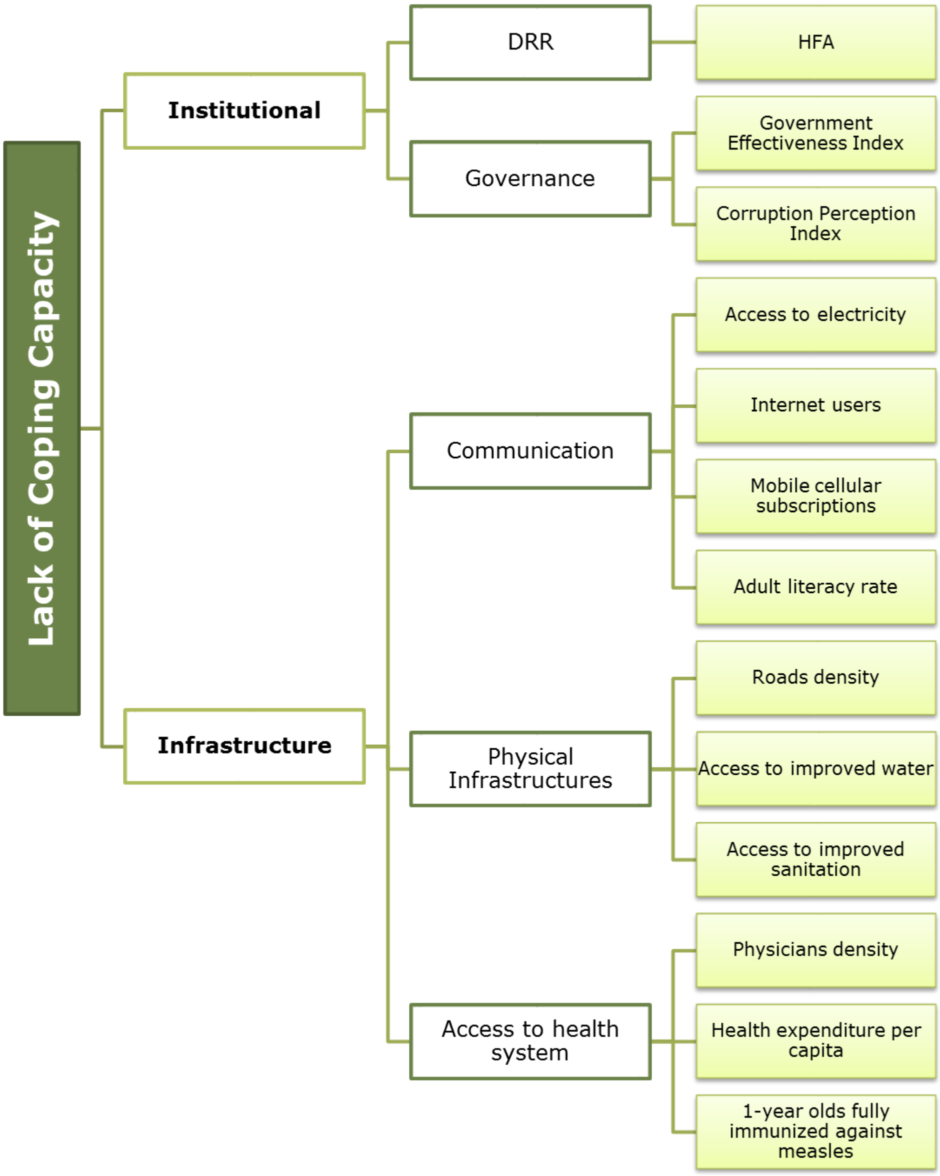

Figure 7: Graphical presentation of the Lack of Coping Capacity dimension

4.4.3. Category: Institutional

4.4.3.1. Definition

The Institutional category quantifies the government's priorities and institutional basis for the implementation of DRR activities. It is calculated as an arithmetic average of two components, **Disaster Risk Reduction** and **Governance** (Table 16), in order to incorporate the effectiveness of the governments' effort for building resilience across all sectors of society.

Table 15: Indicators of the Institutional category

Component	Indicator	Source	MIN - MAX	No. of Missing values
Disaster risk Reduction	Hyogo Framework for Action self-assessment reports	UNISDR	1 – 5	40/191
Governance	Government Effectiveness	World Bank	-2.5 – 2.5	-
	Corruption Perception Index	Transparency International	0 - 100	17/191

Table 16: Aggregation of Institutional category

<table>
<tr><td>Category</td><td colspan="3">Institutional</td></tr>
<tr><td rowspan="2">Component</td><td colspan="3">ARITHMETIC AVERAGE</td></tr>
<tr><td>Disaster Risk Reduction</td><td colspan="2">Governance</td></tr>
<tr><td rowspan="2">Core Indicator</td><td rowspan="2">Hyogo Framework for Action Scores</td><td colspan="2">ARITHMETIC AVERAGE</td></tr>
<tr><td>Government Effectiveness</td><td>Corruption Perception Index</td></tr>
</table>

Scalability: For all indicators of the Institutional category only annual updates on national scale are possible.

4.4.3.2. Component: Disaster Risk Reduction

The indicator for the **Disaster Risk Reduction** activity in the country comes from the score of Hyogo Framework for Action self-assessment reports of the countries. The Hyogo Framework for Action [31] covers the following topics:

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.
2. Identify, assess and monitor disaster risks and enhance early warning.
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels.
4. Reduce the underlying risk factors.
5. Strengthen disaster preparedness for effective response at all levels.

Self-evaluation has a risk of being perceived as a process of presenting inflated grades and being unreliable.

4.4.3.3. Component: Governance

The subjectivity of HFA Scores is counterweighted by arithmetical average with external indicators of **Governance component**, i.e., the Government Effectiveness and Corruption Perception Index.

The Government Effectiveness[33] captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies [14] while the **Corruption Perception Index** adds another perspective, that is the level of misuse of political power for private benefit, which is not directly considered in the construction of the Government Effectiveness even though interrelated.

4.4.4. Category: Infrastructure

4.4.4.1. Definition

Communication networks, physical infrastructure and accessible health systems are treated as essential parts of the infrastructure needed during emergency response, focusing on the early warning phase, and carrying through response and recovery. Since all parts of the infrastructure should be operational to a certain level, the aggregation process uses the arithmetic average of indicators describing accessibility as well as the redundancy of the concerned system that are two crucial characteristics in a crisis situation.

Table 17: Indicators of the Infrastructure category

Component	Indicator	Source	MIN - MAX	No. of Missing values
Communication	Access to Electricity	World Bank	$(30)^2$ - $(100)^2$	1/191
	Internet Users	World Bank	0% – 100%	1/191
	Mobile Cellular Subscriptions	World Bank	5 – 200	-
	Adult Literacy Rate	UNESCO	0% – 100%	42/191
Physical infrastructure	Roads Density	OpenStreetMap	1 – 100	-
	Access to Improved Water Source	WHO / UNICEF	50% – 100%	2/191
	Access to Improved Sanitation Facilities	WHO / UNICEF	10% – 100%	3/191
Access to health system	Physicians Density	WHO	0 – 4	19/191
	Health Expenditure per capita	WHO	50 – 3000	6/191
	Measles Immunization Coverage	WHO	60% - 99%	1/191

[33] http://info.worldbank.org/governance/wgi/index.aspx#doc

Table 18: Aggregation of the Infrastructure category

Category	Infrastructure									
	ARITHMETIC AVERAGE									
Component	Communication				Physical infrastructure			Access to health system		
	ARITHMETIC AVERAGE				ARITHMETIC AVERAGE			ARITHMETIC AVERAGE		
Core Indicator	Access to Electricity	Internet Users	Mobile Cellular Subscriptions	Adult Literacy Rate	Roads Density	Access to Improved Water Source	Access to Improved Sanitation Facilities	Physicians Density	Health Expenditure per capita	Measles Immunization Coverage

Scalability: Health Expenditure per capita has a unit of analysis locked to country while all the other indicators could be potentially developed on subnational scale if the data would exist. Regarding the temporal scalability only annual updates are expected.

4.4.4.2. Component: Communication

The **Communication** component aims at measuring the efficiency of dissemination of early warnings through a communication network as well as coordination of preparedness and emergency activities. It is dependent on the dispersion of the communication infrastructure as well as the literacy and education level of the recipients.

4.4.4.3. Component: Physical infrastructure

Physical Infrastructure component is the arithmetic average of different proxy measures. We mainly try to assess the accessibility as well as the redundancy of the lifeline systems, which are crucial in a crisis situation, i.e., roads, water and sanitation systems.

4.4.4.4. Component: Access to health system

Access to Health System component is the arithmetic average of different proxy measures. We mainly try to assess the accessibility as well as the redundancy of the different assets of the existing health systems.

5. LIMITATIONS & CONSTRAINTS OF INFORM

There are certain areas of the three dimensions of INFORM that are not covered or covered only partially. The main constraints are related to limitations of the methodology and incomplete data availability.

5.1. Methodological limitations

Composite Indicator. The composite indicators are simplification of reality. The simple "big picture" results which composite indicators show may invite politicians to draw simplistic policy conclusions. Composite indicators should be used in combination with the sub-indicators to draw sophisticated policy conclusions[34].

Interactions among dimensions are not considered. For example, the measures of disaster risk reduction in the Lack of Coping Capacity dimension might reduce the exposure data in the Hazard & Exposure dimension. The methodology is not able to introduce such interactions in a quantitative manner.

The usage of proxies limits the "representativeness". Certain phenomena that were addressed as important for the humanitarian risk assessment cannot be measured exactly in the way we want or adequate indicators are not available. In such situations, proxy measures are used which measure something that is close enough to reflect similar behaviour and can provide relative differences among the countries for the ranking purposes. The proper representativeness of phenomena is limited to the presence of causes, consequences, measurable parts of the process or even accompanying processes. For example, the Malaria Mortality Rate is a proxy used to rank countries by the prevalence of malaria as the latter data are deemed unreliable.

5.2. Data limitations

Extensive hazardous events and sudden onset hazardous events with a more limited geographic extent such as landslides, forest fires and volcanoes, are not included. One reason is lack of data availability while the other is their lower relevance in terms of causing humanitarian crises. According to the CRED EM-DAT database [36] the death toll of natural hazards during 1900-1999 is less than 0.2% due to volcanic eruptions, landslides and wildfires. On the other hand the rapid onset hazards with a more limited geographic extent seldom exceed entry criteria of the EM-DAT database. From that point of view their presence in the database is incomplete and the cumulative death toll is higher, as one event rarely causes humanitarian crises.

Biological hazards (i.e., epidemics / large scale epidemics / pandemics) are not included. They can have a large impact not only on mortality and morbidity but also on travel and trade as well

[34] https://composite-indicators.jrc.ec.europa.eu/?q=content/what-composite-indicator

as socio-economic effects. To consider their potential threat the data on probability of re-emerging diseases with certain level of impact are needed and are not so easily available.

Technological hazards are not included. Technological hazards originate from technological or industrial accidents that may arise as a result of an intentional plan (terrorist attack), a random process (human error), natural hazardous event (Natech), or the lack of maintenance or ageing processes. The likelihood of such events is partially related to the presence of critical assets (uranium tailings, UXO, nuclear power plants, chemical plants) in the country and partially to the probability of occurrence of triggering event. The list of critical assets (uranium tailings, UXO, nuclear power plants, chemical plants) by country is therefore not enough to define the country's risk. To consider the consequences, data with a certain level of impact are needed, for example in terms of physical exposure, and each critical asset should come together with impact area not constrained by country borders. These data are currently not available.

Lower reliability of disaster risk reduction component. The disaster risk reduction component is based on the scores of Hyogo Framework for Action self-assessment reports of which the reliability is unknown. Self-assessment reports cover almost 80% of the countries. But it is not stand alone indicator and its trustfulness is estimated with the governance component. However, at the time being there are no other international frameworks for assessing the capacity to cope with humanitarian crises that would fit the scope so well [17]. Sendai Framework [32] for development and disaster risk reduction aims to provide new indicators to monitor global targets. As soon as they will become available they will replace the HFA scores within the DRR component.

Missing data can distort the real value of the composite indicator. The presence of missing data cannot be completely avoided. The goal of the composite indicator is to aggregate the different aspects of the humanitarian risk. Whenever certain values are missing, the aggregation process fails as a tool to compensate a deficit in one dimension / category / components by surplus in another. In the case of poor coverage we introduced, whenever available, more than one proxy measure for the same component to complement each other.

Table 19: Countries with more than 20% of missing values in INFORM 2016

Country	Missing values (% of total)
Liechtenstein	19 (37%)
Nauru	14 (27%)
Kiribati	12 (24%)
Marshall Islands	12 (24%)
Tuvalu	12 (24%)
Dominica	11 (22%)
Grenada	11 (22%)
Micronesia	11 (22%)
Saint Kitts and Nevis	11 (22%)
Antigua and Barbuda	10 (20%)
South Sudan	10 (20%)

In INFORM 2016 40 countries have all data, while 11 countries have more than 20% of missing values (Table 19).

Countries in conflict. In countries facing internal conflicts (i.e. Syria, Iraq, Libya), the reliability of the data (when available) is normally weak. Therefor the resulting INFORM score for those countries have to be taken with caution.

Limitations in the sensitivity of indicators and data updates affect the responsiveness of the INFORM index. Some indicators in the INFORM index are designed to reflect the real-time situation but there are time constraints that should be kept in mind. Firstly, there is a time lag between a situation changing and the indicator reflecting this change and, secondly, the indicators are usually issued with delays because they need to go through a validation process.

Natural Hazard category is static. The probability of natural hazard doesn't change in short-medium period, while the population movement is more dynamic. Urbanisation, economical and conflict induced migration are process that can changed the population distribution dramatically. Moreover, vulnerable population is likely to move to the more hazard risk areas. The exposure data currently used in INFORM cannot capture the described dynamics, but some potential alternative exist and they will be taken into consideration for the next realises (Box 3).

5.3. Ranking of countries

The composite indicator is a simplified view of the reality and the user should be aware of its limitations. Understanding humanitarian risk is a complex problem which can be referred to as a multidimensional phenomenon. The role of the theoretical framework is to specify single dimensions and their interrelations as well as to provide the basis for indicator selection. The ranking value of the index is the result of the methodology that defines the mathematical combination of individual indicators. Therefor not risk, but risk as described by the methodology of the composite indicator could be managed.

