RUHR UNIVERSITÄT BOCHUM

RUB

IFHV

Bündnis Entwicklung Hilft

Gemeinsam für Menschen in Not.

WorldRiskReport 2019

Focus: Water Supply

WorldRiskReport 2019

Imprint

Publisher WorldRiskReport 2019

Bündnis Entwicklung Hilft
and
Ruhr University Bochum – Institute for International Law
of Peace and Armed Conflict (IFHV)

Concept, implementation and editing

Peter Mucke, Bündnis Entwicklung Hilft, Project Leader
Lotte Kirch, Bündnis Entwicklung Hilft, Editor in Chief
Julia Walter, MediaCompany

Scientific Lead

Dr. Katrin Radtke, IFHV

Authors

St John Day, Independent WASH Consultant
Timothy Forster, Oxfam
Jutta Himmelsbach, Misereor
Lisa Korte, Oxfam
Peter Mucke, Bündnis Entwicklung Hilft
Dr. Katrin Radtke, IFHV
Prof. Dr. Pierre Thielbörger, IFHV
Daniel Weller, IFHV

In collaboration with

Svea Brück, IFHV
Leopold Karmann, Bündnis Entwicklung Hilft
Sabine Ludwig, DAHW
Christina Margenfeld, Brot für die Welt
Stephan Schultz, IFHV
Stephan Simon, Welthungerhilfe

Graphic design and information graphics

Naldo Gruden, MediaCompany

Print

Druckerei Conrad, Berlin,
printed on 100% recycled paper

ISBN 978-3-946785-08-8

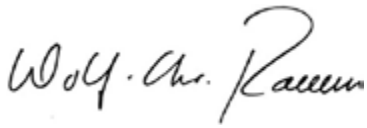
The WorldRiskReport has been published annually since 2011 by Bündnis Entwicklung Hilft
Responsible: Peter Mucke

Foreword

As in recent years, in 2019 we were again confronted with a series of crises and disasters as a result of extreme natural events. The first half of the year was marked in particular by Cyclone Idai, which caused devastation in Mozambique, Malawi and Zimbabwe, but also by new heat records in Europe. Here, the long-term effects of last summer's drought intensified the impact on nature and agriculture. At the same time, society has also experienced a clear politicization of environmental and climate protection issues through the involvement of movements such as Fridays for Future and Scientists for Future. More than ever before, the public became aware, that the effects of climate change and the resulting weather extremes affect the lives of people worldwide and will change them in the long term. It is important for all of us to support those who are already suffering from the effects of climate change and the creeping loss of their livelihoods and to take effective precautions.

The extent to which prevention, coping and adaptation differ from country to country is illustrated by this WorldRiskReport. With the WorldRiskIndex, it provides an analysis of disaster risks worldwide and indicates which countries are in the greatest need to strengthen measures for coping with and adapting to extreme natural events. With this year's focus on water supply, the WorldRiskReport again highlights a key issue in the context of disasters from both a practical and a scientific perspective. The focus on legal issues strengthens the political advocacy component of the WorldRiskReport and is intended to particularly support civil society actors in demanding their rights and those of their communities.

The WorldRiskReport has been published annually since 2011 by Bündnis Entwicklung Hilft. Since 2017, the Institute for Law of Peace and Armed Conflict (IFHV) at Ruhr University Bochum has been responsible for the scientific management and calculation of the WorldRiskIndex contained in the report. As a member of the Network on Humanitarian Action (NOHA), the IFHV ensures the international consolidation of the index in science. Building on the exchange between science and practice, we jointly pursue the goal of maintaining and increasing the utility of the WorldRiskReport as an instrument for decision-makers in politics and society.



Wolf-Christian Ramm
Chairman Bündnis Entwicklung Hilft

Prof. Dr. Pierre Thielbörger
Executive Director IFHV

Bündnis Entwicklung Hilft is comprised of the aid organizations Brot für die Welt, Christoffel-Blindenmission, DAHW, Kindernothilfe, medico international, Misereor, Plan International, terre des hommes, Welthungerhilfe and the associated members German Doctors and Oxfam. In contexts of crises and disasters the members provide emergency relief as well as long-term support in order to overcome poverty and prevent new crises.

The Institute for International Law of Peace and Armed Conflict (IFHV) of Ruhr University Bochum is one of the leading institutions in Europe for research and teaching on humanitarian crises. Coming from a long tradition in scientific analysis of international humanitarian law and human rights, the Institute today combines interdisciplinary research in the fields of law, social science, geoscience, and public health.

Further information

In-depth information, methodologies, and tables are available at **www.WorldRiskReport.org**.

The reports from 2011–2018 can be downloaded there as well.

Contents

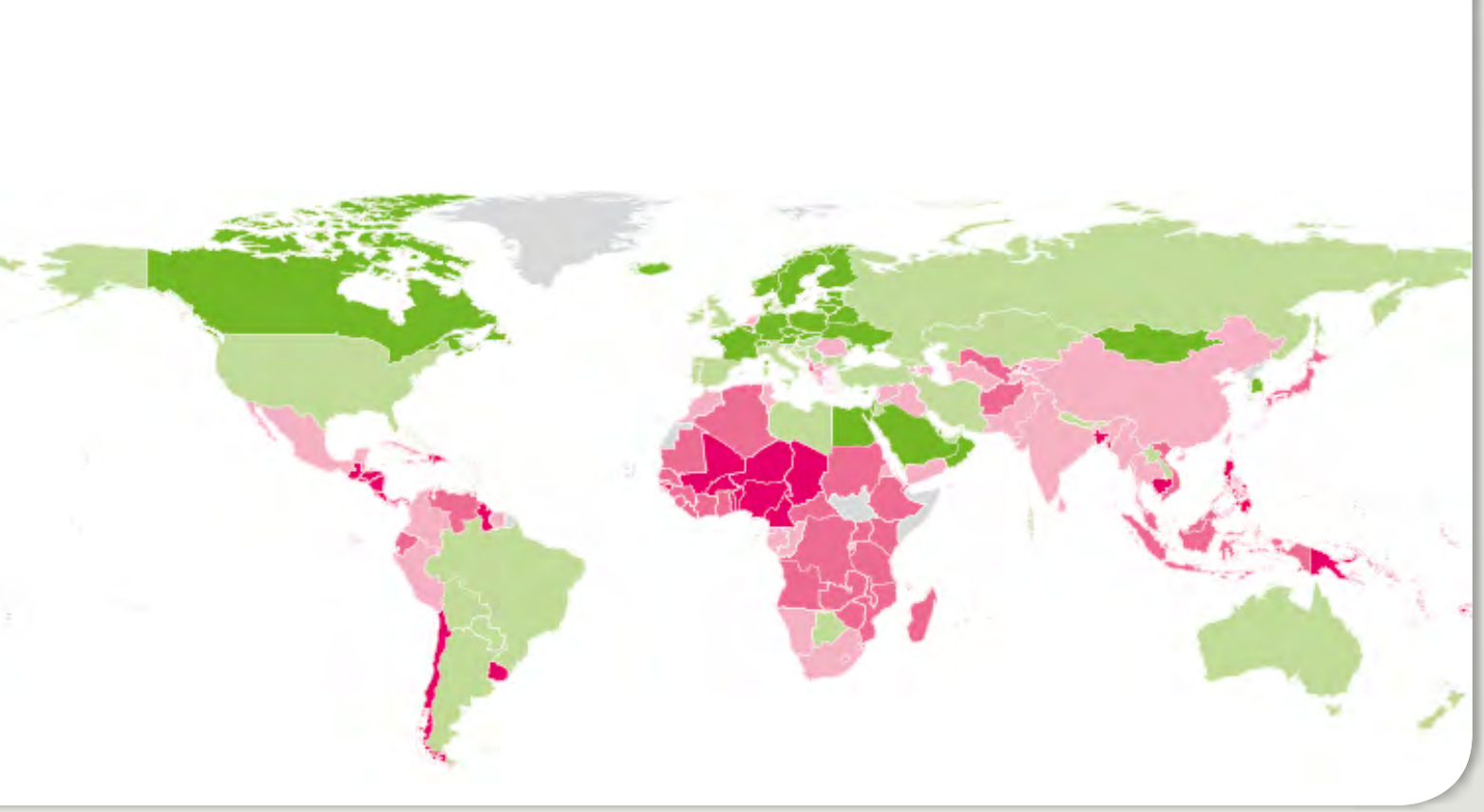


Figure 1: WorldRiskIndex 2019

Key Results

WorldRiskIndex 2019

+ The three countries having the highest disaster risk worldwide are the island states of Vanuatu (index value: 56.71), Antigua and Barbuda (index value: 30.80) and Tonga (index value: 29.39). Island states are above average among countries with a high or very high disaster risk across all continents. This is often due to their high or very high exposure to extreme natural events.

+ As in previous years the disaster risk hotspot regions in 2019 are located in Oceania, Southeast Asia, Central America and West and Central Africa.

+ Looking at continents, Africa has the highest societal vulnerability, followed by Asia and America.

+ Europe is the continent with the lowest disaster risk worldwide. With an index value of 2.43, Germany has a very low disaster risk and ranks 163rd in the WorldRiskIndex. To compare, even lower risks were calculated for Iceland (rank 174) and Malta (rank 179).

+ The country with the lowest disaster risk worldwide is Qatar (index value: 0.31).

+ The WorldRiskIndex 2019 indicates the disaster risk for 180 countries in the world. The index thus includes eight countries more than in the previous year: Antigua and Barbuda (rank 2), Democratic Republic of Congo (rank 56), Federated States of Micronesia (rank 72), Montenegro (rank 88), St. Lucia (rank 123), São Tomé and Príncipe (rank 162), Maldives (rank 169) and St. Vincent and the Grenadines (rank 178).