Furthermore, the INFORM index conveys only the information measured by indicators. Indicators have to be compliant with the selection criteria (Chapter 4.1) and the choice is sometimes more data-driven than user-driven. Different types of indicators are used:

- direct measures (e.g., number of uprooted people) which have a strong influence on the score,
- proxy measures (e.g., Gini index can be a proxy for inequality in education, livelihood, health conditions) which serve mainly for ranking,
- composite indicators (e.g., HDI, MPI, …) that can be a combination of both.

The INFORM index can provide different types of results. One is the ranking of countries. This builds a relationship among the countries in terms of 'certain country is ranked higher or lower than the other'. The other is the score of the countries which can be used for following trends in time series. The higher the presence of the direct measures over proxies, the larger is the relevance of the scores. For more qualitative assessment the countries can be grouped into five classes of very low, low, medium, high and very high risk of humanitarian crises. Furthermore, the same results can be gained in the level of dimensions and categories (Chapter 7).

6. BUILDING THE INFORM MODEL

Before the construction of the composite indicator and sub-indices, all raw data values of the core indicators are pre-processed. A pre-processed indicator is referred to as an index.

Pre-processing may include:

- Imputation of missing values,
- Transformation into non-dimensional scales, e.g., utilizing percentages, per capita or density functions,
- Log transformation,
- Re-scaling into range 0-10 in combination with min-max normalization,
  - Outliers identification,
  - Setting min and max values,
  - Inversion of values for the clear communication of the results: the higher the worse through all the dimensions, categories and components.

For each core indicator, the pre-processing steps are described in a separate document[35].

6.1. Imputation of missing values

If data for some countries are not available for a given year, a systematic imputation of missing values is using the data from the most recent year available in 5 years span.

In the case of the missing data due to the weak coverage, the approach is to introduce more than one indicator for the same component to complement each other.

6.2. Transformations

Transformations are applied whenever it can be justified to change the absolute differences among the countries.

The log transformation is used to reduce the positive skewness of data. Such datasets include those where the indicator is based on a people count with certain conditions. The log scale gives more weight to the differences between the countries with lower values and less weight to the countries with higher values of indicators. Log transformations take into account not only the absolute difference between two countries similar in performance but also the proportion of the gap compared to the real value of the indicator. The same gap on the lower side of the range is more important than being on the upper side of the rank. Therefore transformed data more clearly differentiate the small differences at all ranges of performance and improve the interpretation of differences between the countries on opposite ends of ranking.

[35] Data Factsheet, http://www.inform-index.org/Results/Global/

6.3. Normalisation

Re-scaling normalises indicators to have an identical range of 0.0 – 10.0 with the notion that higher is worse. The normalised indicators have been rounded to the first decimal. As outliers often cause min and max values to be very different from the bulk of the values in the dataset rescaling with predefined min and max values is applied (Equation 2).

Identification of outliers and setting min and max values. Fixed min and max values for each indicator dataset are preferred in order to:

- preserve the rescaling factor and make the transformation stable through the time series,
- exclude the distortion effect of outliers on indicator's set,
- consider the nature of the topic reflected which predefines the reasonable min and max values (e.g., expert opinion).

$$x_{i,norm}^{j} = \frac{x_i^j - x_{i,min}}{x_{i,max} - x_{i,min}} \times 10$$

Equation 2

x_i^j – data point for the j – th country from i – th indicator's dataset
$x_{i,min}$ – min value for i – th indicator's dataset
$x_{i,max}$ – max value for i – th indicator's dataset
$x_{i,norm}^{j}$ – normalized data point or the j – th country from i – th indicator's dataset

An outlier is a data point that is distinctly separate from the rest of the data. Outliers are indicative of heavy tailed distribution, a mixture of two distributions, or errors. In the first two cases they indicate that the distribution has high kurtosis and skewness or may be two distinct sub-populations, then one should be very cautious in using tools or intuitions that assume a normal distribution. In the case of errors one wishes to discard them or use statistics that are robust to outliers. There are many techniques to identify outliers, but in INFORM index a combination of the following two has been used:

- box plot [23] based on interquartile range (IQR) where the lowest datum is still within 1.5 IQR of the lower quartile, and the highest datum is still within 1.5 IQR of the upper quartile and the rest of the data are treated as outliers. This approach focuses on the range containing 50% of the countries and then extends that range independently from the distribution. So the number of data points that exceeds the limits varies. For right–skewed distributions the boxplot typically labels too many large outliers and too few small outliers.
- the min and max values for which skewness is lower than 2 AND kurtosis is lower than 3.5. Skewness and kurtosis are calculated iteratively for the whole dataset without the obvious outliers, until pre-set conditions are met. The minimum and maximum data point of the remaining dataset are taken as min and max.

The two technics were used to find the indicative min and max values based on data from 2008-2013. They were adjusted to cover expected changes (beyond 2013) over time based on expert opinion. The min and max values will be re-evaluate periodically, e.g. every five years.

Inversion. The methodology defines in what way single indicator affects the composite indicator. In the model all values are presented with the notion that higher is worse. So, whenever higher values of the indicator would contribute to a lower INFORM index, the following inversion of already rescaled dataset, is executed:

$$x^{j}_{i,norm,inv} = 10 - x^{j}_{i,norm}$$ **Equation 3**

$x^{j}_{i,norm}$ $- normalized\ data\ point\ for\ the\ j-th\ country\ from\ i-th\ indicator's\ dataset$

$x^{j}_{i,norm,inv}$ $- normalized\ data\ for\ the\ j-th\ country\ from\ i-th\ indicator's\ dataset\ inversed$

6.4. Aggregation

Different aggregation rules are possible. Which one to choose depends on the methodology [15] which defines how the information from indicators should contribute to the composite indicator. Aggregation rules can be defined using mathematical operations such as:

- Minimum: the best indicator only
- Maximum: the worst indicator only
- Arithmetic average
- Geometric average

The INFORM methodology implements the arithmetic and geometric average. Aggregation rules are applied to indexes at each level in order to progress through the levels in a hierarchical bottom-up way, i.e. starting at indicator level and going one by one through the component level, the category level, to the dimension level. The final score of the INFORM index is calculated with the risk equation (Equation 1) in Chapter 2.2.

In arithmetic and geometric aggregations weighting can be applied to control the contribution of each indicator to the overall composite and should be justified by the theoretical framework. Practically, weights express a desired trade-off between indicators.

Box 8: Arithmetic vs. geometric average

For ranking purposes, aggregation is a tool to compensate a deficit in one dimension by surplus in another. With arithmetic average compensation is constant while with geometric average compensation is lower and rewards more the indicators with higher scores[36]. For a country with high and low scores, an equal improvement for low scores will have a much greater effect on the aggregation score than an equal improvement in the high score. So, the country should focus in those sectors with the lowest score if it wants to improve its position in ranking in case of the geometric aggregation.

	Natural Hazard	Human Hazard	Hazard & Exposure	
			Arithmetic Average	Geometric Average
Ethiopia	5.4	6.7	6.0	6.1
Nigeria	2.4	9.6	6.0	7.3

To provide an understanding of the implication of using either average, let us consider the Hazard & Exposure dimension which is aggregated by two categories with equal weights, Natural and Human Hazard. For example, we consider Ethiopia and Nigeria. These two countries have almost equal arithmetic average in those two categories. However, arithmetic average implies that in order to have a high score in the Hazard & Exposure dimension, then both the Natural AND the Human Hazard category have to be high. Instead, the use of a geometric average implies that it is enough for a country to have a high score either on the Natural OR on the Human Hazard category, in order for the country to have a high Hazard & Exposure score. As a high exposure in at least one of the hazard category put already the country at high risk of exposure to hazards, it is more logical to use geometric average.

[36] The geometric average is always smaller or equal than the arithmetic average. To use that characteristic of geometric average, i.e., to reward more those countries with high scores, the following procedure was applied [6]:

1. Inversion of index following the notion higher the better.
2. Rescaling of index into the range [1,10].
3. Calculation of geometric average.
4. Rescaling the score back into the range [0,10].
5. Inversion of the score with the notion that higher is worse .

7. INTERPRETATION OF THE INFORM INDEX SCORES

The INFORM index is scored between 0.0 and 10.0. The low values of the index represent a positive performance, and the high values of the index represent a negative performance in terms of managing humanitarian risk. The notion that higher is the worse is consistently applied also at dimension, category and component level.

For the better perception of risk the countries were sorted into different clusters based on their score/scores from the past five years. The scope of the fixed threshold obtained from the clustering analysis on the 5- year of historical data is:

- more meaningful trend analysis,
- more solid perception of risk classes among users.

Previous quartile approach in INFORM 2015 to define four classes of risk have many drawbacks:

- constant number of countries within the classes,
- change of the class doesn't imply improvement in score,
- the transitions among classes based on the performance was not allowed.

In this section, we describe the new approach in INFORM 2016 to cluster countries, and provide a guide to interpretation of the scores.

7.1. Cluster analysis

Clustering is finding groups in a data set by some natural criterion of similarity[37]. This is also the common objective of many different cluster algorithm[38]. In INFORM the hierarchical clustering model was used. Hierarchical clustering models also called connectivity based clustering were among the earliest techniques developed. They are based on the idea that the objects are more related to nearby objects than those further away. Clusters are thus developed based on distance between objects in the data space. The idea is to build a binary tree of the data that successively merges similar groups. Each level of the resulting tree is a segmentation of data. There is no single partitioning provided, but rather a hierarchy of clusters which expand or decrease in number solely based on distance measure and linkage criterion without the need to know the number of clusters in advance.

In the case of INFORM, Ward's minimum variance criterion was applied. This is an agglomerative hierarchical clustering procedure (bottom up approach) where the criterion for choosing the pair of clusters to merge at each step is based on minimum increase in total within-cluster variance

[37] *Estivill-Castro, Vladimir (20 June 2002). "Why so many clustering algorithms — A Position Paper". ACM SIGKDD Explorations Newsletter **4** (1): 65–75. doi:10.1145/568574.568575*

[38] Clustering algorithms can be categorized based on their cluster model. Some typical cluster model are hierarchy, centroid, distribution and density clustering. There are possibly over 100 published clustering algorithms. The most appropriate clustering model for a particular problem often needs to be chosen experimentally, unless there is a mathematical reason to prefer one cluster model over another.

after merging. At the initial step, all clusters are singletons (clusters containing a single object). To apply a recursive algorithm with this criterion, the initial distance between individual objects must be squared Euclidean distance. This was implemented using *hcluster* function in R.

7.2. Fixed 5 risk classes

It was decided to fix the threshold for five classes (Table 20) within each category (6), each dimension (3) and the final INFORM risk score(1) based on all data for the last five years (2011-2015). 10 datasets were assembled with 5 values for each 191 countries. Data within each dataset are grouped into five classes. Dealing with 1-dimensional data the output of the cluster analysis for each dataset are 5 intervals with defined thresholds. The thresholds were rounded generally at the first decimal while for the final risk score the thresholds were rounded to 0.5. Next, in the category of Human hazard the thresholds for the very high and high risk of conflict were adjusted to correspond to the meaning of the initial definitions of conflict risk score (Table 8). It is foreseen to keep the same thresholds for at least five years.

There were two reasons to pass from four classes in the previous releases to five classes (Table 20):

- to have a balanced scale of risk assessment,
- to have manageable size of the classes.

The whole purpose of risk classification in the form of a hierarchical scale is to systematically identify risk in a consistent manner. Risk classes give greater ability to monitor, control and even manage risk because it helps to identify the root causes of risk in better way. It might be that a similarity-based approach to risk classification is inherently ambiguous. As it is open to more than one interpretation we believe it makes sense for each organization to describe the risk classes according to the goals of the organization and the risk management decision that they face. In most cases the users will find it useful to look at the classes within specific dimension or even categories (Table 21 and Table 22).

Table 20: The labels of the five risk classes

Level	Risk class	Number of countries (INFORM 2016)
1	very high	12
2	high	22
3	medium	59
4	low	67
5	very low	31

Table 21: Fixed thresholds at the level of dimensions

CLASSES THRESHOLDS IN INFORM 2016			
Dimension	CLASS	MAX	MIN
RISK	very high	10	6.5
	high	6.4	5.0
	medium	4.9	3.5
	low	3.4	2.0
	very low	1.9	0.0
HAZARD & EXPOSURE	very high	10.0	6.1
	high	6.0	4.1
	medium	4.0	2.7
	low	2.6	1.5
	very low	1.4	0.0
VULNERABILITY	very high	10.0	6.4
	high	6.3	4.8
	medium	4.7	3.3
	low	3.2	2.0
	very low	1.9	0.0
LACK OF COPING CAPACITY	very high	10.0	7.4
	high	7.3	6.0
	medium	5.9	4.7
	low	4.6	3.2
	very low	3.1	0.0

Table 22: Fixed thresholds at the level of categories

CLASSES THRESHOLDS IN INFORM 2016			
Category	CLASS	MAX	MIN
NATURAL	very high	10.0	6.9
	high	6.8	4.7
	medium	4.6	2.8
	low	2.7	1.3
	very low	1.2	0.0
HUMAN	very high	10.0	9.0
	high	8	7
	medium	6.9	3.1
	low	3.0	1.0
	very low	0.9	0.0
SOCIO-ECONOMIC	very high	10.0	7.1
	high	7.0	5.4
	medium	5.3	3.5
	low	3.4	1.8
	very low	1.7	0.0
VULNERABLE GROUPS	very high	10.0	6.3
	high	6.2	4.4
	medium	4.3	2.9
	low	2.8	1.6
	very low	1.5	0.0
INSTITUTIONAL	very high	10.0	7.3
	high	7.2	6.0
	medium	5.9	4.9
	low	4.8	3.3
	very low	3.2	0.0
INFRASTRUCTURE	very high	10.0	7.4
	high	7.3	5.4
	medium	5.3	3.5
	low	3.4	2.1
	very low	2.0	0.0

7.3. Trends

Due to fixed threshold the countries can in the future change the class based on their performance. As there are many global proactive initiatives to improve the disaster risk management on national level most probably the number of the countries within the very high/high risk cluster will be decreasing. On the other hand increased exposure and increased hazard probability due to climate change would increase the number of countries in the very high/high risk cluster.

INFORM results are always available for at least five years, making it easy to analyse risk trends[39]. The historical results are back calculated using the same methodology and data source of the published release.

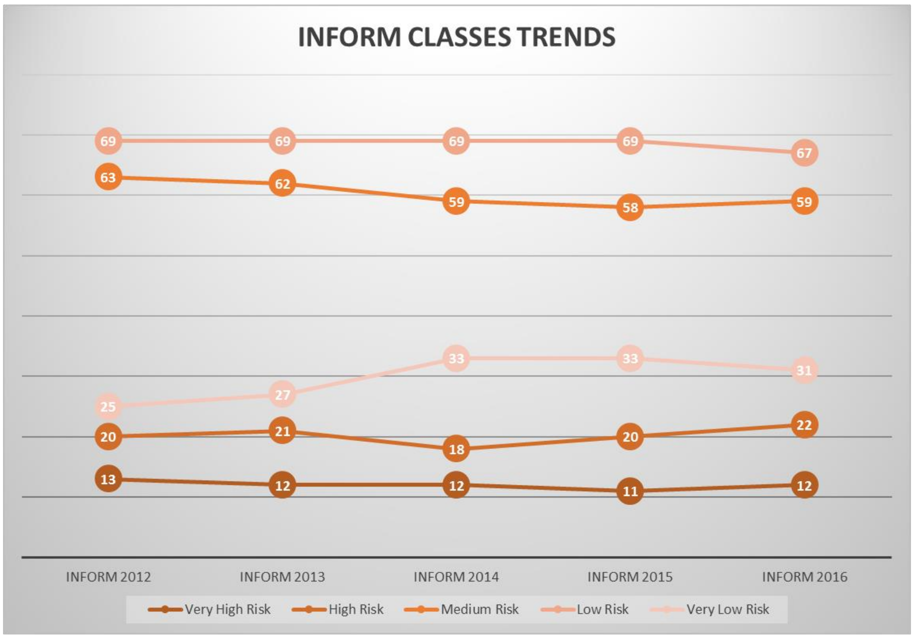

Figure 8: Dynamics of the classes sizes through last five years

Limitation of the trend data. The natural hazard category is kept constant over the five years. In order to have continuous data for the all five years, the most recent values has been used to cover missing values for the previous years (e.g. in the HFA some countries started reporting very recently, and there are cases where exist data for 2013 but not for previous year).

[39] http://www.inform-index.org/Results/Global

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ANNEX A: KEY STATISTICAL METRICS

Table 23: Correlation matrix[40]

	Earthquakes	Floods	Tsunamis	Tropical cyclones	Droughts	Natural	Conflict Probability	Current Highly violent conflicts	Human	Development & Deprivation	Inequality	Aid Dependency	Social-Economics Vulnerability	Uprooted people	HIV, TBC, Malaria Prevalence	Children U5	Recent Shocks	Food Security	Other Vulnerable Groups	Vulnerable Groups	DRR	Governance	Institutional	Communication	Physical infrastructure	Access to health care	Infrastructure	HAZARD	VULNERABILITY	COPING CAPACITY	RISK
RISK	0.19	0.45	0.21	0.06	0.46	0.43	0.76	0.67	0.78	0.65	0.54	0.36	0.64	0.63	0.41	0.69	0.21	0.54	0.67	0.80	0.40	0.75	0.68	0.69	0.72	0.72	0.76	0.80	0.85	0.79	1.00
COPING CAPACITY	-0.11	0.24	-0.06	-0.05	0.40	0.09	0.39	0.35	0.39	0.86	0.68	0.52	0.85	0.26	0.64	0.84	0.14	0.63	0.79	0.53	0.69	0.88	0.90	0.87	0.88	0.88	0.94	0.34	0.81	1.00	0.79
VULNERABILITY	-0.07	0.18	-0.03	-0.11	0.36	0.06	0.55	0.47	0.55	0.80	0.60	0.59	0.83	0.63	0.59	0.76	0.23	0.58	0.78	0.84	0.46	0.67	0.65	0.82	0.72	0.75	0.82	0.44	1.00	0.81	0.85
HAZARD	0.46	0.56	0.47	0.26	0.36	0.71	0.83	0.72	0.87	0.18	0.20	-0.02	0.15	0.58	0.00	0.29	0.12	0.22	0.23	0.58	0.02	0.43	0.31	0.22	0.33	0.32	0.32	1.00	0.44	0.34	0.80
Infrastructure	-0.15	0.22	-0.05	-0.01	0.41	0.08	0.40	0.30	0.37	0.89	0.69	0.51	0.87	0.26	0.70	0.89	0.13	0.63	0.82	0.54	0.49	0.75	0.70	0.93	0.94	0.93	1.00	0.32	0.82	0.94	0.76
Access to health care	-0.09	0.18	0.01	0.04	0.31	0.12	0.35	0.29	0.33	0.79	0.70	0.53	0.81	0.21	0.61	0.79	0.18	0.58	0.75	0.48	0.51	0.72	0.68	0.81	0.78	1.00	0.93	0.32	0.75	0.88	0.72
Physical infrastructure	-0.14	0.31	-0.06	-0.07	0.47	0.09	0.42	0.31	0.39	0.79	0.65	0.33	0.73	0.29	0.66	0.84	0.06	0.58	0.74	0.53	0.41	0.69	0.65	0.82	1.00	0.78	0.94	0.33	0.72	0.88	0.72
Communication	-0.18	0.11	-0.08	0.01	0.35	0.01	0.34	0.23	0.29	0.93	0.61	0.60	0.91	0.21	0.69	0.86	0.13	0.63	0.81	0.49	0.45	0.67	0.64	1.00	0.82	0.81	0.93	0.22	0.82	0.87	0.69
Institutional	-0.02	0.21	-0.06	-0.09	0.31	0.09	0.30	0.36	0.35	0.64	0.57	0.45	0.68	0.20	0.45	0.62	0.13	0.51	0.61	0.43	0.87	0.91	1.00	0.64	0.65	0.68	0.70	0.31	0.65	0.90	0.68
Governance	0.07	0.33	0.02	-0.03	0.39	0.23	0.41	0.37	0.43	0.68	0.57	0.39	0.68	0.25	0.45	0.67	0.16	0.53	0.63	0.47	0.54	1.00	0.91	0.67	0.69	0.72	0.75	0.43	0.67	0.88	0.75
DRR	-0.08	-0.08	-0.15	-0.09	0.08	-0.12	0.06	0.21	0.10	0.42	0.45	0.48	0.53	0.03	0.31	0.40	0.11	0.36	0.43	0.23	1.00	0.54	0.87	0.45	0.41	0.51	0.49	0.02	0.46	0.69	0.40
Vulnerable Groups	0.06	0.37	0.02	-0.19	0.31	0.15	0.68	0.58	0.70	0.46	0.31	0.18	0.41	0.92	0.37	0.54	0.21	0.43	0.58	1.00	0.23	0.47	0.43	0.49	0.53	0.48	0.54	0.58	0.84	0.53	0.80
Other Vulnerable Groups	-0.17	0.19	-0.10	-0.03	0.35	0.02	0.36	0.21	0.29	0.79	0.57	0.47	0.77	0.23	0.74	0.81	0.44	0.74	1.00	0.58	0.43	0.63	0.61	0.81	0.74	0.75	0.82	0.23	0.78	0.79	0.67
Food Security	-0.09	0.20	-0.12	0.01	0.26	0.04	0.30	0.23	0.27	0.64	0.51	0.30	0.59	0.18	0.46	0.60	0.08	1.00	0.74	0.43	0.36	0.53	0.51	0.63	0.58	0.58	0.63	0.22	0.58	0.63	0.54
Recent Shocks	0.18	0.07	0.15	0.12	0.12	0.23	0.06	-0.07	0.01	0.10	0.13	0.21	0.17	0.05	-0.04	0.04	1.00	0.08	0.44	0.21	0.11	0.16	0.13	0.13	0.06	0.18	0.13	0.12	0.23	0.14	0.21
Children U5	-0.25	0.24	-0.13	-0.07	0.40	-0.01	0.47	0.31	0.40	0.88	0.56	0.38	0.78	0.29	0.70	1.00	0.04	0.60	0.81	0.54	0.40	0.67	0.62	0.86	0.84	0.79	0.89	0.29	0.76	0.84	0.69
HIV, TBC, Malaria Prevalence	-0.37	0.06	-0.18	-0.14	0.25	-0.20	0.18	0.12	0.14	0.68	0.52	0.37	0.65	0.10	1.00	0.70	-0.04	0.46	0.74	0.37	0.31	0.45	0.45	0.69	0.66	0.61	0.70	0.00	0.59	0.64	0.41
Uprooted people	0.14	0.39	0.06	-0.22	0.21	0.16	0.66	0.57	0.69	0.19	0.10	-0.03	0.12	1.00	0.10	0.29	0.05	0.18	0.23	0.92	0.03	0.25	0.20	0.21	0.29	0.21	0.26	0.58	0.63	0.26	0.63
Social-Economics Vulnerability	-0.20	-0.03	-0.09	0.01	0.33	-0.04	0.25	0.20	0.22	0.93	0.75	0.77	1.00	0.12	0.65	0.78	0.17	0.59	0.77	0.41	0.53	0.68	0.68	0.91	0.73	0.81	0.87	0.15	0.83	0.85	0.64
Aid Dependency	-0.09	-0.29	-0.09	0.02	0.09	-0.13	0.02	0.10	0.03	0.53	0.40	1.00	0.77	-0.03	0.37	0.38	0.21	0.30	0.47	0.18	0.48	0.39	0.45	0.60	0.33	0.53	0.51	-0.02	0.59	0.52	0.36
Inequality	-0.09	0.09	0.01	0.13	0.35	0.10	0.23	0.16	0.20	0.62	1.00	0.40	0.75	0.10	0.52	0.56	0.13	0.51	0.57	0.31	0.45	0.57	0.57	0.61	0.65	0.70	0.69	0.20	0.60	0.68	0.54
Development & Deprivation	-0.25	0.10	-0.12	-0.04	0.36	-0.05	0.33	0.21	0.27	1.00	0.62	0.53	0.93	0.19	0.68	0.88	0.10	0.64	0.79	0.46	0.42	0.68	0.64	0.93	0.79	0.79	0.89	0.18	0.80	0.86	0.65
Human	0.13	0.49	0.12	0.00	0.29	0.30	0.93	0.86	1.00	0.27	0.20	0.03	0.22	0.69	0.14	0.40	0.01	0.27	0.29	0.70	0.10	0.43	0.35	0.29	0.39	0.33	0.37	0.87	0.55	0.39	0.78
Current Highly violent conflicts	0.06	0.29	0.05	-0.04	0.13	0.14	0.68	1.00	0.86	0.21	0.16	0.10	0.20	0.57	0.12	0.31	-0.07	0.23	0.21	0.58	0.21	0.37	0.36	0.23	0.31	0.29	0.30	0.72	0.47	0.35	0.67
Conflict Probability	0.14	0.55	0.14	0.05	0.33	0.35	1.00	0.68	0.93	0.33	0.23	0.02	0.25	0.66	0.18	0.47	0.06	0.30	0.36	0.68	0.06	0.41	0.30	0.34	0.42	0.35	0.40	0.83	0.55	0.39	0.76
Natural	0.73	0.46	0.74	0.52	0.34	1.00	0.35	0.14	0.30	-0.05	0.10	-0.13	-0.04	0.16	-0.20	-0.01	0.23	0.04	0.02	0.15	-0.12	0.23	0.09	0.01	0.09	0.12	0.08	0.71	0.06	0.09	0.43
Droughts	0.08	0.27	0.05	-0.07	1.00	0.34	0.33	0.13	0.29	0.36	0.35	0.09	0.33	0.21	0.25	0.40	0.12	0.26	0.35	0.31	0.08	0.39	0.31	0.35	0.47	0.31	0.41	0.36	0.36	0.40	0.46
Tropical cyclones	0.25	-0.01	0.38	1.00	-0.07	0.52	0.05	-0.04	0.00	-0.04	0.13	0.02	0.01	-0.22	-0.14	-0.07	0.12	0.01	-0.03	-0.19	-0.09	-0.03	-0.09	0.01	-0.07	0.04	-0.01	0.26	-0.11	-0.05	0.06
Tsunamis	0.43	0.11	1.00	0.38	0.05	0.74	0.14	0.05	0.12	-0.12	0.01	-0.09	-0.09	0.06	-0.18	-0.13	0.15	-0.12	-0.10	0.02	-0.15	0.02	-0.06	-0.08	-0.06	0.01	-0.05	0.47	-0.03	-0.06	0.21
Floods	0.15	1.00	0.11	-0.01	0.27	0.46	0.55	0.29	0.49	0.10	0.09	-0.29	-0.03	0.39	0.06	0.24	0.07	0.20	0.19	0.37	-0.08	0.33	0.21	0.11	0.31	0.18	0.22	0.56	0.18	0.24	0.45
Earthquakes	1.00	0.15	0.43	0.25	0.08	0.73	0.14	0.06	0.13	-0.25	-0.09	-0.09	-0.20	0.14	-0.37	-0.25	0.18	-0.09	-0.17	0.06	-0.08	0.07	-0.02	-0.18	-0.14	-0.09	-0.15	0.46	-0.07	-0.11	0.19

40 Element i,j equals to the Pearson's correlation coefficient between the i^{th} row and the j^{th} column variable.

Table 24: Statistical influences of the INFORM categories within dimensions

	Hazard & Exposure		Vulnerability		Lack of Coping Capacity		InfoRM	
	CC^2	Norm	CC^2	Norm	CC^2	Norm	CC^2	Norm
Natural 50%	0.51	0.40						
Human 50%	0.76	0.60						
Socio- economic 50%			0.69	0.49				
Vulnerable Groups 50%			0.71	0.51				
Institutional 50%					0.81	0.48		
Infrastructure 50%					0.89	0.52		
Hazard & Exposure 33%							0.63	0.32
Vulnerability 33%							0.73	0.37
Lack of Coping Capacity 33%							0.62	0.31

CC - Pearson's correlation coefficient
Norm - Normalized influence

Correlation analysis reveals bivariate (i.e., pairwise) Pearson's correlation coefficients between the indexes (i.e., variables), positioned in the same level or different levels of the composite index structure (Table 23). A lack of correlation among the sub-indices of the same component/category/dimension, that is the indices within the same level, is a useful property. It indicates that they are measuring different "statistical dimensions" in data. The less they are correlated the more variables are needed to explain the same level of the variance. The covariance of indices may be further investigated via factor analysis[41]. How many "factors" should be retained in the composite index without losing to much information can be decided by, among others, variance explained criteria [15]. Usually the rule is to keep enough factors to account for 90% of the variation. This is the way to reduce the number of variables by finding dominant ones within the full set.