+ For the first time since 2012, it was possible to update data on exposure to extreme natural events. All data in the exposure component of the WorldRiskIndex are now taken from one population data set (LandScan 2017).

Focus: Water Supply

+ Providing water security means two things: on the one hand, guaranteeing people access to sufficient water supply (security through water), and on the other hand, protecting people from the dangers of water (security from water).

+ The main problems with water supply are unequal distribution by region and inequality within societies. The poorest often have to pay the most for clean water.

+ The effects of climate change intensify water-related problems not only in arid regions, but worldwide. Extreme natural events such as droughts in the Horn of Africa, cyclones causing floodings in southern Africa or Asia have pushed long-established water supply processes to their limits.

+ In the event of extreme natural disasters and violent conflicts, ensuring a secure water supply can, depending on the situation, become even more difficult than in times of non-crisis.

+ If there is a lack of water and only basic needs for survival are met, important development processes fall short. Water shortages do not only affect agriculture and health care. When children are sent to fetch water instead of going to school, water shortages also compromise education.

+ The international community dramatically fails in guaranteeing the right to sanitation. This is largely due to the unease of putting issues such as toilets and sanitation on the political agenda and mobilizing resources for these matters.

+ Humanitarian donors are often hesitant to finance robust infrastructures for water supply and tend to rely on mobile water supply by water trucking for too long. However, there are approved long-term operating models on a professional and community basis which could be applied in different contexts.

+ Sustainable water supply in densely populated areas such as refugee camps and cities has great potential for improvement. Donors and humanitarian organizations should identify requirements for a successful handover of technologies to local actors at an early stage and pay more attention to developing necessary capacities.

Rank	Country	Risk
1.	Vanuatu	56.71
2.	Antigua and Barbuda	30.80
3.	Tonga	29.39
4.	Solomon Islands	29.36
5.	Guyana	22.87
6.	Papua New Guinea	22.18
7.	Brunei Darussalam	21.68
8.	Guatemala	20.69
9.	Philippines	20.69
10.	Bangladesh	18.78
11.	Cape Verde	18.02
12.	Fiji	17.83
13.	Costa Rica	17.37
14.	Djibouti	16.46
15.	Timor-Leste	16.39
...	...	...
163.	Germany	2.43
...	...	...
166.	Norway	2.34
167.	Lithuania	2.29
168.	Sweden	2.20
169.	Maldives	2.08
170.	Switzerland	2.05
171.	Estonia	2.04
172.	Finland	1.94
173.	Egypt	1.84
174.	Iceland	1.71
175.	Barbados	1.35
176.	Saudi Arabia	1.04
177.	Grenada	1.01
178.	St. Vincent and the Grenadines	0.80
179.	Malta	0.54
180.	Qatar	0.31

Figure 2:
Extract from the WorldRiskIndex 2019

1 Water Worldwide: Scarcity versus Abundance

Peter Mucke
Managing Director, Bündnis Entwicklung Hilft

Access to sufficient clean water, safe sanitation and sanitary facilities varies widely around the world. With the Sustainable Development Goals (SDGs), the international community has adopted goals for improved water supply and sanitation for the benefit of all people. Progress in this area is of great importance, not only for disaster prevention. After extreme natural disasters, the water supply must be restored quickly, even if the infrastructure is destroyed, in order to ensure the survival and prevent the spread of diseases.

The human body consists largely of water; in adults it is about 60 percent, in infants even 75 percent of the body weight. The body constantly releases water through evaporation from the skin, through urine production and through the release of water from the lungs with the air we breathe – an average of 2.4 liters per day (Kurtz 2014). When sweating, the loss of water is significantly higher.

If there is a lack of drinking water, the thirst gradually increases to unbearable levels. The body temperature increases and the heart begins to beat faster. If the water loss rises to ten percent of the body weight, confusion and delusions begin. Without solid food a human can survive for weeks. Without water a human can only survive a few days even under favorable climatic conditions. Unlike hunger, thirst ruthlessly remains, only strong pain or shortness of breath can distract from it.

7.5 to 15 liters of water are required as a minimum quantity per person and day, whereby 2.5 to 3 liters are needed for the survival, i.e. water intake by drinking and eating, 2 to 6 liters for hygiene and 3 to 6 liters for cooking (Sphere Association 2018). Specific needs are generally higher depending on climatic conditions, cultural and social norms and individual needs. In Germany, the average per capita consumption is 127 liters per day (BDEW 2019), there is an abundance of water. The preciousness of clean water becomes particularly clear to those people who live in areas with extended drought, without adequate water supply and without wastewater disposal.

The right to water

Water is available on earth in almost unlimited quantities. Approximately 71 percent of the earth's surface is covered with it. The total volume of water is around 1.4 billion cubic kilometers. But only a very limited part of it can be used for human needs. Around 96.5 percent is salt water, another approximately two percent is frozen as ice caps of the poles, and another portion is in the atmosphere as water steam or clouds. Only 0.3 percent of the total amount of fresh water, about 100,000 cubic kilometers, is relatively easily accessible (BPB 2017). This resource is distributed very differently.

Unequal distribution

The main problems with water supply are the unequal distribution both by region and within societies. It is not uncommon for water to be

most expensive for the poorest people (see Chapter 2.2). 22 countries suffer from acute water stress, meaning that the water resources consumed are not regenerated to the necessary extent by rain or the return of purified water (UN 2018). Moreover, the use of underground deposits is not a viable alternative without its renewal. At present, an estimated 3.6 billion people live in areas where water is limited for at least one month a year. This population could grow to between 4.8 and 5.7 billion by 2050 (WWAP 2019, 14).

Global demand for water has been rising by about one percent a year since 1980. The United Nations forecasts even higher growth rates in the coming years (WWAP 2019, 13). For example, the size of the world's irrigated land has doubled in the past 50 years. At the same time, the renewal of water resources by water cycle management is a distant prospect: 80 percent of the world's wastewater is discharged into the environment (rivers, lakes or oceans) untreated or insufficiently treated (WWAP 2017, 2).

The human right to water

With resolution 64/292, the United Nations adopted the human right to water in 2010: The General Assembly "recognizes the right to safe and clean drinking water and sanitation as a human right that is essential for the full enjoyment of life and all human rights". Furthermore, the General Assembly also calls upon states and international organizations "to provide financial resources, capacity building and technology transfer, through international assistance and cooperation, in particular for developing countries, in order to scale up efforts to provide safe, clean, accessible and affordable drinking water and sanitation for all" (UN Doc. A/Res/64/292). Until today, the interpretation of the human right to water is controversial (see chapter 2.1).

In terms of a water supply worldwide, the United Nations demand to secure availability, quality and accessibility (physical and economic) of water. Water supply must be safe and accessible, including for people with disabilities and the elderly. Water must be affordable and meet cultural demands (CESCR 2002).

Drinking water and sanitation

It is true that the United Nations Millennium Declaration of 2000 had already agreed internationally to halve both the proportion of people unable to reach or afford safe drinking water and the proportion of people without access to basic sanitation by 2015 (UN Doc. A/Res/55/2). But it was only with the 2015 Sustainable Development Goals (SDGs, see showcase on the right) that the internationally agreed efforts for improved water and sanitation have been expanded to benefit all people by 2030 – in accordance with the human right to water.

Current situation

In June 2019, UNICEF and WHO published the latest figures on water supply worldwide (UNICEF / WHO 2019). According to the figures, 785 million people worldwide lack basic access to drinking water. This means that they cannot reach a protected source of drinking water within a total walking distance of 30 minutes. 2.2 billion people do not have a safe water supply, meaning no drinking water on the property that is available at all times and free of contamination. Two billion people worldwide have no access to basic sanitation. They do not have a latrine that does not need to be shared with other households. Another 2.2 billion people lack safe sanitation with hygienic toilets, whose waste water is adequately treated and disposed of. In contrast, 3.4 billion people have access to safe sanitation. A lack of basic sanitation services and drinking water particularly affects rural areas, 70 percent of the people lacking basic sanitation and 80 percent of the people lacking drinking water live in rural areas.

The global trends for hygiene also show that there is still a great need for action: Three

billion people worldwide have no or only limited opportunities to wash their hands with soap in or around the house. Every year, 297,000 children under the age of five die of diarrheal diseases linked to the lack of water, sanitation, and hygiene (UN 2019; see chart "Sick by water", p. 31).

However, it should not be overlooked that much has already been achieved between 2000 and 2017 (UNICEF / WHO 2019): The proportion of the population with access to a safe drinking water supply rose from 61 to 71 percent, 1.8 billion people gained access to at least basic services. The number of people without a basic supply thus fell to 785 million and the number of people who have to resort to untreated surface water dropped from 256 million to 144 million. This progress has been made mainly in rural areas. Access to safe sanitation rose from 28 to 45 percent. The number of people forced to defecate outdoors almost halved, from 1.3 billion to 673 million.

The interim conclusion in 2019 thus shows a twofold assessment: much has been set in motion, much remains to be done. The high inequality of income, population growth and the rapid expansion of urban agglomerations remain major challenges for water and sanitation in the future.