A square of a Pearson's correlation coefficient between the sub-indices and one-level-up aggregate index (component/category/dimension) can measure the influence of sub-index on the aggregate index due to correlation [16]. The relative differences among those correlations explain the influence of a given sub-index for the aggregate index. In weighted arithmetic or geometric average (including the case of equal weights), nominal weights are defined by the methodology. However the relative influence of indices for the aggregated index depends on their distribution after normalization as well as their correlation structure. So, it can be the case that the nominal weighting scheme of the composite index is not reflecting the statistical importance of individual indices within the structure. In that case is good practice to adjust the weighting scheme.

[41] An extended statistical audit will be performed in 2015 by JRC, and will be published separately.

Table 25: Statistical influences of the underlying components

	Natural		*Human*		*Socio-Economic Vulnerability*		*Vulnerable Groups*		*Institutional*		*Infrastructure*	
	CC^2	Norm	CC^2	Norm	CC^2	Norm	CC^2	Norm	CC^2	Norm	CC^2	Norm
Earthquakes 20%	0.53	0.32										
Tsunamis 20%	0.21	0.13										
Floods 20%	0.55	0.33										
Tropical cyclones 20%	0.27	0.16										
Droughts 20%	0.12	0.07										
Current Highly Violent Conflict 50%			0.74	0.46								
Conflict Probability 50%			0.87	0.54								
Development & Deprivation 50%					0.86	0.43						
Inequality 25%					0.56	0.28						
Aid Dependency 25%					0.60	0.30						
Uprooted people 50%							0.84	0.71				
Other Vulnerable Groups 50%							0.34	0.29				
DRR 50%									0.76	0.48		
Governance 50%									0.82	0.52		
Communication 33%											0.87	0.33
Physical infrastructure 33%											0.87	0.33
Access to health care 33%											0.86	0.33

CC - Pearson's correlation coefficient
Norm - Normalized influence

The results of the correlation analysis are shown in Table 24 - Table 25. Similar Pearson's correlation coefficients (always squared) of the categories within the same dimension justifies the equal weighting imposed in the INFORM methodology (Table 24). The higher influence of the Vulnerability dimension and the Lack of Coping Capacity dimension compared to the Hazard & Exposure dimension is appreciated in order to increase the sensitivity of the composite index to the indicator that can be most influenced by DRR activities. So, dimensions and categories of the composite index are well structured and balanced.

For the lower levels (Table 25) results suggest that all underlying components contribute in a similar way to the variation of the aggregated score of the next level. Within the Socio-Economic Vulnerability category the Development & Deprivation component has a stronger influence as intended through a double nominal weight. Within the Human Hazard category the normalized influences of are well balanced between the Current Highly Violent Conflict and Conflict Probability. So, the overall index is well-structured and balanced in the underlying components.

The results of the correlation analysis are time-dependent and will change with updated datasets.

ANNEX B: CORE INDICATORS

N.	Name of core indicator	Position in the INFORM model		
1	Physical exposure to earthquake MMI VI (absolute)	Earthquake	Natural	Hazard & Exposure
2	Physical exposure to earthquake MMI VI (relative)			
3	Physical exposure to earthquake MMI VIII (absolute)			
4	Physical exposure to earthquake MMI VIII (relative)			
5	Physical exposure to tsunamis (absolute)	Tsunami		
6	Physical exposure to tsunamis (relative)			
7	Physical exposure to flood (absolute)	Flood		
8	Physical exposure to flood (relative)			
9	Physical exposure to surge from tropical cyclone (absolute)	Tropical Cyclone		
10	Physical exposure to surge from tropical cyclone (relative)			
11	Physical exposure to tropical cyclone of SS 1 (absolute)			
12	Physical exposure to tropical cyclone of SS 1 (relative)			
13	Physical exposure to tropical cyclone of SS 3 (absolute)			
14	Physical exposure to tropical cyclone of SS 3 (relative)			
15	People affected by droughts (absolute)	Drought		
16	People affected by droughts (relative)			
17	Frequency of Drought events			
18	Agriculture Drought probability			
19	GCRI Violent Internal Conflict probability	Projected Conflict Risk	Human	
20	GCRI High Violent Internal Conflict probability			
21	Current National Power Conflict Intensity	Current Conflicts Intensity		
22	Current Subnational Conflict Intensity			
23	Human Development Index	Poverty & Development	Socio-Economic Vulnerability	Vulnerability
24	Multidimensional Poverty Index			
25	Gender Inequality Index	Inequality		
26	Gini Coefficient			
27	Public Aid per capita	Aid Dependency		
28	Net ODA Received (% of GNI)			
29	Total Persons of Concern (absolute)	Uprooted people	Vulnerable Groups	
30	Total Persons of Concern (relative)			
31	Children Underweight	Other Vulnerable Groups Children under-5		
32	Child Mortality			
33	Prevalence of HIV-AIDS above 15years	Other Vulnerable Groups Health Conditions		
34	Tuberculosis prevalence			
35	Malaria mortality rate			
36	Relative number of affected population by natural disasters in the last three years	Other Vulnerable Groups Recent Shocks		
37	Prevalence of undernourishment	Other Vulnerable Groups Food Security		
38	Average dietary supply adequacy			
39	Domestic Food Price Level Index			
40	Domestic Food Price Volatility Index			
41	Hyogo Framework for Action	DRR implementation	Institutional	Lack of Coping Capacity
42	Government effectiveness	Governance		
43	Corruption Perception Index			
44	Access to electricity (% of population)	Communication	Infrastructure	
45	Internet Users (per 100 people)			
46	Mobile cellular subscriptions (per 100 people)			
47	Adult literacy rate			
48	Road density (km of road per 100 sq. km of land area)	Physical Connectivity		
49	Access to Improved water source (% of pop with access)			
50	Access to Improved sanitation facilities (% of pop with access)			
51	Physicians density	Access to health system		
52	Health expenditure per capita			
53	Measles immunization coverage			

ANNEX C: INFORM INDEX - COUNTRIES BY ALPHABETIC ORDER

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Afghanistan	AFG	5.5	10.0	8.6	6.9	7.4	7.2	7.4	8.5	8.0	7.9	3	2
Albania	ALB	5.1	0.3	3.0	2.3	1.0	1.7	6.2	3.1	4.8	2.9	111	2
Algeria	DZA	3.6	8.0	6.3	3.3	3.6	3.5	4.9	4.9	4.9	4.8	37	2
Angola	AGO	2.0	2.6	2.3	4.5	4.7	4.6	6.6	7.5	7.1	4.2	62	2
Antigua and Barbuda	ATG	3.7	0.0	2.0	2.0	1.3	1.7	4.7	2.1	3.5	2.3	144	10
Argentina	ARG	3.1	1.7	2.4	1.9	1.1	1.5	5.0	2.1	3.7	2.4	138	2
Armenia	ARM	3.8	0.1	2.1	2.4	3.6	3.0	6.6	2.7	5.0	3.2	100	0
Australia	AUS	5.7	0.1	3.4	0.6	2.7	1.7	2.2	1.9	2.1	2.3	144	5
Austria	AUT	2.3	0.1	1.3	0.8	3.4	2.2	2.2	1.2	1.7	1.7	167	4
Azerbaijan	AZE	3.8	0.5	2.3	1.8	6.5	4.6	6.5	2.9	5.0	3.8	80	3
Bahamas	BHS	3.2	0.0	1.7	2.3	0.9	1.6	3.1	2.8	3.0	2.0	154	7
Bahrain	BHR	0.1	0.1	0.1	1.9	1.2	1.6	4.2	1.6	3.0	0.8	188	6
Bangladesh	BGD	8.6	5.0	7.2	3.9	5.7	4.9	5.1	6.3	5.7	5.9	20	0
Barbados	BRB	1.7	0.0	0.9	2.6	0.8	1.7	2.7	2.4	2.6	1.6	170	5
Belarus	BLR	1.8	1.3	1.6	1.0	1.3	1.2	4.9	1.5	3.4	1.9	161	2
Belgium	BEL	1.4	0.0	0.7	0.8	2.7	1.8	2.1	0.8	1.5	1.2	180	6
Belize	BLZ	4.8	0.0	2.7	3.2	1.0	2.2	5.4	4.4	4.9	3.1	104	4
Benin	BEN	1.2	1.3	1.3	6.4	2.2	4.6	5.8	8.3	7.2	3.5	89	0
Bhutan	BTN	2.8	0.1	1.5	4.9	1.2	3.3	4.2	5.7	5.0	2.9	111	0
Bolivia	BOL	3.4	0.7	2.2	3.4	2.2	2.8	5.9	5.1	5.5	3.2	100	0
Bosnia and Herzegovina	BIH	3.8	1.8	2.9	2.6	6.5	4.8	6.0	2.8	4.6	4.0	70	3
Botswana	BWA	2.6	0.3	1.5	4.3	3.6	4.0	4.9	4.9	4.9	3.1	104	1
Brazil	BRA	3.7	3.6	3.7	2.5	2.5	2.5	4.9	3.3	4.1	3.4	94	0
Brunei Darussalam	BRN	0.6	0.0	0.3	1.0	0.8	0.9	4.9	4.5	4.7	1.1	182	8
Bulgaria	BGR	3.1	1.1	2.2	2.0	2.6	2.3	4.2	2.0	3.2	2.5	134	2
Burkina Faso	BFA	2.4	2.7	2.6	7.3	6.2	6.8	4.7	7.7	6.4	4.8	37	0
Burundi	BDI	2.5	1.8	2.2	7.6	6.4	7.0	6.1	6.5	6.3	4.6	42	2
Cabo Verde	CPV	2.0	0.1	1.1	6.0	1.2	4.0	4.0	4.5	4.3	2.7	122	4
Cambodia	KHM	4.4	1.1	2.9	4.1	2.2	3.2	7.1	6.4	6.8	4.0	70	0
Cameroon	CMR	2.1	3.7	2.9	4.9	6.2	5.6	4.8	7.0	6.0	4.6	42	0
Canada	CAN	4.9	1.4	3.3	0.9	3.7	2.4	2.3	2.4	2.4	2.7	122	4
Central African Republic	CAF	1.4	10.0	7.8	8.3	8.2	8.3	8.1	9.1	8.7	8.3	2	3

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Chad	TCD	2.8	3.6	3.2	6.8	8.0	7.4	7.9	9.7	9.0	6.0	18	4
Chile	CHL	7.4	0.9	5.0	2.4	1.7	2.1	2.9	2.9	2.9	3.1	104	2
China	CHN	8.2	5.1	6.9	1.7	4.0	2.9	4.2	3.8	4.0	4.3	56	0
Colombia	COL	6.7	7.0	6.9	2.8	7.9	5.9	4.3	4.1	4.2	5.6	24	0
Comoros	COM	0.8	0.1	0.5	7.6	2.4	5.6	7.8	6.3	7.1	2.7	122	7
Congo	COG	1.9	0.2	1.1	4.1	6.0	5.1	7.6	7.3	7.5	3.5	89	1
Congo DR	COD	2.9	7.0	5.3	7.1	8.1	7.6	7.8	8.3	8.1	6.9	8	3
Costa Rica	CRI	6.5	0.1	4.0	2.8	3.1	3.0	3.0	3.0	3.0	3.3	95	1
Côte d'Ivoire	CIV	1.5	2.7	2.1	5.9	6.0	6.0	7.4	7.8	7.6	4.6	42	0
Croatia	HRV	5.3	0.1	3.1	1.6	1.2	1.4	4.4	1.7	3.2	2.4	138	3
Cuba	CUB	5.1	2.3	3.8	2.3	0.2	1.3	4.1	2.4	3.3	2.5	134	6
Cyprus	CYP	3.6	0.1	2.0	1.3	6.5	4.4	3.0	1.9	2.5	2.8	117	5
Czech Republic	CZE	2.0	0.4	1.2	0.9	2.0	1.5	3.3	1.1	2.3	1.6	170	3
Denmark	DNK	0.5	0.1	0.3	0.6	2.6	1.7	1.9	0.9	1.4	0.9	187	4
Djibouti	DJI	4.5	0.5	2.7	4.9	4.4	4.7	6.3	7.2	6.8	4.4	52	5
Dominica	DMA	3.3	0.0	1.8	4.5	0.9	2.9	3.9	2.9	3.4	2.6	129	11
Dominican Republic	DOM	6.6	1.0	4.4	2.7	1.6	2.2	5.5	4.0	4.8	3.6	87	0
Ecuador	ECU	7.1	0.2	4.5	3.3	4.5	3.9	4.7	4.2	4.5	4.3	56	1
Egypt	EGY	5.0	7.0	6.1	2.7	4.0	3.4	5.4	3.9	4.7	4.6	42	0
El Salvador	SLV	5.8	0.3	3.5	3.7	1.3	2.6	5.5	3.8	4.7	3.5	89	1
Equatorial Guinea	GNQ	1.3	0.2	0.8	4.2	2.3	3.3	8.2	6.7	7.5	2.7	122	7
Eritrea	ERI	2.9	2.0	2.5	6.3	4.9	5.6	8.2	7.5	7.9	4.8	37	7
Estonia	EST	0.9	0.1	0.5	1.4	1.2	1.3	3.1	1.3	2.2	1.1	182	4
Ethiopia	ETH	3.8	6.7	5.4	6.7	6.6	6.7	4.7	8.8	7.3	6.4	13	0
Fiji	FJI	5.7	0.1	3.4	3.7	0.9	2.4	3.5	4.9	4.2	3.2	100	7
Finland	FIN	0.1	0.1	0.1	0.8	2.4	1.6	1.6	1.0	1.3	0.6	190	5
France	FRA	3.8	3.3	3.6	0.9	4.0	2.6	2.8	1.2	2.0	2.7	122	4
Gabon	GAB	1.5	0.2	0.9	3.0	3.0	3.0	6.6	6.0	6.3	2.6	129	1
Gambia	GMB	1.4	0.1	0.8	6.7	3.9	5.5	4.9	5.9	5.4	2.9	111	0
Georgia	GEO	3.9	3.7	3.8	3.0	5.7	4.5	4.6	2.2	3.5	3.9	77	3
Germany	DEU	2.1	1.4	1.8	0.6	3.8	2.3	2.4	0.7	1.6	1.9	161	3
Ghana	GHA	1.3	1.2	1.3	4.1	3.3	3.7	4.3	6.4	5.4	3.0	110	0
Greece	GRC	5.3	1.7	3.7	1.3	2.4	1.9	3.6	1.0	2.4	2.6	129	3
Grenada	GRD	1.8	0.0	0.9	2.9	1.3	2.1	4.6	2.8	3.8	1.9	161	11

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Guatemala	GTM	6.5	1.1	4.3	4.4	5.7	5.1	6.1	5.8	6.0	5.1	29	1
Guinea	GIN	3.1	3.9	3.5	6.2	3.8	5.1	6.3	8.6	7.6	5.1	29	1
Guinea-Bissau	GNB	1.7	0.6	1.2	7.8	4.9	6.6	7.9	7.8	7.9	4.0	70	4
Guyana	GUY	2.8	0.1	1.5	4.1	1.0	2.7	6.2	4.9	5.6	2.8	117	4
Haiti	HTI	6.1	2.7	4.6	6.9	5.6	6.3	7.4	7.8	7.6	6.0	18	1
Honduras	HND	5.9	1.0	3.9	4.2	4.2	4.2	6.0	4.8	5.4	4.5	50	1
Hungary	HUN	3.5	0.4	2.1	1.6	1.8	1.7	2.8	1.3	2.1	2.0	154	3
Iceland	ISL	1.7	0.0	0.9	0.7	1.0	0.9	2.1	1.8	2.0	1.2	180	6
India	IND	7.8	6.9	7.4	4.0	5.3	4.7	3.8	6.1	5.1	5.6	24	0
Indonesia	IDN	7.4	5.5	6.5	2.4	3.1	2.8	4.7	5.6	5.2	4.6	42	0
Iran	IRN	6.7	1.4	4.6	2.9	5.6	4.4	5.7	4.0	4.9	4.6	42	1
Iraq	IRQ	5.1	10.0	8.5	2.8	8.1	6.1	8.1	5.9	7.1	7.2	6	1
Ireland	IRL	2.4	0.1	1.3	0.8	1.8	1.3	2.4	1.5	2.0	1.5	173	5
Israel	ISR	3.3	2.4	2.9	1.2	3.2	2.3	3.3	1.1	2.3	2.5	134	4
Italy	ITA	5.1	3.6	4.4	1.1	3.2	2.2	3.7	1.0	2.5	2.9	111	3
Jamaica	JAM	3.9	0.2	2.2	3.3	1.3	2.4	4.5	4.0	4.3	2.8	117	2
Japan	JPN	8.5	1.8	6.2	0.9	0.9	0.9	2.0	1.1	1.6	2.1	149	4
Jordan	JOR	2.8	1.3	2.1	3.6	7.8	6.1	5.7	2.8	4.4	3.8	80	2
Kazakhstan	KAZ	3.5	0.6	2.2	1.5	0.5	1.0	5.2	2.6	4.0	2.1	149	3
Kenya	KEN	4.2	7.0	5.8	5.1	7.0	6.1	5.4	7.5	6.6	6.2	16	0
Kiribati	KIR	4.7	0.1	2.7	6.9	2.7	5.2	6.7	6.3	6.5	4.5	50	12
Korea DPR	PRK	4.1	1.8	3.0	5.0	2.9	4.0	9.1	3.6	7.2	4.4	52	8
Korea Republic of	KOR	5.9	0.4	3.6	0.8	0.5	0.7	2.6	1.4	2.0	1.7	167	4
Kuwait	KWT	2.2	0.5	1.4	2.0	1.2	1.6	5.4	1.6	3.7	2.0	154	5
Kyrgyzstan	KGZ	5.4	1.1	3.5	3.4	1.0	2.3	5.3	3.8	4.6	3.3	95	2
Lao PDR	LAO	4.4	1.1	2.9	4.2	3.3	3.8	6.6	6.4	6.5	4.2	62	0
Latvia	LVA	1.8	0.1	1.0	1.8	1.2	1.5	3.9	1.7	2.9	1.6	170	4
Lebanon	LBN	4.1	4.8	4.5	4.2	8.5	6.9	5.7	2.6	4.3	5.1	29	5
Lesotho	LSO	2.0	1.3	1.7	6.4	4.0	5.3	7.0	6.2	6.6	3.9	77	2
Liberia	LBR	1.6	0.6	1.1	8.3	5.4	7.1	7.0	8.8	8.0	4.0	70	3
Libya	LBY	4.2	8.0	6.5	2.1	6.6	4.7	8.1	4.8	6.8	5.9	20	7
Liechtenstein	LIE	1.3	0.0	0.7	0.6	2.5	1.6	1.5	0.9	1.2	1.1	182	19
Lithuania	LTU	1.5	0.1	0.8	1.3	1.2	1.3	3.8	1.3	2.6	1.4	174	4
Luxembourg	LUX	0.3	0.1	0.2	1.1	1.3	1.2	1.8	0.7	1.3	0.7	189	6

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Macedonia FYR	MKD	2.8	1.3	2.1	2.5	2.9	2.7	4.6	2.7	3.7	2.8	117	1
Madagascar	MDG	5.7	0.7	3.6	5.3	3.0	4.2	6.0	9.1	7.9	4.9	35	1
Malawi	MWI	3.3	0.5	2.0	7.0	4.2	5.8	5.2	7.3	6.4	4.2	62	0
Malaysia	MYS	4.3	3.2	3.8	2.4	4.2	3.4	3.2	3.3	3.3	3.5	89	1
Maldives	MDV	3.4	0.0	1.9	2.6	1.0	1.8	5.7	1.9	4.1	2.4	138	3
Mali	MLI	3.2	8.0	6.2	7.7	5.6	6.8	5.9	7.6	6.8	6.6	10	0
Malta	MLT	1.6	0.1	0.9	1.7	3.0	2.4	3.5	1.0	2.3	1.7	167	6
Marshall Islands	MHL	3.6	0.0	2.0	7.5	2.4	5.5	7.8	5.2	6.7	4.2	62	12
Mauritania	MRT	4.5	2.0	3.4	6.2	5.1	5.7	5.9	7.9	7.0	5.1	29	0
Mauritius	MUS	3.2	0.0	1.7	3.1	0.9	2.1	3.6	2.3	3.0	2.2	148	5
Mexico	MEX	7.1	9.0	8.2	2.2	4.1	3.2	5.3	3.6	4.5	4.9	35	0
Micronesia	FSM	3.9	0.0	2.2	6.6	2.3	4.8	6.1	5.8	6.0	4.0	70	11
Moldova Republic of	MDA	3.8	3.2	3.5	2.9	1.5	2.2	6.2	2.9	4.8	3.3	95	1
Mongolia	MNG	2.7	2.0	2.4	3.2	1.6	2.4	5.6	4.8	5.2	3.1	104	1
Montenegro	MNE	3.9	0.1	2.2	2.2	2.8	2.5	4.7	2.4	3.6	2.7	122	4
Morocco	MAR	4.3	1.1	2.9	4.3	0.9	2.8	5.6	4.5	5.1	3.5	89	2
Mozambique	MOZ	6.0	3.0	4.7	7.5	4.6	6.3	4.4	8.4	6.8	5.9	20	0
Myanmar	MMR	8.2	7.0	7.7	5.5	6.0	5.8	7.6	6.2	7.0	6.8	9	2
Namibia	NAM	3.2	0.6	2.0	4.8	4.5	4.7	4.6	6.3	5.5	3.7	84	0
Nauru	NRU	1.3	0.0	0.7	5.3	3.0	4.2	7.2	4.2	5.9	2.6	129	14
Nepal	NPL	5.5	2.5	4.2	4.1	6.0	5.1	6.2	5.9	6.1	5.1	29	1
Netherlands	NLD	1.7	0.1	0.9	0.5	3.5	2.1	1.7	1.0	1.4	1.4	174	4
New Zealand	NZL	5.8	0.1	3.5	0.9	1.3	1.1	1.9	2.2	2.1	2.0	154	7
Nicaragua	NIC	6.6	0.9	4.3	3.9	1.8	2.9	5.8	5.1	5.5	4.1	68	0
Niger	NER	3.0	3.8	3.4	7.4	6.0	6.8	5.9	9.1	7.9	5.7	23	0
Nigeria	NGA	2.3	9.0	6.8	4.1	6.8	5.6	5.0	7.8	6.6	6.3	15	1
Norway	NOR	0.2	0.3	0.3	0.2	3.5	2.0	1.9	1.3	1.6	1.0	186	5
Oman	OMN	5.8	0.3	3.5	2.5	0.8	1.7	5.1	3.1	4.2	2.9	111	5
Pakistan	PAK	6.9	8.0	7.5	4.0	6.9	5.6	5.5	6.6	6.1	6.4	13	0
Palau	PLW	2.2	0.0	1.2	5.1	0.8	3.2	6.1	4.0	5.1	2.7	122	9
Palestine	PSE	2.4	9.0	6.8	4.3	8.4	6.8	6.2	2.9	4.8	6.1	17	8
Panama	PAN	5.5	1.2	3.7	3.1	3.2	3.2	4.9	3.9	4.4	3.7	84	1
Papua New Guinea	PNG	5.2	0.2	3.1	6.4	3.7	5.2	6.9	9.0	8.1	5.1	29	4
Paraguay	PRY	2.1	0.1	1.2	3.7	1.3	2.6	5.5	4.0	4.8	2.5	134	1

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Peru	PER	7.6	1.3	5.2	2.3	4.3	3.4	4.7	4.7	4.7	4.4	52	0
Philippines	PHL	8.9	7.0	8.1	2.5	5.2	4.0	4.6	4.1	4.4	5.2	28	1
Poland	POL	2.1	1.3	1.7	1.4	2.3	1.9	4.1	1.6	2.9	2.1	149	3
Portugal	PRT	4.6	0.1	2.6	1.4	1.1	1.3	2.9	1.0	2.0	1.9	161	4
Qatar	QAT	0.9	0.1	0.5	2.5	0.9	1.7	3.9	0.5	2.4	1.3	178	5
Romania	ROU	4.4	3.2	3.8	1.9	1.5	1.7	4.6	2.7	3.7	2.9	111	2
Russian Federation	RUS	6.1	7.0	6.6	2.3	4.1	3.3	6.5	2.4	4.8	4.7	40	4
Rwanda	RWA	2.9	2.2	2.6	6.6	5.1	5.9	4.1	6.5	5.4	4.4	52	0
Saint Kitts and Nevis	KNA	3.1	0.0	1.7	4.2	0.8	2.7	3.6	2.2	2.9	2.4	138	11
Saint Lucia	LCA	3.2	0.0	1.7	3.5	0.8	2.3	4.1	3.3	3.7	2.4	138	8
St Vincent and the Grenadines	VCT	2.4	0.0	1.3	3.1	0.9	2.1	3.3	3.5	3.4	2.1	149	9
Samoa	WSM	1.3	0.0	0.7	6.2	0.4	3.9	4.7	4.1	4.4	2.3	144	8
Sao Tome and Principe	STP	0.1	0.0	0.1	5.6	1.4	3.8	6.2	5.2	5.7	1.3	178	5
Saudi Arabia	SAU	2.1	2.8	2.5	2.0	0.7	1.4	5.0	2.6	3.9	2.4	138	4
Senegal	SEN	2.4	2.4	2.4	6.0	4.7	5.4	5.3	7.0	6.2	4.3	56	0
Serbia	SRB	4.6	1.7	3.3	2.0	6.4	4.6	5.3	2.7	4.1	4.0	70	2
Seychelles	SYC	2.4	0.0	1.3	3.9	1.2	2.7	4.4	2.6	3.6	2.3	144	7
Sierra Leone	SLE	1.2	2.7	2.0	7.0	3.6	5.6	5.3	8.3	7.1	4.3	56	0
Singapore	SGP	0.1	0.0	0.1	0.7	0.3	0.5	1.3	1.1	1.2	0.4	191	5
Slovakia	SVK	3.2	0.6	2.0	1.2	1.3	1.3	3.8	1.3	2.6	1.9	161	4
Slovenia	SVN	2.6	0.1	1.4	0.7	1.2	1.0	2.3	1.4	1.9	1.4	174	3
Solomon Islands	SLB	6.4	0.0	3.9	8.1	3.6	6.4	6.7	7.3	7.0	5.6	24	9
Somalia	SOM	6.2	10.0	8.8	7.7	8.8	8.3	9.3	8.8	9.1	8.7	1	8
South Africa	ZAF	3.5	2.2	2.9	3.4	4.5	4.0	4.4	4.7	4.6	3.8	80	0
South Sudan	SSD	2.4	9.0	6.8	7.8	8.6	8.2	8.3	9.4	8.9	7.9	3	10
Spain	ESP	4.4	2.4	3.5	1.1	1.7	1.4	2.8	0.8	1.9	2.1	149	3
Sri Lanka	LKA	5.3	3.4	4.4	2.7	5.1	4.0	4.8	4.0	4.4	4.3	56	1
Sudan	SDN	3.5	9.0	7.1	5.4	8.3	7.1	6.7	7.8	7.3	7.2	6	4
Suriname	SUR	3.0	0.0	1.6	3.0	1.1	2.1	5.7	4.2	5.0	2.6	129	2
Swaziland	SWZ	1.8	0.8	1.3	4.6	3.4	4.0	5.1	6.1	5.6	3.1	104	2
Sweden	SWE	0.7	0.1	0.4	0.5	4.3	2.6	1.9	0.9	1.4	1.1	182	4
Switzerland	CHE	1.8	0.9	1.4	0.5	3.5	2.1	1.2	0.6	0.9	1.4	174	4
Syria	SYR	4.4	10.0	8.4	3.6	7.7	6.0	6.3	5.3	5.8	6.6	10	4
Tajikistan	TJK	5.6	1.8	3.9	3.0	2.9	3.0	6.1	4.5	5.4	4.0	70	2