Per capita consumption and virtual water

Water consumption per capita is used as an opportunity to compare water supply internationally. The amount of clean water consumed per capita includes much more than just drinking, cooking and washing. For the production of consumer goods such as cotton, coffee, meat or textiles, agriculture and industry need large quantities of fresh water, which is only recovered to a small extent. The amount of water used for the entire manufacturing process of products is known as "virtual water". This is also included in the per capita water consumption of a country (see figure 3 on page 12). Based on the data available in AQUASTAT, a database of the United Nations Food and Agriculture Organization collecting information on water resources and use from over 180 countries since 1960, the water consumption per

Sustainable Development Goals

Goal 6 "Ensure availability and sustainable management of water and sanitation for all" contains:

6.1 By 2030, achieve universal and equitable access to safe and affordable drinking water for all

6.2 By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations

6.3 By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

6.A By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies

6.B Support and strengthen the participation of local communities in improving water and sanitation management

(Quoted from UN General Assembly 2015)

capita in the survey period 2013 – 2017 ranges from 47.83 m³ per year in Côte d'Ivoire to 1,710 m³ in Uzbekistan.

However, caution is required when interpreting the data. This is because per capita consumption is not a measured variable that can be interpreted linearly. It is generally true that water consumption is low in countries with a lower level of development according to the Human Development Index (HDI) and generally high in countries with a high level of development according to the HDI. But there are counter-examples: Great Britain (HDI rank: 14) has a water consumption of 127.2 cubic meters per capita per year and Indonesia (HDI rank: 116) of 843.2 cubic meters (FAO 2019; UNDP 2018).

A country's high per capita water consumption can be an indicator of good drinking water supply, extensive hygiene opportunities, high-yield agriculture and extensive manufacturing of products. But it can also be a sign of waste and overuse of water. Although low water consumption per capita usually indicates a problem, it can also be caused by water-saving measures in households, efficient irrigation systems or closed water cycles in industrial production. When assessing a country's water situation (see also map "Water Supply: Need for Action in Countries at Risk"), other important aspects must therefore be taken into account in addition to per capita consumption:

+ Is there a regeneration of the water reserves?
+ Is water use equally guaranteed for all residents?
+ Is used water adequately treated and cleanly returned to the water cycle?

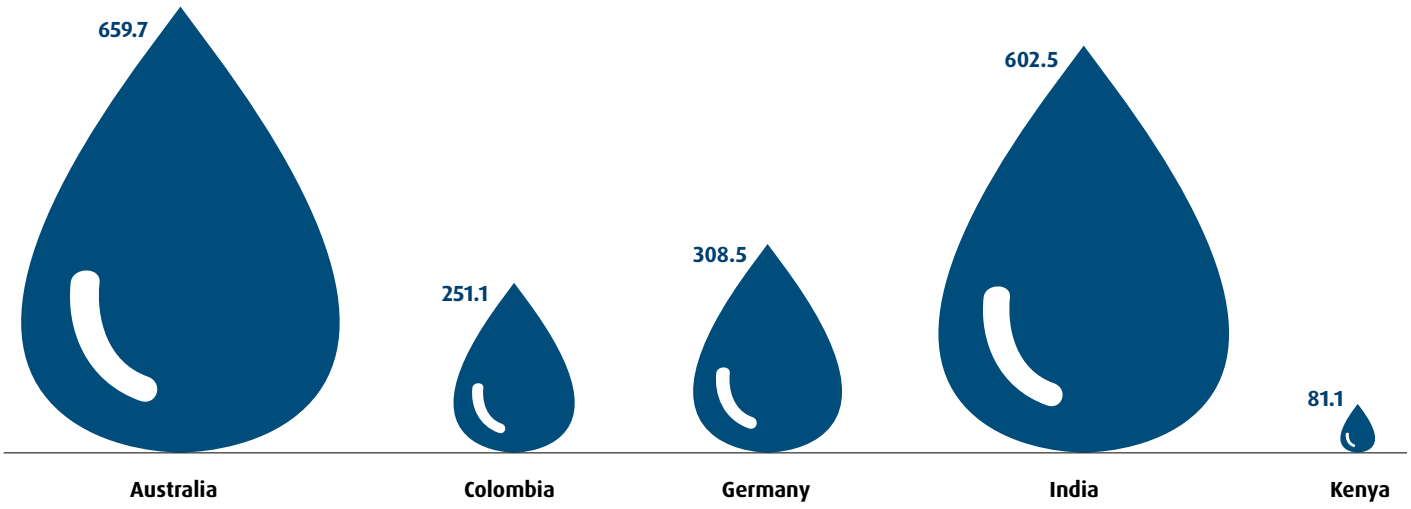


Figure 3: Total water withdrawal per capita by countries (direct and indirect consumption, all figures in m^3 / year)
Data source: FAO AQUASTAT 2019

Water supply in disasters and crises

In the case of extreme natural events and violent conflicts, guaranteeing a secure water supply can, depending on the situation, become even more difficult than in times of non-crisis, for example:

+ Water sources, such as reservoirs or wells, are polluted or destroyed.
+ Water storage systems or distribution networks for drinking water, such as pipe systems, meaning the infrastructure, are impaired or destroyed.
+ Waste water transport, sewage treatment plants and pumping systems fail because they are damaged or energy supply is disrupted.
+ The damage to the infrastructure can result, among other things, in unequal access to water or unequal distribution of water for different population groups.
+ As a result of the damage, water quality and the standard of sanitation suffer and water-induced diseases increase.

In many cases, the disaster is directly or indirectly related to water. Between 1995 and 2015, over 90 percent of disasters were caused by floods, cyclones, heat waves or other weather-related events (CRED / UNISDR 2015, 5). The United Nations estimate that the number of people threatened by floods will rise from the current 1.2 billion to 1.6 billion in 2050.

Risk evaluation

The relevance of this year's focus "Water Supply" is also reflected in the WorldRiskIndex: a total of three of the 27 indicators are directly related to this issue area (see Chapter 3). For the indicators "proportion of the population without access to basic drinking water" and "proportion of the population without access to basic sanitation", both assigned to the susceptibility component, the following applies: The fewer people in a society have access to basic drinking water and sanitation facilities, the more vulnerable they are to extreme natural events. Moreover, the management of available water resources is a decisive factor in determining a society's disaster prevention capacities. This is included in the WorldRiskIndex by the indicator "Water resources" or the proportion of wastewater that undergoes at least primary treatment, which is part of the adaptation component.

Disaster response measures

In disaster situations, water supply is often a major challenge (see also map, "How Extreme Natural Events Threaten the Water Supply"). Survivors must be given quick access to clean water; contamination of water sources must be prevented and existing infrastructure for water and sanitation must be repaired.

Measures should be based on a precise analysis of existing water access and the quality of available water. Depending on the situation in the disaster area, for example, one or more of the following short-term measures can be used:

+ Water transport via trucks (water trucking)
+ Construction of water reservoirs (rapid installation tanks)
+ Repair and installation of pipe systems for water distribution and dispensers
+ Cleaning and disinfection of larger quantities of water (centralized and decentralized directly in the households)
+ Transitional use of groundwater resources.

Simple technologies are often used for short-term water supply. For example, Welthungerhilfe uses mobile treatment plants that can be installed within a few hours near a water source (river, lake) in emergency situations (Welthungerhilfe 2019). This will ensure a water supply with a capacity of over 60 m³ per day. The water is pumped into a circular "onion tank", where it is purified and the sediments are deposited on the bottom of the tank. The water is then

pumped into two flexible tanks and disinfected with chlorine. It is ready for consumption after only 30 minutes. Via a large number of taps connected to these tanks over 2,800 people per day can provide themselves with water. It is made sure, that people fill the water into clean containers and that impurities are avoided on their way home. Drinking water quality is regularly monitored.

The PAUL (Portable Aqua Unit for Lifesaving) water backpack is an easy-to-transport drinking water treatment system for mobile emergency supply. It is used by the member organizations Christoffel-Blindenmission and terre des hommes, for example. The core element of the water backpack is a filter membrane which retains particles, bacteria and viruses as far as possible. The system weighs around 20 kilograms and is characterized by its simple mechanical construction, simple handling and operation without external energy or chemicals. The water backpack developed by the University of Kassel can clean up to 2,500 liters of water per day. By the end of 2018, 3,000 devices were already in use worldwide (Frechen 2019).

Since disasters caused by extreme natural events particularly affect island states and countries with extensive coastal regions (see Chapter 3), the further development of mobile seawater desalination plants is of particular importance. Numerous desalination plants based on different technologies are used in development cooperation projects in various countries, some on a small scale at household level (Boden / Subban 2018).

As a humanitarian crisis persists, longer-term water supply solutions should be established and replace mobile treatment plants and other short-term supply measures (see Chapter 2.3). Chapter 4 of the report formulates further recommendations for action on how progress can be made in water and sanitation to make people more resilient to disasters.

The concept of the WorldRiskReport

Concept of "risk" and approach

The risk assessment in the WorldRiskReport is based on the general notion that the intensity of the extreme natural event is not the only factor of relevance to the disaster risk, but that the society's level of development is equally important. If it is less developed, a society will be more vulnerable to natural events than if it is better prepared in regard to susceptibility, coping capacities, and adaptive capacities (Bündnis Entwicklung Hilft 2011).

Risk assessment

The WorldRiskReport contains the WorldRiskIndex. Since 2018, it has been calculated by the Institute for International Law of Peace and Armed Conflict (IFHV) at Ruhr University Bochum. The Index was developed by Bündnis Entwicklung Hilft in cooperation with the United Nations University in Bonn. In addition to the data section, the WorldRiskReport always contains a focus chapter examining background and context from a qualitative perspective – this year of the topic "water supply".

The calculation of the disaster risk has been performed for 180 states worldwide and is based on four components:

+ **Exposure** to earthquakes, cyclones, floods, drought, and sea-level rise
+ **Susceptibility** depending on infrastructure, food supply, and economic framework conditions
+ **Coping capacities** depending on governance, healthcare, social and material security
+ **Adaptive capacities** related to coming natural events, climate change, and other challenges.

The WorldRiskIndex can only consider indicators for which comprehensible, quantifiable data is available. For example, while immediate neighborhood assistance cannot be measured in the event of a disaster, it is nonetheless very important. Furthermore, variances in data quality among different countries may occur if data is only gathered by national authorities and not by an independent international institution.

The aim of the report

The exposition of the disaster risk using the index and its four components shows the disaster risk hotspots across the world and the fields of action to achieve the necessary reduction of risks. Complemented by the qualitative analyses within the report, it is possible to formulate recommendations for action for national and international, state and civil society actors.

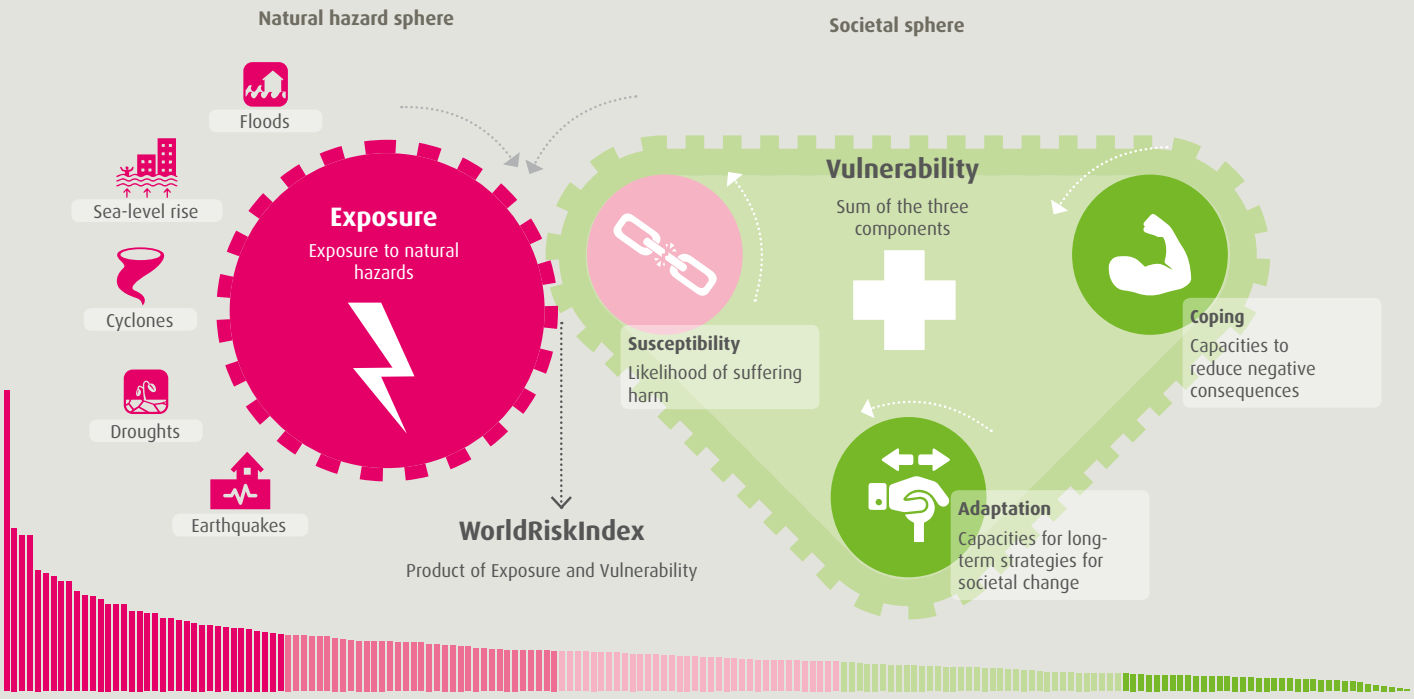


Figure 4: The WorldRiskIndex and its components

2 Water Supply

2.1 'Water Security' through the Lens of International Law and Politics

Pierre Thielbörger
Professor of German Public Law and Public International Law, IFHV, Ruhr University Bochum

"Water security" has a twofold meaning. On the one hand, it means security through *water in the sense of access to clean water for individuals as their foundation for life. On the other hand, security* from *water describes the absence of water-related threats. Security* through *water implies a human rights-based approach. It is a means to guarantee certain minimum levels of accessing water. In the case of security* from *water, water is perceived as a source of danger. First, such danger can take the form of rising sea levels as well as water-related extreme natural events, such as floods and tsunamis, which increase in their numbers and intensities. Second, experts estimate that in the future even war might be waged for accessing water. After examining these two forms of "water security", this article turns to current and future challenges to water security, including the role of private investment in the water sector, the consequences of climate change, and the global sanitation crisis.*

Water is an essential element for human life – particularly in emergencies such as disasters. Nevertheless, the term water security is normatively blurred and controversial and without a distinct definition and interpretation (Allouche et al. 2011). Water can save humans, but equally kill them. The term 'water security' thus has a twofold meaning: security *through* water in the sense of access to water for individuals, and security *from* water, meaning the absence of water-related dangers, which can be natural or man-made. A more comprehensive legal analysis of water security is found in Thielbörger (2019b).

Security *through* water, implies a human rights perspective as a tool to guarantee minimum standards of water for individuals for drinking, hygiene, sanitation and other basic purposes at all times (also in states of emergency and disasters). While security had traditionally been understood as a state-centric concept, the ideas of environmental security (Tuchman Mathews 1989) and later of human security (World Summit for Social Development 1995) entered the international arena the last few decades and have materially broadened the concept of security. Under this understanding, water security is closely related to the human right to water, which still is widely contested (out of many: Thielbörger 2014; Winkler 2012; Laskowski 2010). Its normative basis and scope raise many questions until today (Chirwa 2019; Thielbörger 2019a).

Security *from* water implies protection against threats that water can pose. On the one hand, this means the protection against water, in particular against disasters resulting from extreme natural events caused by water. Scientific research has shown that water systems are particularly affected by climate change, most notably by sea level rise as well as floods and tsunamis, which will increase in number and severity (IPCC 2018). Second, the likelihood of 'water wars' (Wolf 1999; Rahaman 2012) has been discussed in international law and politics

for some time. Given its outstanding political and economic significance, many observers have even predicted that future wars would be fought over water.

While significant improvements have been achieved both in terms of security *through* water and security *from* water, some pressing challenges remain to which the global community must respond promptly in order to make a water-safe world still possible for future generations.

Legal framework for security through water

Already in 1977, the Action Plan of the UN Water Conference in Mar del Plata proclaimed water to be a human right (p. 63). Two years later, the right was recognized in Article 14(2)(h) of the Convention on the Elimination of Discrimination against Women, mirrored again ten years later also in Article 24(2) of the Convention on the Rights of the Child. For the first time, the right to water was recognized in a legally binding manner, albeit only for certain groups.

In 2000, states committed themselves to the Millennium Development Goals (MDGs). MDG 7c demanded that by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation should have been halved (UN-Doc. A/Res/55/2, para. 19), and indeed by 2015, significant progress had been achieved. By that year, 147 of 193 countries had met MDG 7c. Thereby in 2015, 91 percent of the global population had access to improved drinking water sources (compared to 76 percent in 1990, for all figures: UN 2015, 7, 52). However, the 2015 MDG Report also explicitly highlighted water insecurity as a challenge for the future, given acute environmental challenges such as rising global temperatures and an increasing number of natural hazards (UN 2015, 61).

In 2002, the Committee on Economic, Social and Cultural Rights of the United Nations (CESCR) released General Comment No. 15 on 'The Right to Water' (CESCR 2002). Therein it described the normative content of the right and emphasized that, while not included in the International Covenant on Economic, Social and Cultural Rights (ICESCR) explicitly, it must be understood as being derived from the right to an adequate standard of living (para. 3). The experts also saw it as being closely related to the right to the highest attainable standard of health and the right to life (para. 11). While not legally-binding, General Comment No. 15 must be considered a landmark document in the establishment of the right to water (Thielbörger 2014, 67), as it developed the normative content of a right to water in a unique way and as it was met with broad support from the very beginning, with only few exceptions (Tully 2005).

In July 2010 the UN General Assembly adopted a declaration on the human right to water (UN-Doc. A/RES/64/292) in which it declared water and sanitation to be human rights. While the resolution was met with significant reluctance by some states (Thielbörger 2014, 79 – 80), only a few months later, in October 2010, a similar declaration was unanimously adopted in the Human Rights Council (UN Doc. A/HRC/Res/15/9).

Fifteen years after the MDGs, the UN General Assembly unanimously proclaimed the Sustainable Development Goals (SDGs). SDG 6 specifically demands the availability and sustainable management of water and sanitation for all. In its recent report in mid 2018, the UN was only partially optimistic about whether SDG 6 can be met (UN Water 2018). Only 20 percent of the countries below 5 percent coverage in 2015 are on track to achieving universal basic water services by 2030 (UN Water 2018, 39). Altogether, immediate action must be taken if the 2030 Agenda targets are still to be met (UN 2018, 178).

As with all socio-economic rights, states are obliged to respect, protect and fulfill the human right to water (CESCR 2002, para. 20). This applies at all times, even in exceptional situations such as disasters caused by extreme natural events (for water needs in emergency situation see figure 5, page 20). However, regarding socio-economic rights, it should be noted that according to Article 2 ICESCR, states are only required to implement the rights of the Covenant within the scope of their possibilities. In contrast to civil-political rights, the obligation therefore applies only relatively to the capacity

of the state, apart from a minimum core obligation that always must be fulfilled by states. In the case of disasters, the capacity of states is often very limited, which considerably weakens the legal obligations under the right to water.