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Tanzania	TZA	4.0	1.1	2.7	5.7	5.2	5.5	5.1	7.8	6.6	4.6	42	0
Thailand	THA	6.3	5.2	5.8	2.0	4.2	3.2	5.1	3.5	4.3	4.3	56	0
Timor-Leste	TLS	3.5	0.3	2.0	4.7	4.5	4.6	6.9	7.7	7.3	4.1	68	4
Togo	TGO	1.3	1.6	1.5	5.4	4.3	4.9	8.3	7.9	8.1	3.9	77	0
Tonga	TON	3.5	0.0	1.9	5.9	1.0	3.9	5.6	4.2	4.9	3.3	95	9
Trinidad and Tobago	TTO	2.5	0.1	1.4	1.8	1.5	1.7	4.9	2.1	3.6	2.0	154	3
Tunisia	TUN	4.3	0.4	2.6	2.3	1.0	1.7	6.0	3.6	4.9	2.8	117	1
Turkey	TUR	5.9	6.7	6.3	2.8	6.5	4.9	3.5	3.1	3.3	4.7	40	1
Turkmenistan	TKM	4.5	1.3	3.1	2.7	2.1	2.4	8.0	4.2	6.5	3.6	87	8
Tuvalu	TUV	2.0	0.0	1.0	7.5	1.3	5.2	6.3	4.7	5.6	3.1	104	12
Uganda	UGA	3.1	8.0	6.1	5.9	6.5	6.2	6.8	7.4	7.1	6.5	12	1
Ukraine	UKR	2.8	9.0	6.9	1.6	6.4	4.4	6.9	2.7	5.2	5.4	27	2
United Arab Emirates	ARE	5.4	0.4	3.3	1.8	0.3	1.1	2.5	1.8	2.2	2.0	154	7
United Kingdom	GBR	2.2	2.0	2.1	1.2	3.3	2.3	2.2	1.0	1.6	2.0	154	4
United States of America	USA	7.4	5.1	6.4	1.3	3.4	2.4	2.7	1.7	2.2	3.2	100	3
Uruguay	URY	1.1	0.8	1.0	2.4	1.3	1.9	3.8	2.0	2.9	1.8	166	2
Uzbekistan	UZB	5.9	2.8	4.5	2.0	1.6	1.8	5.1	3.7	4.4	3.3	95	3
Vanuatu	VUT	5.8	0.0	3.4	5.5	3.2	4.4	5.4	7.1	6.3	4.6	42	7
Venezuela	VEN	5.7	0.2	3.4	3.0	4.3	3.7	5.1	3.9	4.5	3.8	80	2
Viet Nam	VNM	7.3	3.0	5.6	2.7	1.0	1.9	5.3	3.8	4.6	3.7	84	2
Yemen	YEM	2.7	10.0	8.1	4.8	7.9	6.6	8.2	7.6	7.9	7.5	5	0
Zambia	ZMB	2.1	1.8	2.0	5.8	5.6	5.7	4.8	7.5	6.3	4.2	62	0
Zimbabwe	ZWE	2.5	2.2	2.4	5.3	5.4	5.4	5.1	6.2	5.7	4.2	62	4

ANNEX D: INFORM INDEX - COUNTRIES BY RANK

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Somalia	SOM	6.2	10.0	8.8	7.7	8.8	8.3	9.3	8.8	9.1	8.7	1	8
Central African Republic	CAF	1.4	10.0	7.8	8.3	8.2	8.3	8.1	9.1	8.7	8.3	2	3
Afghanistan	AFG	5.5	10.0	8.6	6.9	7.4	7.2	7.4	8.5	8.0	7.9	3	2
South Sudan	SSD	2.4	9.0	6.8	7.8	8.6	8.2	8.3	9.4	8.9	7.9	3	10
Yemen	YEM	2.7	10.0	8.1	4.8	7.9	6.6	8.2	7.6	7.9	7.5	5	0
Iraq	IRQ	5.1	10.0	8.5	2.8	8.1	6.1	8.1	5.9	7.1	7.2	6	1
Sudan	SDN	3.5	9.0	7.1	5.4	8.3	7.1	6.7	7.8	7.3	7.2	6	4
Congo DR	COD	2.9	7.0	5.3	7.1	8.1	7.6	7.8	8.3	8.1	6.9	8	3
Myanmar	MMR	8.2	7.0	7.7	5.5	6.0	5.8	7.6	6.2	7.0	6.8	9	2
Mali	MLI	3.2	8.0	6.2	7.7	5.6	6.8	5.9	7.6	6.8	6.6	10	0
Syria	SYR	4.4	10.0	8.4	3.6	7.7	6.0	6.3	5.3	5.8	6.6	10	4
Uganda	UGA	3.1	8.0	6.1	5.9	6.5	6.2	6.8	7.4	7.1	6.5	12	1
Ethiopia	ETH	3.8	6.7	5.4	6.7	6.6	6.7	4.7	8.8	7.3	6.4	13	0
Pakistan	PAK	6.9	8.0	7.5	4.0	6.9	5.6	5.5	6.6	6.1	6.4	13	0
Nigeria	NGA	2.3	9.0	6.8	4.1	6.8	5.6	5.0	7.8	6.6	6.3	15	1
Kenya	KEN	4.2	7.0	5.8	5.1	7.0	6.1	5.4	7.5	6.6	6.2	16	0
Palestine	PSE	2.4	9.0	6.8	4.3	8.4	6.8	6.2	2.9	4.8	6.1	17	8
Chad	TCD	2.8	3.6	3.2	6.8	8.0	7.4	7.9	9.7	9.0	6.0	18	4
Haiti	HTI	6.1	2.7	4.6	6.9	5.6	6.3	7.4	7.8	7.6	6.0	18	1
Bangladesh	BGD	8.6	5.0	7.2	3.9	5.7	4.9	5.1	6.3	5.7	5.9	20	0
Libya	LBY	4.2	8.0	6.5	2.1	6.6	4.7	8.1	4.8	6.8	5.9	20	7
Mozambique	MOZ	6.0	3.0	4.7	7.5	4.6	6.3	4.4	8.4	6.8	5.9	20	0
Niger	NER	3.0	3.8	3.4	7.4	6.0	6.8	5.9	9.1	7.9	5.7	23	0
Colombia	COL	6.7	7.0	6.9	2.8	7.9	5.9	4.3	4.1	4.2	5.6	24	0
India	IND	7.8	6.9	7.4	4.0	5.3	4.7	3.8	6.1	5.1	5.6	24	0
Solomon Islands	SLB	6.4	0.0	3.9	8.1	3.6	6.4	6.7	7.3	7.0	5.6	24	9
Ukraine	UKR	2.8	9.0	6.9	1.6	6.4	4.4	6.9	2.7	5.2	5.4	27	2
Philippines	PHL	8.9	7.0	8.1	2.5	5.2	4.0	4.6	4.1	4.4	5.2	28	1
Guatemala	GTM	6.5	1.1	4.3	4.4	5.7	5.1	6.1	5.8	6.0	5.1	29	1
Guinea	GIN	3.1	3.9	3.5	6.2	3.8	5.1	6.3	8.6	7.6	5.1	29	1
Lebanon	LBN	4.1	4.8	4.5	4.2	8.5	6.9	5.7	2.6	4.3	5.1	29	5
Mauritania	MRT	4.5	2.0	3.4	6.2	5.1	5.7	5.9	7.9	7.0	5.1	29	0

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Nepal	NPL	5.5	2.5	4.2	4.1	6.0	5.1	6.2	5.9	6.1	5.1	29	1
Papua New Guinea	PNG	5.2	0.2	3.1	6.4	3.7	5.2	6.9	9.0	8.1	5.1	29	4
Madagascar	MDG	5.7	0.7	3.6	5.3	3.0	4.2	6.0	9.1	7.9	4.9	35	1
Mexico	MEX	7.1	9.0	8.2	2.2	4.1	3.2	5.3	3.6	4.5	4.9	35	0
Algeria	DZA	3.6	8.0	6.3	3.3	3.6	3.5	4.9	4.9	4.9	4.8	37	2
Burkina Faso	BFA	2.4	2.7	2.6	7.3	6.2	6.8	4.7	7.7	6.4	4.8	37	0
Eritrea	ERI	2.9	2.0	2.5	6.3	4.9	5.6	8.2	7.5	7.9	4.8	37	7
Russian Federation	RUS	6.1	7.0	6.6	2.3	4.1	3.3	6.5	2.4	4.8	4.7	40	4
Turkey	TUR	5.9	6.7	6.3	2.8	6.5	4.9	3.5	3.1	3.3	4.7	40	1
Burundi	BDI	2.5	1.8	2.2	7.6	6.4	7.0	6.1	6.5	6.3	4.6	42	2
Cameroon	CMR	2.1	3.7	2.9	4.9	6.2	5.6	4.8	7.0	6.0	4.6	42	0
Côte d'Ivoire	CIV	1.5	2.7	2.1	5.9	6.0	6.0	7.4	7.8	7.6	4.6	42	0
Egypt	EGY	5.0	7.0	6.1	2.7	4.0	3.4	5.4	3.9	4.7	4.6	42	0
Indonesia	IDN	7.4	5.5	6.5	2.4	3.1	2.8	4.7	5.6	5.2	4.6	42	0
Iran	IRN	6.7	1.4	4.6	2.9	5.6	4.4	5.7	4.0	4.9	4.6	42	1
Tanzania	TZA	4.0	1.1	2.7	5.7	5.2	5.5	5.1	7.8	6.6	4.6	42	0
Vanuatu	VUT	5.8	0.0	3.4	5.5	3.2	4.4	5.4	7.1	6.3	4.6	42	7
Honduras	HND	5.9	1.0	3.9	4.2	4.2	4.2	6.0	4.8	5.4	4.5	50	1
Kiribati	KIR	4.7	0.1	2.7	6.9	2.7	5.2	6.7	6.3	6.5	4.5	50	12
Djibouti	DJI	4.5	0.5	2.7	4.9	4.4	4.7	6.3	7.2	6.8	4.4	52	5
Korea DPR	PRK	4.1	1.8	3.0	5.0	2.9	4.0	9.1	3.6	7.2	4.4	52	8
Peru	PER	7.6	1.3	5.2	2.3	4.3	3.4	4.7	4.7	4.7	4.4	52	0
Rwanda	RWA	2.9	2.2	2.6	6.6	5.1	5.9	4.1	6.5	5.4	4.4	52	0
China	CHN	8.2	5.1	6.9	1.7	4.0	2.9	4.2	3.8	4.0	4.3	56	0
Ecuador	ECU	7.1	0.2	4.5	3.3	4.5	3.9	4.7	4.2	4.5	4.3	56	1
Senegal	SEN	2.4	2.4	2.4	6.0	4.7	5.4	5.3	7.0	6.2	4.3	56	0
Sierra Leone	SLE	1.2	2.7	2.0	7.0	3.6	5.6	5.3	8.3	7.1	4.3	56	0
Sri Lanka	LKA	5.3	3.4	4.4	2.7	5.1	4.0	4.8	4.0	4.4	4.3	56	1
Thailand	THA	6.3	5.2	5.8	2.0	4.2	3.2	5.1	3.5	4.3	4.3	56	0
Angola	AGO	2.0	2.6	2.3	4.5	4.7	4.6	6.6	7.5	7.1	4.2	62	2
Lao PDR	LAO	4.4	1.1	2.9	4.2	3.3	3.8	6.6	6.4	6.5	4.2	62	0
Malawi	MWI	3.3	0.5	2.0	7.0	4.2	5.8	5.2	7.3	6.4	4.2	62	0
Marshall Islands	MHL	3.6	0.0	2.0	7.5	2.4	5.5	7.8	5.2	6.7	4.2	62	12
Zambia	ZMB	2.1	1.8	2.0	5.8	5.6	5.7	4.8	7.5	6.3	4.2	62	0