The human right to water entitles everyone to "sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (CESCR 2002, para. 2). This describes the main requirements of water availability, water quality and water accessibility (both physical and economic accessibility). These elements of the right in turn explain the right's origin in different core rights. In other words, if water is not available for drinking and other basic uses, the right to life (Article 2 of the International Covenant on Civil and Political Rights, ICCPR) is at stake. If water is not of the required quality, it puts consumers' right to health (Article 12 ICESCR) in danger; and if water is out of proportionate physical or financial reach, it jeopardizes the fulfillment of the right to an adequate standard of living (Article 11 ICESCR).

Legal framework for security from water

Turning to security *from* water, there are three normative facets: first, the general obligation of states to prevent disasters in the wake of extreme natural events to the best of their abilities and to mitigate their consequences; second, the (very contested) obligation to counteract climate change through state actions (and not increase the probability of climate-induced disasters); and third, the obligation to not let water scarcity or water-related disasters turn into military conflicts.

a) Protection from the effects of disasters resulting from extreme natural events

On the international level, several political declarations of intent address such protection, but do not have binding legal force e.g. the Sendai Framework for Disaster Risk Reduction 2015 – 2030 (UN-Doc. A./Res/69/283) by the United Nations. Only general principles, such as the "no-harm" principle established by customary international law since the Trail Smelter Case, define the obligation of states not to cause transboundary harm. Said case concerned damage to the US-American side caused by toxic smoke produced by a lead smelter on the Canadian side of the border. However, this environmental principle often remains without much effect, as proving a direct link between cause and damage is often hard in such cases.

Basic and human rights are more promising from a legal standpoint when trying to capture a legal obligation to protect against extreme natural events. Not only do they entail a protective dimension directly towards the state; they also oblige the state to ensure protection from dangers that the state did not cause itself (such as often the case for extreme natural events). The European Court of Human Rights (ECtHR) has produced explicit jurisprudence on this obligation by progressively interpreting the European Convention on Human Rights (ECHR). According to the ECtHR, the state's obligation to protect depends on the feasibility of necessary actions for the state in order to prevent danger and reduce damage. In Budayeva vs. Russia (ECtHR 15339/02) for instance the Court saw a violation of Art. 2 ECHR, after eight people had died in a mudslide in Tyrnauz. The state had failed to conduct proper land-planning and put disaster prevention measures in place, although the area was known to be susceptible to mudslides. In Kolyandenko vs. Russia (ECtHR 17423/05) the Strasbourg judges found a violation of Art. 2 and 8 ECHR, as the town of Vladivostok had failed to prevent floods and minimize flood damages in a canal of the river Pionerskaya.

b) Obligation relating to climate change

Originally the Kyoto Protocol 1997 developed promising legal approaches to counteract global climate change. However, after a number of key states had pulled out of the agreement, the protocol was no longer perceived as adequate to solve the problem of climate change. This led to the Paris Agreement in 2015. The obligations from this treaty are, however, not of a legal nature and for the most part leave it to the states to set themselves (often not very ambitious) climate goals.

European and national law provides some more concrete legal approaches. A decision

Water Needs in Emergency Situations

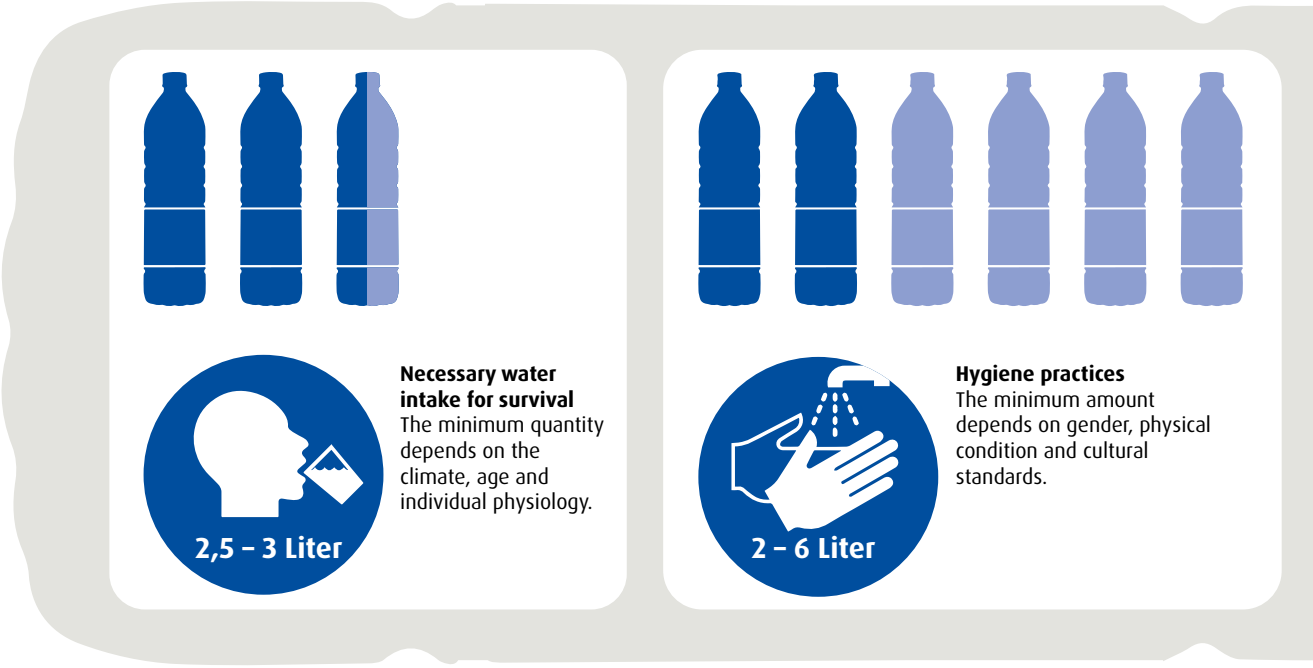


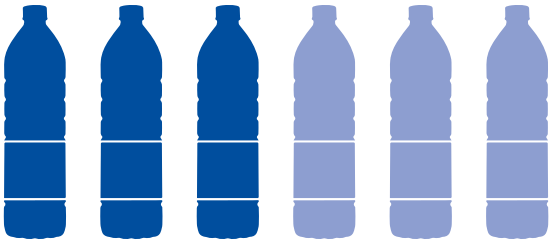
Figure 5: Need for water in emergency situations per person per day, grouped by intended use
Data source: Sphere Association 2018

of the District Court of The Hague from June 2015 received international attention in which a Dutch NGO by the name of Urgenda filed a case against the Dutch government arguing that the Netherlands were obliged to reduce greenhouse gases by 25 percent until 2020. With reference to Art. 21 of the Dutch constitution ('Protection of Natural Livelihood') the court based its decision on Dutch civil law, informed by Art. 2 and 8 ECHR. In the opinion of the District Court these articles cannot be applied directly in the Dutch legal order, but influence the interpretation of significant Dutch civil law. The court ruled in favor of Urgenda, mostly because the Dutch government failed to comply with their obligation to protect Dutch citizens (not only of the current, but also of the future generation). While there is no explicit reference to water security in the judgment, the connection to climate change induced flood dangers for the low-lying Netherlands is obvious. Meanwhile the judgment has been upheld by the Court of Appeal, which concurred with the District Court, but expressly based its judgment directly on Art. 2 and 8 ECHR. Currently the case is negotiated at the Dutch Supreme Court.

c) Water scarcity as a driver for armed conflict

The rather inadequate term 'water wars' has been used in the literature and in the media alike (Rahaman 2012, Leithead 2019). It is, however, misleading. Existing empirical studies show that inter-state water conflicts are the less likely form of violent water conflicts. Most water conflicts take place within a state (Homer-Dixon 1999, 12 – 27).

Some researchers have claimed that aggravating water scarcity has a direct positive effect on the incidence of civil war (Hauge / Ellingson 1998, 299 – 317). Other researchers, however, found that resource scarcity (as water scarcity) had no effect on state failure and civil war (Esty et al. 1998). Some studies found precipitation patterns and water scarcity to have no robust effect on inter-group conflicts such as civil war (Theisen / Brandsegg 2007). Some authors even claim the reverse effect, namely



Basic cooking
The minimum amount depends on social and cultural standards as well as the type of food.

3 – 6 Liter

Total basic water needs
7.5 liters is the absolute minimum of the individual water needs. The supply should only be limited to this during situations of extreme water scarcity. 15 liters are enough to cover the acutely necessary demand. In the event of prolonged emergency situations, the water quantity should be increased as quickly as possible. People with certain disabilities or illnesses (e.g. AIDS) have an increased minimum need.

7,5 – 15 Liter

that population density combined with renewable resource abundance (including improved access to water) can increase, rather than decrease, the risk of civil war (De Soysa 2002, 395 – 416). The current findings are inconsistent and in parts even contradictory. This could lead to the conclusion that water can increase the danger of conflicts, but that at the same time water scarcity also enables cooperation, which can also affect other policy areas positively. Additional studies in the future should shine further light on the inter-relation on (increasing) water scarcity and the incidence of armed conflict.

At least the UN Security Council is concerned about the effects of climate change (such as increasing water scarcity) as driver for armed conflict. In 2017, for instance, the Council highlighted the security risks with regard to (inter alia) water scarcity, drought, desertification, and land degradation (UN-Doc. S/Res/2349). The Council has also recently emphasized water-related security risks for specific countries and regions, such as West Africa and the Sahel region (UN-Doc. S/PRST/2018/3), Somalia (UN-Doc. S/RES/2408, UN-Doc. S/RES/2431), Sudan (UN-Doc. S/RES/2429) and Mali (UN-Doc. S/RES/2432).