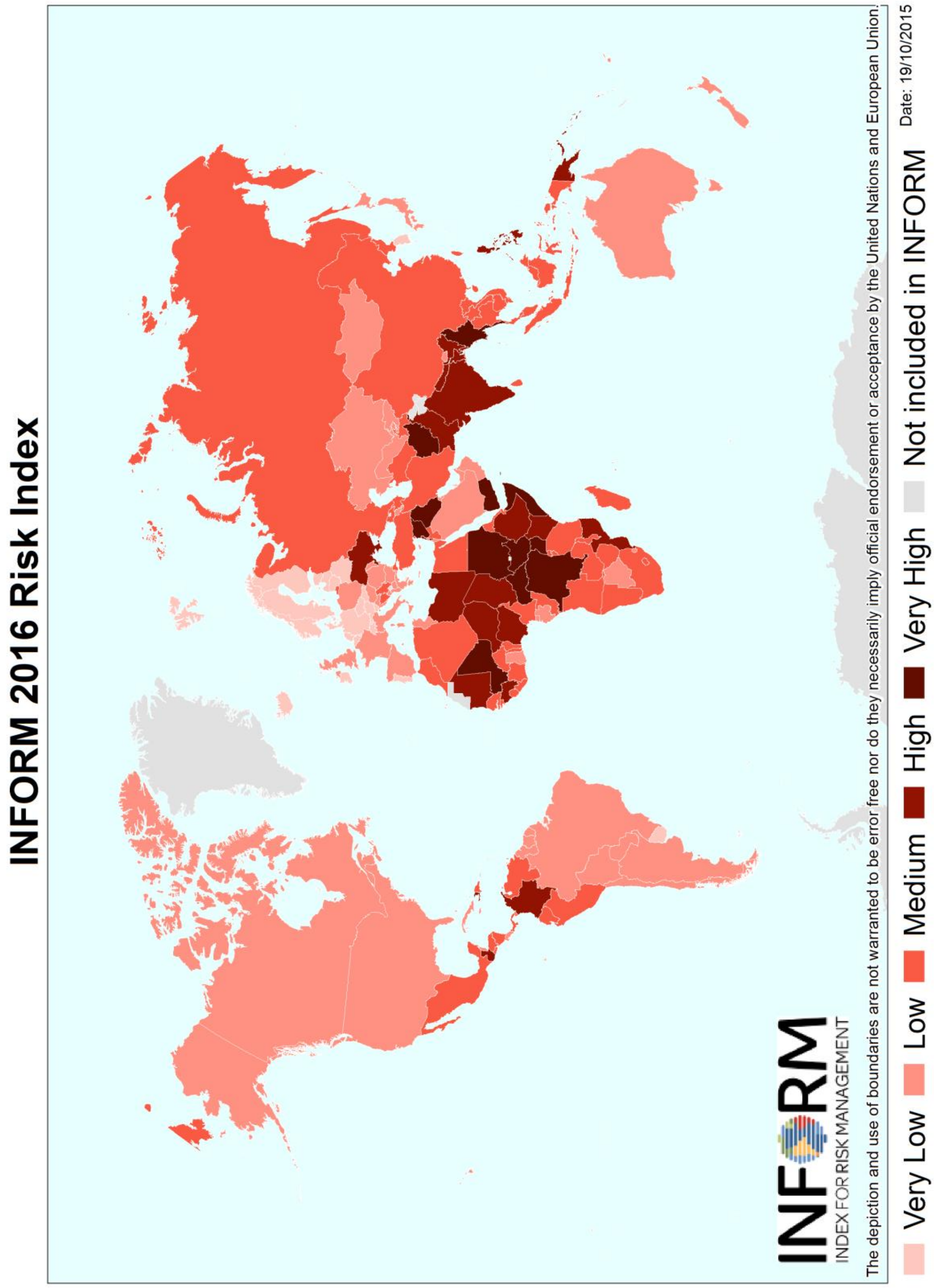
COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Zimbabwe	ZWE	2.5	2.2	2.4	5.3	5.4	5.4	5.1	6.2	5.7	4.2	62	4
Nicaragua	NIC	6.6	0.9	4.3	3.9	1.8	2.9	5.8	5.1	5.5	4.1	68	0
Timor-Leste	TLS	3.5	0.3	2.0	4.7	4.5	4.6	6.9	7.7	7.3	4.1	68	4
Bosnia and Herzegovina	BIH	3.8	1.8	2.9	2.6	6.5	4.8	6.0	2.8	4.6	4.0	70	3
Cambodia	KHM	4.4	1.1	2.9	4.1	2.2	3.2	7.1	6.4	6.8	4.0	70	0
Guinea-Bissau	GNB	1.7	0.6	1.2	7.8	4.9	6.6	7.9	7.8	7.9	4.0	70	4
Liberia	LBR	1.6	0.6	1.1	8.3	5.4	7.1	7.0	8.8	8.0	4.0	70	3
Micronesia	FSM	3.9	0.0	2.2	6.6	2.3	4.8	6.1	5.8	6.0	4.0	70	11
Serbia	SRB	4.6	1.7	3.3	2.0	6.4	4.6	5.3	2.7	4.1	4.0	70	2
Tajikistan	TJK	5.6	1.8	3.9	3.0	2.9	3.0	6.1	4.5	5.4	4.0	70	2
Georgia	GEO	3.9	3.7	3.8	3.0	5.7	4.5	4.6	2.2	3.5	3.9	77	3
Lesotho	LSO	2.0	1.3	1.7	6.4	4.0	5.3	7.0	6.2	6.6	3.9	77	2
Togo	TGO	1.3	1.6	1.5	5.4	4.3	4.9	8.3	7.9	8.1	3.9	77	0
Azerbaijan	AZE	3.8	0.5	2.3	1.8	6.5	4.6	6.5	2.9	5.0	3.8	80	3
Jordan	JOR	2.8	1.3	2.1	3.6	7.8	6.1	5.7	2.8	4.4	3.8	80	2
South Africa	ZAF	3.5	2.2	2.9	3.4	4.5	4.0	4.4	4.7	4.6	3.8	80	0
Venezuela	VEN	5.7	0.2	3.4	3.0	4.3	3.7	5.1	3.9	4.5	3.8	80	2
Namibia	NAM	3.2	0.6	2.0	4.8	4.5	4.7	4.6	6.3	5.5	3.7	84	0
Panama	PAN	5.5	1.2	3.7	3.1	3.2	3.2	4.9	3.9	4.4	3.7	84	1
Viet Nam	VNM	7.3	3.0	5.6	2.7	1.0	1.9	5.3	3.8	4.6	3.7	84	2
Dominican Republic	DOM	6.6	1.0	4.4	2.7	1.6	2.2	5.5	4.0	4.8	3.6	87	0
Turkmenistan	TKM	4.5	1.3	3.1	2.7	2.1	2.4	8.0	4.2	6.5	3.6	87	8
Benin	BEN	1.2	1.3	1.3	6.4	2.2	4.6	5.8	8.3	7.2	3.5	89	0
Congo	COG	1.9	0.2	1.1	4.1	6.0	5.1	7.6	7.3	7.5	3.5	89	1
El Salvador	SLV	5.8	0.3	3.5	3.7	1.3	2.6	5.5	3.8	4.7	3.5	89	1
Malaysia	MYS	4.3	3.2	3.8	2.4	4.2	3.4	3.2	3.3	3.3	3.5	89	1
Morocco	MAR	4.3	1.1	2.9	4.3	0.9	2.8	5.6	4.5	5.1	3.5	89	2
Brazil	BRA	3.7	3.6	3.7	2.5	2.5	2.5	4.9	3.3	4.1	3.4	94	0
Costa Rica	CRI	6.5	0.1	4.0	2.8	3.1	3.0	3.0	3.0	3.0	3.3	95	1
Kyrgyzstan	KGZ	5.4	1.1	3.5	3.4	1.0	2.3	5.3	3.8	4.6	3.3	95	2
Moldova Republic of	MDA	3.8	3.2	3.5	2.9	1.5	2.2	6.2	2.9	4.8	3.3	95	1
Tonga	TON	3.5	0.0	1.9	5.9	1.0	3.9	5.6	4.2	4.9	3.3	95	9
Uzbekistan	UZB	5.9	2.8	4.5	2.0	1.6	1.8	5.1	3.7	4.4	3.3	95	3
Armenia	ARM	3.8	0.1	2.1	2.4	3.6	3.0	6.6	2.7	5.0	3.2	100	0

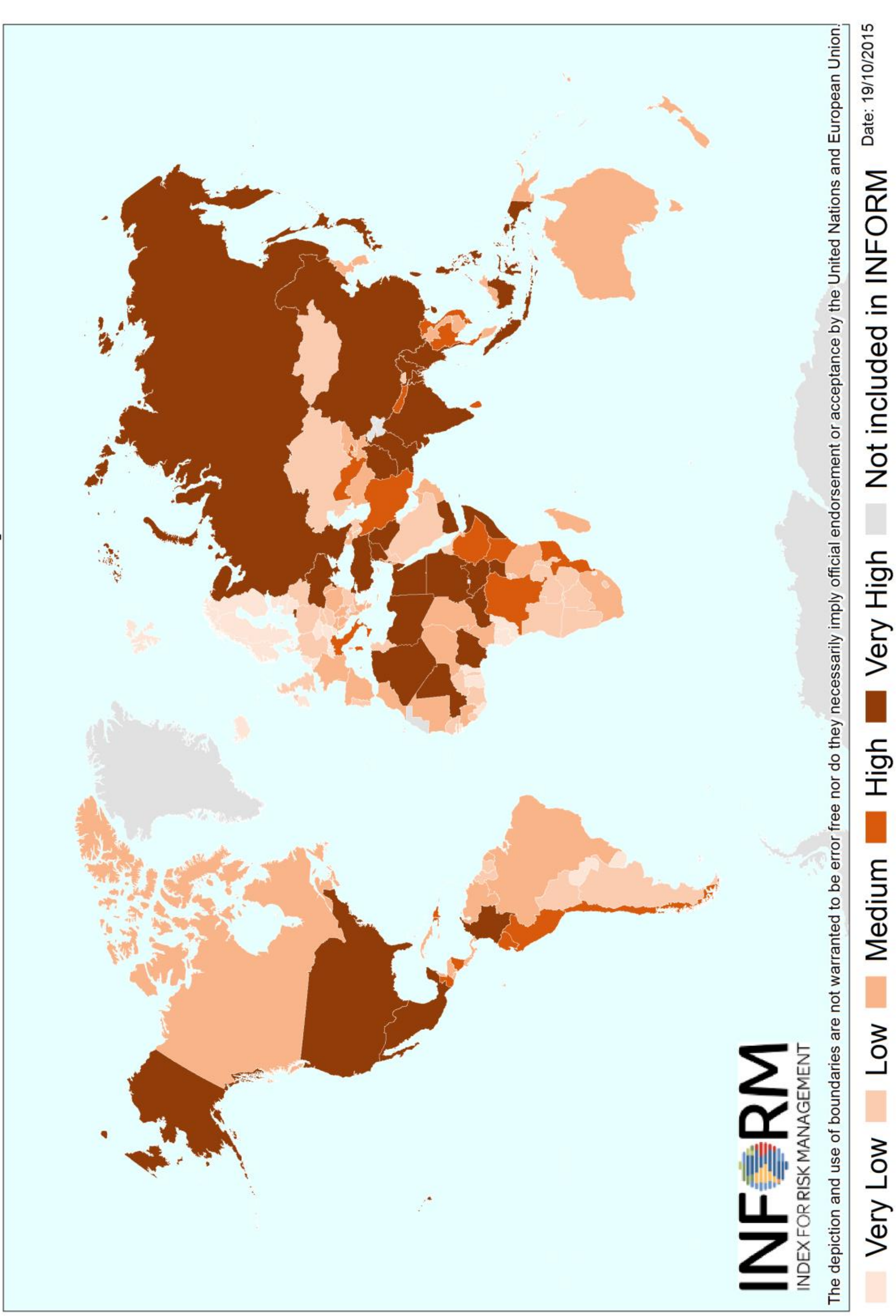
COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Bolivia	BOL	3.4	0.7	2.2	3.4	2.2	2.8	5.9	5.1	5.5	3.2	100	0
Fiji	FJI	5.7	0.1	3.4	3.7	0.9	2.4	3.5	4.9	4.2	3.2	100	7
United States of America	USA	7.4	5.1	6.4	1.3	3.4	2.4	2.7	1.7	2.2	3.2	100	3
Belize	BLZ	4.8	0.0	2.7	3.2	1.0	2.2	5.4	4.4	4.9	3.1	104	4
Botswana	BWA	2.6	0.3	1.5	4.3	3.6	4.0	4.9	4.9	4.9	3.1	104	1
Chile	CHL	7.4	0.9	5.0	2.4	1.7	2.1	2.9	2.9	2.9	3.1	104	2
Mongolia	MNG	2.7	2.0	2.4	3.2	1.6	2.4	5.6	4.8	5.2	3.1	104	1
Swaziland	SWZ	1.8	0.8	1.3	4.6	3.4	4.0	5.1	6.1	5.6	3.1	104	2
Tuvalu	TUV	2.0	0.0	1.0	7.5	1.3	5.2	6.3	4.7	5.6	3.1	104	12
Ghana	GHA	1.3	1.2	1.3	4.1	3.3	3.7	4.3	6.4	5.4	3.0	110	0
Albania	ALB	5.1	0.3	3.0	2.3	1.0	1.7	6.2	3.1	4.8	2.9	111	2
Bhutan	BTN	2.8	0.1	1.5	4.9	1.2	3.3	4.2	5.7	5.0	2.9	111	0
Gambia	GMB	1.4	0.1	0.8	6.7	3.9	5.5	4.9	5.9	5.4	2.9	111	0
Italy	ITA	5.1	3.6	4.4	1.1	3.2	2.2	3.7	1.0	2.5	2.9	111	3
Oman	OMN	5.8	0.3	3.5	2.5	0.8	1.7	5.1	3.1	4.2	2.9	111	5
Romania	ROU	4.4	3.2	3.8	1.9	1.5	1.7	4.6	2.7	3.7	2.9	111	2
Cyprus	CYP	3.6	0.1	2.0	1.3	6.5	4.4	3.0	1.9	2.5	2.8	117	5
Guyana	GUY	2.8	0.1	1.5	4.1	1.0	2.7	6.2	4.9	5.6	2.8	117	4
Jamaica	JAM	3.9	0.2	2.2	3.3	1.3	2.4	4.5	4.0	4.3	2.8	117	2
Macedonia FYR	MKD	2.8	1.3	2.1	2.5	2.9	2.7	4.6	2.7	3.7	2.8	117	1
Tunisia	TUN	4.3	0.4	2.6	2.3	1.0	1.7	6.0	3.6	4.9	2.8	117	1
Cabo Verde	CPV	2.0	0.1	1.1	6.0	1.2	4.0	4.0	4.5	4.3	2.7	122	4
Canada	CAN	4.9	1.4	3.3	0.9	3.7	2.4	2.3	2.4	2.4	2.7	122	4
Comoros	COM	0.8	0.1	0.5	7.6	2.4	5.6	7.8	6.3	7.1	2.7	122	7
Equatorial Guinea	GNQ	1.3	0.2	0.8	4.2	2.3	3.3	8.2	6.7	7.5	2.7	122	7
France	FRA	3.8	3.3	3.6	0.9	4.0	2.6	2.8	1.2	2.0	2.7	122	4
Montenegro	MNE	3.9	0.1	2.2	2.2	2.8	2.5	4.7	2.4	3.6	2.7	122	4
Palau	PLW	2.2	0.0	1.2	5.1	0.8	3.2	6.1	4.0	5.1	2.7	122	9
Dominica	DMA	3.3	0.0	1.8	4.5	0.9	2.9	3.9	2.9	3.4	2.6	129	11
Gabon	GAB	1.5	0.2	0.9	3.0	3.0	3.0	6.6	6.0	6.3	2.6	129	1
Greece	GRC	5.3	1.7	3.7	1.3	2.4	1.9	3.6	1.0	2.4	2.6	129	3
Nauru	NRU	1.3	0.0	0.7	5.3	3.0	4.2	7.2	4.2	5.9	2.6	129	14
Suriname	SUR	3.0	0.0	1.6	3.0	1.1	2.1	5.7	4.2	5.0	2.6	129	2
Bulgaria	BGR	3.1	1.1	2.2	2.0	2.6	2.3	4.2	2.0	3.2	2.5	134	2

COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Cuba	CUB	5.1	2.3	3.8	2.3	0.2	1.3	4.1	2.4	3.3	2.5	134	6
Israel	ISR	3.3	2.4	2.9	1.2	3.2	2.3	3.3	1.1	2.3	2.5	134	4
Paraguay	PRY	2.1	0.1	1.2	3.7	1.3	2.6	5.5	4.0	4.8	2.5	134	1
Argentina	ARG	3.1	1.7	2.4	1.9	1.1	1.5	5.0	2.1	3.7	2.4	138	2
Croatia	HRV	5.3	0.1	3.1	1.6	1.2	1.4	4.4	1.7	3.2	2.4	138	3
Maldives	MDV	3.4	0.0	1.9	2.6	1.0	1.8	5.7	1.9	4.1	2.4	138	3
Saint Kitts and Nevis	KNA	3.1	0.0	1.7	4.2	0.8	2.7	3.6	2.2	2.9	2.4	138	11
Saint Lucia	LCA	3.2	0.0	1.7	3.5	0.8	2.3	4.1	3.3	3.7	2.4	138	8
Saudi Arabia	SAU	2.1	2.8	2.5	2.0	0.7	1.4	5.0	2.6	3.9	2.4	138	4
Antigua and Barbuda	ATG	3.7	0.0	2.0	2.0	1.3	1.7	4.7	2.1	3.5	2.3	144	10
Australia	AUS	5.7	0.1	3.4	0.6	2.7	1.7	2.2	1.9	2.1	2.3	144	5
Samoa	WSM	1.3	0.0	0.7	6.2	0.4	3.9	4.7	4.1	4.4	2.3	144	8
Seychelles	SYC	2.4	0.0	1.3	3.9	1.2	2.7	4.4	2.6	3.6	2.3	144	7
Mauritius	MUS	3.2	0.0	1.7	3.1	0.9	2.1	3.6	2.3	3.0	2.2	148	5
Japan	JPN	8.5	1.8	6.2	0.9	0.9	0.9	2.0	1.1	1.6	2.1	149	4
Kazakhstan	KAZ	3.5	0.6	2.2	1.5	0.5	1.0	5.2	2.6	4.0	2.1	149	3
Poland	POL	2.1	1.3	1.7	1.4	2.3	1.9	4.1	1.6	2.9	2.1	149	3
Saint Vincent and the Grenadines	VCT	2.4	0.0	1.3	3.1	0.9	2.1	3.3	3.5	3.4	2.1	149	9
Spain	ESP	4.4	2.4	3.5	1.1	1.7	1.4	2.8	0.8	1.9	2.1	149	3
Bahamas	BHS	3.2	0.0	1.7	2.3	0.9	1.6	3.1	2.8	3.0	2.0	154	7
Hungary	HUN	3.5	0.4	2.1	1.6	1.8	1.7	2.8	1.3	2.1	2.0	154	3
Kuwait	KWT	2.2	0.5	1.4	2.0	1.2	1.6	5.4	1.6	3.7	2.0	154	5
New Zealand	NZL	5.8	0.1	3.5	0.9	1.3	1.1	1.9	2.2	2.1	2.0	154	7
Trinidad and Tobago	TTO	2.5	0.1	1.4	1.8	1.5	1.7	4.9	2.1	3.6	2.0	154	3
United Arab Emirates	ARE	5.4	0.4	3.3	1.8	0.3	1.1	2.5	1.8	2.2	2.0	154	7
United Kingdom	GBR	2.2	2.0	2.1	1.2	3.3	2.3	2.2	1.0	1.6	2.0	154	4
Belarus	BLR	1.8	1.3	1.6	1.0	1.3	1.2	4.9	1.5	3.4	1.9	161	2
Germany	DEU	2.1	1.4	1.8	0.6	3.8	2.3	2.4	0.7	1.6	1.9	161	3
Grenada	GRD	1.8	0.0	0.9	2.9	1.3	2.1	4.6	2.8	3.8	1.9	161	11
Portugal	PRT	4.6	0.1	2.6	1.4	1.1	1.3	2.9	1.0	2.0	1.9	161	4
Slovakia	SVK	3.2	0.6	2.0	1.2	1.3	1.3	3.8	1.3	2.6	1.9	161	4
Uruguay	URY	1.1	0.8	1.0	2.4	1.3	1.9	3.8	2.0	2.9	1.8	166	2
Austria	AUT	2.3	0.1	1.3	0.8	3.4	2.2	2.2	1.2	1.7	1.7	167	4
Korea Republic of	KOR	5.9	0.4	3.6	0.8	0.5	0.7	2.6	1.4	2.0	1.7	167	4

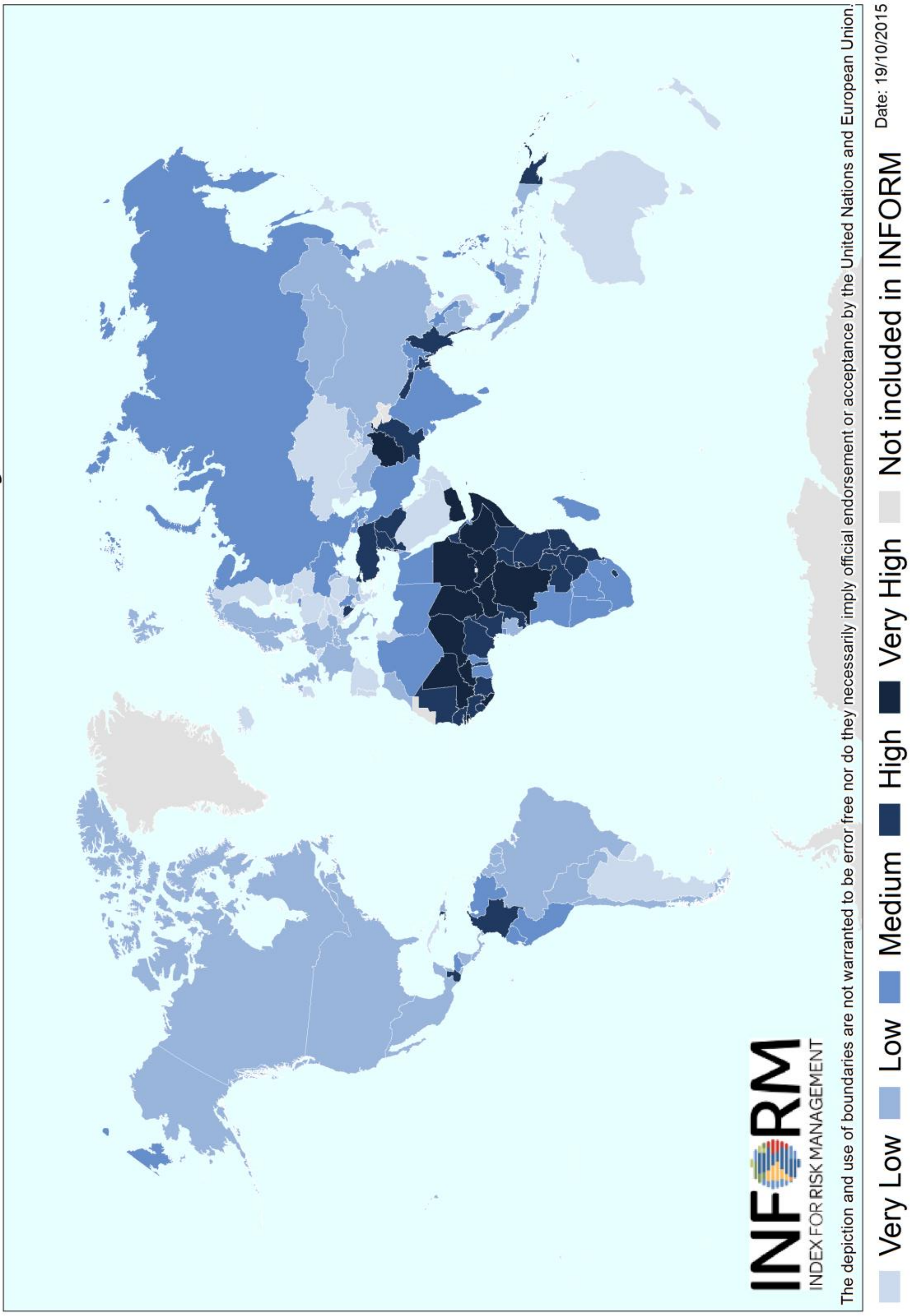
COUNTRY	ISO3	Natural	Human	Hazard & Exposure	Social-Economics Vulnerability	Vulnerable Groups	Vulnerability	Institutional	Infrastructure	Lack of Coping Capacity	INFORM 2016	RANK	Missing Indicators
Malta	MLT	1.6	0.1	0.9	1.7	3.0	2.4	3.5	1.0	2.3	1.7	167	6
Barbados	BRB	1.7	0.0	0.9	2.6	0.8	1.7	2.7	2.4	2.6	1.6	170	5
Czech Republic	CZE	2.0	0.4	1.2	0.9	2.0	1.5	3.3	1.1	2.3	1.6	170	3
Latvia	LVA	1.8	0.1	1.0	1.8	1.2	1.5	3.9	1.7	2.9	1.6	170	4
Ireland	IRL	2.4	0.1	1.3	0.8	1.8	1.3	2.4	1.5	2.0	1.5	173	5
Lithuania	LTU	1.5	0.1	0.8	1.3	1.2	1.3	3.8	1.3	2.6	1.4	174	4
Netherlands	NLD	1.7	0.1	0.9	0.5	3.5	2.1	1.7	1.0	1.4	1.4	174	4
Slovenia	SVN	2.6	0.1	1.4	0.7	1.2	1.0	2.3	1.4	1.9	1.4	174	3
Switzerland	CHE	1.8	0.9	1.4	0.5	3.5	2.1	1.2	0.6	0.9	1.4	174	4
Qatar	QAT	0.9	0.1	0.5	2.5	0.9	1.7	3.9	0.5	2.4	1.3	178	5
Sao Tome and Principe	STP	0.1	0.0	0.1	5.6	1.4	3.8	6.2	5.2	5.7	1.3	178	5
Belgium	BEL	1.4	0.0	0.7	0.8	2.7	1.8	2.1	0.8	1.5	1.2	180	6
Iceland	ISL	1.7	0.0	0.9	0.7	1.0	0.9	2.1	1.8	2.0	1.2	180	6
Brunei Darussalam	BRN	0.6	0.0	0.3	1.0	0.8	0.9	4.9	4.5	4.7	1.1	182	8
Estonia	EST	0.9	0.1	0.5	1.4	1.2	1.3	3.1	1.3	2.2	1.1	182	4
Liechtenstein	LIE	1.3	0.0	0.7	0.6	2.5	1.6	1.5	0.9	1.2	1.1	182	19
Sweden	SWE	0.7	0.1	0.4	0.5	4.3	2.6	1.9	0.9	1.4	1.1	182	4
Norway	NOR	0.2	0.3	0.3	0.2	3.5	2.0	1.9	1.3	1.6	1.0	186	5
Denmark	DNK	0.5	0.1	0.3	0.6	2.6	1.7	1.9	0.9	1.4	0.9	187	4
Bahrain	BHR	0.1	0.1	0.1	1.9	1.2	1.6	4.2	1.6	3.0	0.8	188	6
Luxembourg	LUX	0.3	0.1	0.2	1.1	1.3	1.2	1.8	0.7	1.3	0.7	189	6
Finland	FIN	0.1	0.1	0.1	0.8	2.4	1.6	1.6	1.0	1.3	0.6	190	5
Singapore	SGP	0.1	0.0	0.1	0.7	0.3	0.5	1.3	1.1	1.2	0.4	191	5

ANNEX E: MAPS OF INDEXES

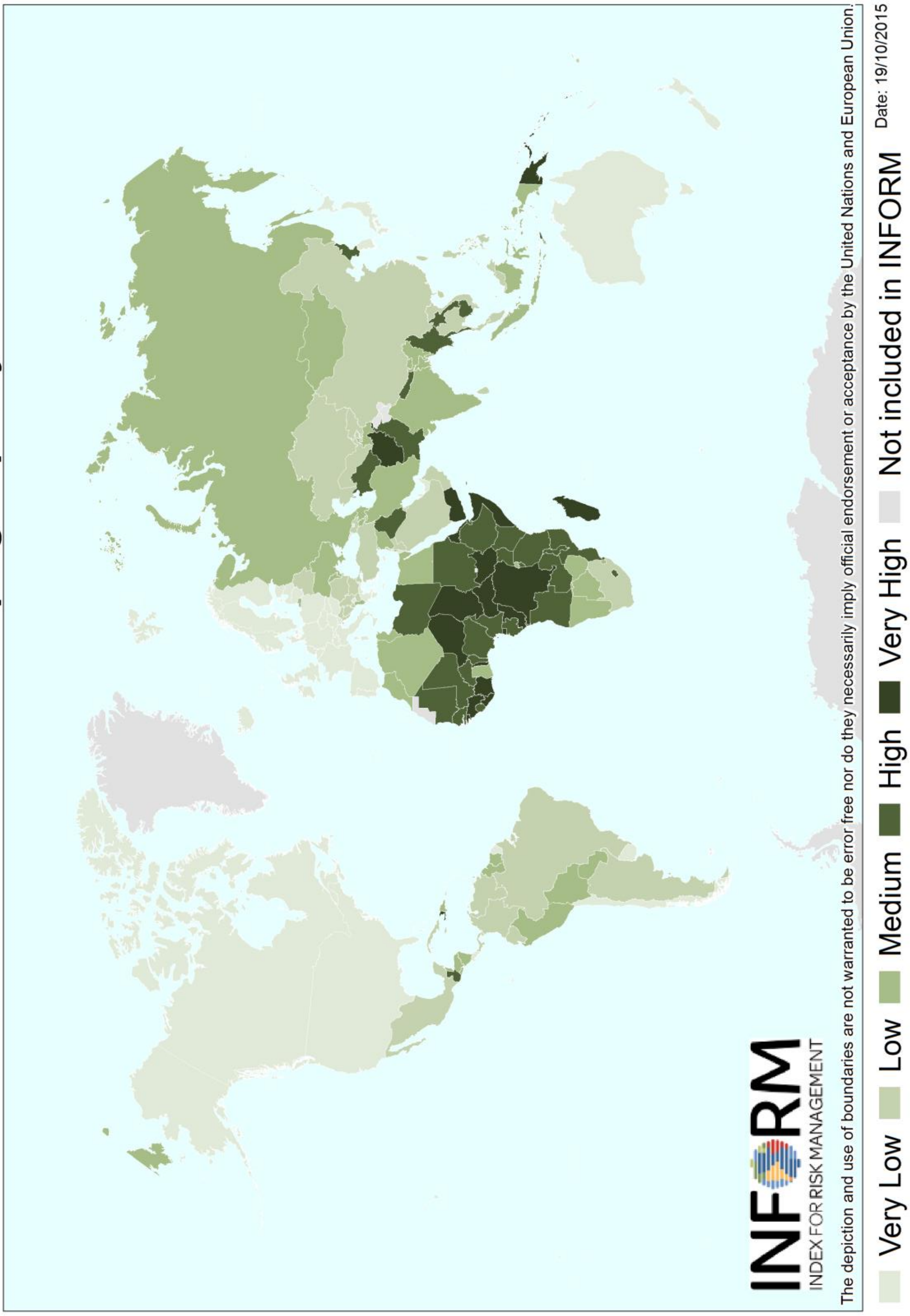



INFORM 2016 Hazard & Exposure Index
INFORM
INDEX FOR RISK MANAGEMENT
The depiction and use of boundaries are not warranted to be error free nor do they necessarily imply official endorsement or acceptance by the United Nations and European Union.
Date: 19/10/2015
Very Low
Low
Medium
High
Very High
Not included in INFORM

INFORM 2016 Vulnerability Index



INFORM 2016 Lack of Coping Capacity Index



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