In order to avoid future water conflicts and expand water cooperation, an increasing number of bilateral and multilateral water agreements have been concluded in the last few decades. The most general (and most important) of these treaties is the Convention on the Law of Non-Navigational Uses of International Watercourses (Watercourse Convention 1997), adopted by the UN in 1997 aiming to regulate the uses and the conservation of all transboundary waters (Preamble para. 5 and article 1). Notably the convention took almost 20 years to enter into force, due to the lack of the ratifications by states. Even today only 36 states have ratified the treaty, with key states such as the USA, Canada, Russia and Brazil still missing.

In the absence of a widely-ratified global treaty, regional treaties and initiatives, such as the Indus Water Treaty between India and

Pakistan, the transnational Nile Basin Initiative and several treaties in Central Asia, have gained particular importance. According to the UN Water Commission (UN Water), around 300 international water agreements were concluded between the late 1940s and mid-2010s. The Stockholm International Water Institute points out, that around two thirds of the world's transboundary rivers today are still not governed by a cooperative management framework.

Remaining challenges

As we have seen, while much progress has been achieved with regard to security *through* water and security *from* water, some pressing challenges remain.

a) Privatization of water

Water is one of the most financially valuable goods worldwide. Not surprisingly, foreign direct investment in the water sector law has become more and more important, in particular in cases of privatization of water services through international enterprises. Certain water disputes before investment tribunals have gained particular attention since the 1990s and the early 2000s, including Aguas del Tunari (ICSID Case No. ARB/02/3, dubbed as the 'water war of Cochabamba' by the media), Azurix (ICSID Case No. ARB/01/12) and Aguas del Aconquija (ICSID Case No. ARB/97/3) – often with favorable results for the investors (for a more detailed analysis see: Thielbörger 2009). Whether the tribunals should refer to human rights (and not only to the investors' rights) as part of the applicable law when addressing investment disputes relating to water remains an open question (introductory: Steininger 2018). A particular important investment case with regard to water security is the 2016 Urbaser vs. Argentina case (ICSID Case No. ARB/07/26) in which the arbitral tribunal very directly referred to the right to water (e. g. Award paras. 720 – 721, 1193 ff.) and also discussed the possibility of holding the investor, not the state, responsible for possible human rights violations. To what extent the discussion on human rights obligations of companies, as currently intensively discussed (see Thielbörger / Ackermann 2017), will also reach the realm of investment arbitration, is hard to predict. If it does change, the human right to water could play a key role in future investment related water disputes – to tip the scales more often in favor of the affected population.

b) Climate change as an obstacle to future water security

The weak legal obligations of states to counter climate change stand in stark contrast to its dramatic consequences. These consequences are particularly notable in the area of water. In the latest IPCC report of 2018, the experts emphasize the dramatic climate-induced vulnerability of water systems. The report explicitly warns against the imminence of long-term sea level rise that threatens the existence of island states (IPCC 2018, 56 – 67, 186 – 211), irreversible impacts of climate change on oceanic ecosystems (IPCC 2018, 70 – 74, 212 – 252, 253 – 264), a regional increase in intensity or frequency of droughts (IPCC 2018, 183 – 185, 186 – 200) and overall climate change-induced increase in drinking water stress (IPCC 2018, 201 – 202, 213 – 215, 241, 262 – 263). The report continuously emphasizes the dramatic difference for water security between a 1.5°C versus a 2°C or more global warming scenario. The questions if and to what extent water security can be achieved in the future therefore depends heavily on the question when and how the international community bestirs itself to finally face the causes of (man-made) climate change.

c) The sanitation gap

Water features on the international agenda – sanitation does much less so (overview: Winkler 2016). The right to sanitation is closely connected to the right to water, since it can be derived from the same or similar rights. In contrast to water, however, the international community is dramatically failing on sanitation, as the monitoring of the MDGs indicates (see for instance MDG Report 2015). The world is facing a global sanitation crisis. This crisis persists for several reasons. Most prominent amongst them is the unease associated with speaking about the topic of toilets, putting them on the political agenda or raising private funds to improve the realization of the right to sanitation. The subject of water

has a positive connotation, while the subject of sanitation is a taboo. To raise awareness for the topic, the UN declared the year 2008 as the 'Year of Sanitation' (UN Doc A/RES/61/192). The former (and first) Special Rapporteur, Catarina de Albuquerque, was wise in making the topic of sanitation one of the first issues of focus of her mandate (report of de Albuquerque 2009, UN-Doc- A/HRC/12/24).

Nonetheless, the numbers remain alarming: According to most recent estimations, about 4.25 billion people lack access to safely managed sanitation and 673 million people still practice open defecation (UNICEF / WHO 2019). These numbers become even more dramatic if one remembers that the lack of safe sanitation is closely related to high child mortality rates in developing countries (Fink / Gunter / Hell 2011). One can only hope the issue of sanitation will soon receive the same attention on the global agenda as the issue of water, because water security can only be achieved when both rights – the right to water and the right to sanitation – are equally ensured.

Rank 118 in WorldRiskIndex 2019

WorldRiskIndex	4.79
Exposure	11.34
Vulnerability	42.28

Brazil

From Water Overflow to Water Crisis

Country profile

With an area of 8.5 million km², Brazil is the fifth-largest state and one of the countries with the highest water content in the world. Around one-fifth of the total freshwater worldwide flows through the Amazon basin. The moist airstreams that arise over the forest are carried to the south by the wind, where they turn into rainfall. Therefore, they are also called as "flying rivers". The massive deforestation of the Brazilian rainforest for the monoculture cultivation of soybeans and sugarcane as well as for road construction and mining industry, disturbs the natural water cycle. Annually 5,000 km² of rain forest are being destroyed. Many parts of the country, especially the dry northeast, suffer from prolonged periods of drought and underground springs and rivers are drying up.

Despite Brazil's abundance of water, the access to water is not self-evident for large parts of the population. One reason is an insufficient water management by national, regional or local authorities. Many cities and municipalities suffer from a poor drinking water supply and sanitary provision. As a consequence of dilapidated lines and illegal water diversion, 50 percent of the available water does not arrive on site. Many people have no access to a sewage system and only a third of the waste water is purified by treatment plants and reclaimed.

Project context and activities

The Sertão is a semiarid landscape in the northeast of Brazil. With a population of 23 million people on nearly 1 million km², the Sertão is the most densely populated dry area in the world. The residents are used to

Water situation

86.1 %
Share of population with access to at least basic sanitation

97.5 %
Share of population with access to at least basic drinking water

63.5 billion m^3
Annual freshwater withdrawals

3.0 %
Level of water stress

long dry periods of up to eight months, and have adapted their lives to the drought. In addition to the difficult climatic conditions, life in the area is characterized by poverty and social inequality. Access to water plays a key role here. Only those who have the valuable resource at their disposal can cultivate their land and safeguard the harvest. Overgrazing, slash-and-burn methods and the use of pesticides destroy the soils of the fragile ecosystem and lead to desertification. Further, the Sertão rates among the regions in Brazil most affected by the effects of climate change. The last drought lasted over six years – a rarity, even in this region. Due to such extreme weather events, people from the region increasingly move to the coastal cities or the rich south of the country.

For more than 50 years, the partner organization of Brot für die Welt, Diaconia, engages in the region of Pernambuco with projects for water supply. In order to improve the water supply, the organization supports families in planning and constructing drinking and utility water facilities. Thereby, Diaconia focuses on the construction of cisterns that store rainwater and provide people with both drinking water and water for agriculture. In several villages, a 16,000 liter cistern was built for the smallholder families to supply drinking water during the rainy season and a 52,000 liter cistern to store rainwater for irrigation and livestock farming. The cisterns feed the water circuit of the agro-ecological agriculture, which Diaconia builds together with smallholder families in a long-term project.

The agro-ecological approach strengthens the cultivation of indigenous and traditional types of fruits and vegetables that cope better with drought and less irrigation, and does not use pesticides. In this sense, Diaconia, for example, conducts training on organic farming methods, promotes the establishment of seed banks, organizes seed fairs and advises smallholders to grow a variety of fruit and vegetables and in erosion protection. In the vegetable gardens the smallholders plant tomatoes, onions, pepper, corn, pumpkins, okra, mallows, mint and rosemary. In the orchards papayas, mangoes, bananas, oranges, lemons, guavas and the native acerola fruit are harvested. In order to increase yields from fruit growing, smallholder farmers are being trained, for example, in the production of fruit pulp and in marketing. The fruit pulp is sold at schools and kindergartens and thereby contributes to the families' income. Additionally, Diaconia supports local families in reforesting the semi-desert with robust and climate-resistant plant varieties. Thus, the diversity of native plants over there can be preserved.

Results and impact

Thanks to the work of Diaconia, thousands of smallholders are now provided with water facilities and better prepared for dry periods. The diversification of cultivation has opened up new sources of income for the smallholders and enables them to eat healthily. They can live self-sufficiently today.

As a result of insistent lobbying by various local organizations, including Diaconia, the construction of cisterns is now supported by the "One Million Cisterns" State aid program in eight federal states. The program, coordinated by the Articulação Semiarido Brazileiro (ASA) network, was even honored by the UN Habitat in 2014. Meanwhile, over one million cisterns have been built that supply around five million people in the north east with drinking water.

Despite the enormous progress made in water supply through the sustainable cistern program in the Sertão, it has been cut by the governments in recent years. Also under the government of the current president Bolsonaro, nobody knows exactly what will happen with regard to water management and climate change. In November 2018 the Brazilian government withdrew from hosting the UN Climate Conference COP 25 in late 2019. It is uncertain to what extent Brazil will continue to act as a key country and important actor in global climate policy and set standards in water supply for the population.

Christina Margenfeld, Project Communication Latin America, Brot für die Welt

2.2 Water Supply in Crisis

Jutta Himmelsbach
Water, Sanitation and Peace-building Advisor, Misereor

According to the United Nations, around four billion people worldwide do not have access to sufficient water, at least temporarily. Moreover, the water quality often poses a serious problem in many places. The reasons for this include inadequate management, poverty and recurring periods of extreme drought in the wake of climate change. Having negative impacts on agriculture, health care and education, water shortages represent an obstacle to development. The article highlights the regional differences in the availability of and access to safe water in Latin America, Asia, the Middle East and various parts of Africa. The example of the nomadic way of life in Africa shows how people have to adapt differently to changing climatic conditions depending on their lifestyle and place of residence with regard to their water supply.

The hot summer of 2018 has shown in Germany that persistent drought has a real and lasting impact on people's lives. During the drought, many Germans realized the actual consequences of water shortage: Locally grown fruits and vegetables became expensive in the supermarkets, entire regions were dominated by withered fields and rain barrels in the garden remained empty. Numerous media reports raised the questions: Is this climate change? Does it go on like this forever?

In many countries of the world, parts of the population have less water available than they would actually need. According to the UNESCO World Water Assessment Programme (WWAP), around four billion people worldwide suffer from serious water shortages at least temporarily every year (WWAP 2019; BMZ 2017). Water is not only lacking in agriculture, but also in households. As a result, people cannot adequately satisfy their basic nutritional and hygiene needs.

But how much water is actually sufficient? The human right to water is based on the understanding that everyone is entitled to at least 20 liters of water per day for basic needs. This amount is needed to drink enough as well as to maintain personal hygiene and food preparation. In German households, the average consumption of water per capita is over 120 liters (BDEW 2019). If the indirect consumption – i.e. the water required for the cultivation of food, the production of consumer goods or the energy supply – is included, the consumption is 3,900 liters per person and day according to the German Environment Agency (2014).

How water shortage occurs

Water scarcity can be caused by actual water scarcity, which means too little available water to meet existing needs as well as inadequate management of existing water resources and infrastructure. The reasons for this are manifold and often interdependent. One reason is increased water consumption due to global population growth, increases in agricultural production, industrialization processes, and energy generation (WWAP 2019). In addition, the pollution of water reduces the amount of water that can be used by humans. For example, 2.1 billion people worldwide have to drink water that is bacterially contaminated and should therefore not be consumed (German Federal Government 2016). Chemical components such as fluorides and arsenic in groundwater additionally endanger the water supply for parts of Africa or Asia. In the European context, the health hazards of hormones, medicines or multi-resistant germs contained in wastewater are increasingly being investigated when people reabsorb them via drinking water.

At the local level political and economic procedures in some places can impede access to safe and adequate water supplies. Such procedures include the awarding of rights of use of water resources to private, financially strong

companies. In arid regions, there are numerous conflicts over the use of water infrastructure or resources (BMZ 2017, see also Article 2.1).

At the international level, the demarcation of borders between states in areas where the water supply has traditionally been secured across borders can threaten the water supply and lead to political tensions. A striking example of such a development is the construction of the "Grand Ethiopian Renaissance Dam", which has severely strained relations between Ethiopia and Egypt at the intergovernmental level.

Moreover, a lack of accessible, clean and affordable water is closely linked to inequality and poverty. On the one hand, the state of a country's water supply is an indicator of its level of development; on the other hand, the lack of water supply plays an important role in maintaining poverty structures (WWAP 2019). Poorer or marginalized, vulnerable population groups in particular are faced with hindered access to safe water. Many do not even have a basic supply of water and have to use expensive or extremely unsafe sources. They often even pay more for their water supply than financially stronger sections of the population with better access (WWAP 2019). Richer households are more likely to have a water connection and can draw water directly from the tap, poorer people are often forced to fetch their water from public locations and also pay for the operation (e.g. staff) there. In addition, tariff systems commonly also favor financially stronger households or companies; the more water is abstracted, the lower the price per cubic meter. Since lower income sections of the population consume less water on average, they often purchase water at poorer conditions and pay higher prices per cubic meter.

Water shortage as an obstacle to development

Where there is a lack of water and only the basic needs for survival can be met, important development processes fall short. There are three main reasons for this. First, water plays a crucial role in agriculture and livestock production, making it relevant to food security and the income of families dependent on agriculture. Secondly, water plays an important role in health care, as diseases spread when water quality is poor and necessary hygiene cannot be maintained. Thirdly, safe water supply is relevant for the education sector, since students for example miss classes when they suffer from water-induced illness or have to fetch water for the family during school hours.

The United Nations World Water Development Report (WWAP 2019) concludes that ten times more people die each year from inadequate water and sanitation (780,000 people) than from conflict (75,000 people). Globally, two and a half times more people are affected by floods (106 million) and droughts (55 million) than by armed conflicts (65 million) (WWAP 2019, Fig. 1).

The concrete effects of climate change are intensifying water-related problems not only in arid regions, but worldwide. If the annual average temperature rises by 1.5 °C, higher risks to water supply, nutrition and human health are to be expected (IPCC 2018, 11). This makes it clear that climate change will make it more difficult to secure water supplies especially in high-risk areas. Extreme natural events such as droughts in the Horn of Africa, cyclones causing floods in Southern Africa or Asia have pushed long-established water supply processes to their limits. They are no longer sufficient or functional. This also creates new challenges for international cooperation (BMZ 2017).

Current water situation – regional peculiarities

Water consumption and difficulties in supplying water vary greatly from region to region (see also Figure 6 on the right). Based on a selection of regions in which Misereor is also active, the broad spectrum of challenges is outlined below.

The region of **Latin America** does not consume more water than is generated annually by rainfall or inflows. The amount of water available would itself be sufficient to meet the demand. The proportion of people with access to a basic water supply is over 90 percent. In the urban context, about 75 percent have access to a safe water supply, in the rural context the proportion is significantly lower. Water quality and management of the facilities often remain a

problem especially in rural areas. Socially disadvantaged families also have difficult access to safe water supplies. Regulation by the authorities is needed to make water supply more efficient and more sustainable for the poor or rural population (WWAP 2019, 140).

In **Asia**, there is a lack of water in agriculture, especially in densely populated regions such as India. Due to the increasing degree of urbanization, the urban population must be supplied with more and more food from the rural surrounding area. Agriculture is the largest consumer of water due to its need for irrigation. Because of the use of fertilizers and pesticides, it is also a major polluter of water. The dry periods of climate change exacerbate this situation even further, so that agriculture is facing the problem of sparingly using water and at the same time increasing production in order to supply the cities with food.

In addition to the lack of water for agriculture, the water bottlenecks for households in fast-growing cities are also becoming apparent. Megacities generally face the challenge of providing water of sufficient quality and quantity at reasonable cost to users. Privatizations designed to increase cost efficiency in the water sector have also failed in this task. The overuse of available water resources in connection with urbanization, economic growth and population growth can also be seen in many examples in Asia. Concise examples include the lowering of groundwater levels observed in many places, including India and Pakistan (BMZ 2017).

In countries in the **Middle East** currently not suffering from civil war and outbreaks of violence, basic water supply is secured to a large proportion. Wherever violence escalates, the safety of the water supply is reduced by regional comparison (WWAP 2019, Fig. 9.2). Major refugee movements also have an impact on the safety of the water supply. Both refugees and host communities face the challenge of providing sufficient water for all – especially in regions where water is a scarce resource anyway. The World Water Report cites Jordan as an example. A person living in the camp gets only one third of the water consumed by a local person in the vicinity of the camp (WWAP 2019).

In the Middle East, the conflict potential of water resources becoming apparent: The general scarcity of water repeatedly leads to tensions and disputes over who is allowed to decide on the quantities to be withdrawn and the purpose of the scarce resource. The joint use of the Euphrates, which flows through Turkey, Syria and Iraq, is also causing conflicts, as the construction of the various dams led to resettlement. In addition there are also disagreements among neighbors about the use of this central water vein. Sustainable concepts with all affected parties and agreements that consider needs of all sides would be an essential factor in securing peace and water supply in the region (Frings / Lutz 2017).

In a global comparison of the water situation, the figures show that **Sub-Saharan Africa** has the highest proportion of people who do not have access to a safe drinking water supply. One of the central challenges is the lack of water infrastructure, especially in rural areas. More than 40 percent of the population in this region has inadequate access to water. Only 24 percent have safe access, 34 percent have a basic water supply (WWAP 2019). The World Water Development Report makes it clear that many African countries are already severely affected by droughts and floods, which in many places are currently alternating at an ever faster rate. The number of droughts in particular is very high compared with other regions (WWAP 2019, Fig. 5). In addition, Southeastern Africa was hit by cyclones in March 2019, which had a highly destructive impact on the water infrastructure.

Water management, adaptation measures and conflicts of interest

A closer look at different living conditions shows how people have to adapt differently to changing climatic conditions depending on their lifestyle and place of residence. Farmers, for example, face the challenge of both ensuring access to water for their own household and maintaining sufficient water for agriculture. For this to succeed, a functioning infrastructure, that is designed for both types of use and balances the interests, is needed. In that sense there is a great demand for a sustainable water management that meets the various needs and initiates development processes. The common

good - following the principles of subsidiarity and solidarity - should be at the center of planning and orientation, also in international cooperation. However, the understanding of the common good is not always the same. The approaches differ according to region and way of life. An approach that is accepted by one population group reaches its limits in another - or can even endanger its lifestyle.

This is clearly illustrated by the example of nomads in African arid regions. For many generations, nomadic livestock farmers have successfully secured their livelihoods in these regions. Due to their mobility, they find good grazing conditions for their animals even in arid regions by moving from one grazing area to the next. Humans and animals can usually overcome short dry periods without any problems. Their way of livestock holding allows for nomads to even keep a safe herd alive for longer periods of drought even though some losses have to be expected. However, the herds need a period of time thereafter in order to quickly recover. This nomadic system is ideally adapted locally and economically successful (UNEP 2013).

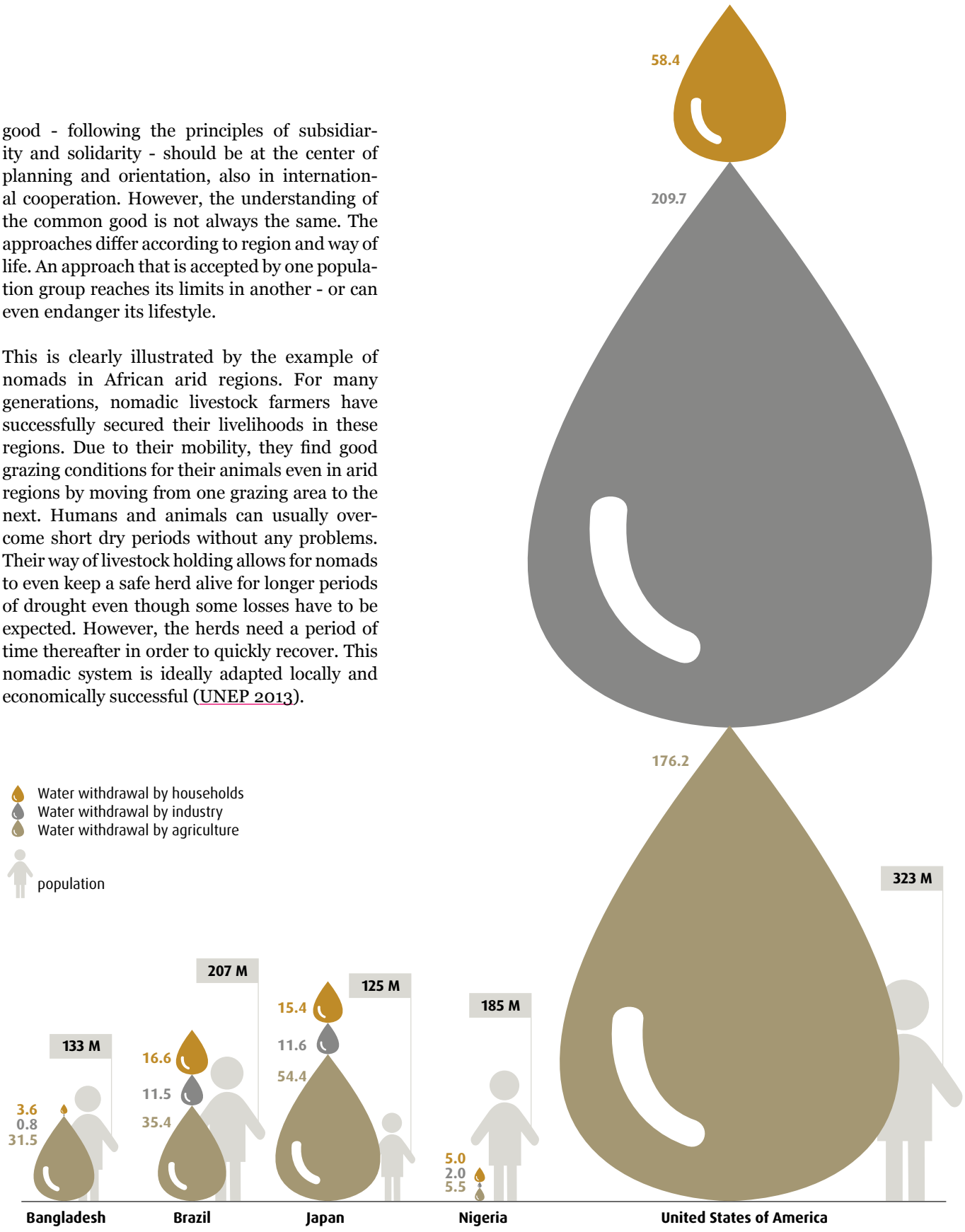


Figure 6: Water withdrawal by sectors (water withdrawal figures in m^3 / year)
Data source: FAO AQUASTAT 2019 (water data), LandScan 2017 (population figures)

At the Horn of Africa, however, there are no longer sufficient recovery phases. Climate change and private land appropriation in strategically important retreat zones are affecting all mobile livestock farmers. The poorer of them, who only have small herds, are particularly affected by the recurring droughts. In order to survive, they have to sell animals of their herd again and again. This makes it more difficult for them to regenerate their herds. Some of these livestock farmers have even lost their entire herd over the past years of drought. Many of those affected now live permanently in barren places where they lack the natural resources to make a living for themselves.

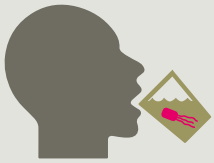
In this nomadic context, public welfare orientation demands implementing infrastructure measures based on very different criteria than in settling societies. It is difficult, for example, to set up a permanent management committee here, to dimension water supply facilities for a defined user group size or to think about tariff systems in an area where there are hardly any monetary means of payment.

The challenge in this context is to create a water supply in such a way, which retains mobility. This water supply is usually located far away from settlements with the result that for long periods of time no one is present to take care of the facilities. Above all, however, these facilities must not tempt people to settle there - which can happen, for example, if water is available there all year round. Settlement destroys the nomads' livelihood - their mobility - in the medium term and leads to new dependencies and conflicts of interest. In other words, the aim must be to create additional access to water for nomads and their herds of cattle, while taking into account the nomadic way of life. This means, that water should be made available only in the amount actually needed without guaranteeing year-round water supply. For this reason complementarity of water supply in a nomadic context is something very different from that in settling contexts – an example of how multifaceted the issue of water supply can be.

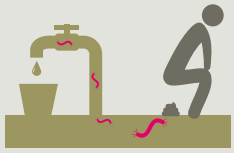
In order to overcome water shortages, the commitment of all actors in the water sector should place the social-ecological common good of the user groups at the center of action. Beyond the mere supply of drinking water, safe access to water offers an enormous potential for social development and peace processes, as well as for the protection of resources.

Sick by Water

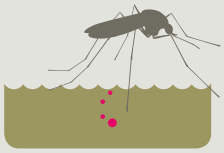
Polluted drinking water, lack of personal hygiene due to lack of water and inadequate sanitation are common causes of disease in many parts of the world. Diseases transmitted by animals in the water and by insects that live or breed by the water are considered "water-induced". Without access to clean water, the treatment of many diseases, wound care, and nursing are considerably more difficult. This has a significant impact on the course of the disease, such as the development of disabilities.



Cholera, typhus, dysentery, hepatitis A and diarrhea are examples of diseases **caused by drinking contaminated water or preparing food with unclean water.** Every year, 297,000 children under the age of five die of diarrhea (UN 2019). Countermeasures include improving water quality and boiling drinking water.



Hookworm, roundworm and whipworm are transmitted **by polluted water and food when feces from already infected people have contaminated water and soil.** Approximately 1.5 billion people, over 20 percent of the world's population, are infected by this type of worms (WHO 2019). Building simple sanitation facilities and improving hygiene practices such as hand washing are successful countermeasures.



Malaria, yellow fever, lymphatic filariasis and river blindness **are transmitted by insects that lay their eggs in water or live near open waters and swamps.** Malaria alone affects 219 million people and kills about 435,000 annually (WHO 2019). Countermeasures are the water supply of the population via pipes in order to prevent people from having to fetch water near breeding sites, as well as improved sewage and waste disposal.

Schistosoma worm and Guinea worm **need aquatic organisms as intermediate hosts in their development.** Pathogens of schistosomiasis (bilharzia) develop in a snail species, the Guinea worm in a tiny water flea. 220 million people suffer from schistosomiasis (WHO 2019). The infection with Guinea worms, which can grow up to 80 centimeters long and drill through the skin to the outside once they are fully developed, is almost completely under control worldwide. As a countermeasure to both diseases, the cycle of development must be broken: The excreta of infected people must not get back into the water, the habitats of the intermediate hosts must be limited and contaminated waters must be avoided.

Skin diseases such as leprosy and yaws as well as eye diseases such as trachoma **are associated with unclean washing water or poor hygienic conditions.** More than 142 million people suffer from the eye disease trachoma, 1.9 million people are blinded or developed visual impairments due to the infection (WHO 2019). The provision of sufficient water, about 30 to 40 liters per person per day, i.e. more than the minimum standard, and improvements in hygiene are suitable preventive measures. Furthermore, adequate hygiene is essential to control the course of the disease and to avoid secondary infections.

Peter Mucke, Bündnis Entwicklung Hilft, in collaboration with **Dr. Saskia Kreibich,** DAHW

Tanzania

Fewer Worm Diseases thanks to Clean Water

Rank 51 in WorldRiskIndex	
WorldRiskIndex	9.23
Exposure	14.40
Vulnerability	64.14

Country profile

Tanzania belongs to the most politically stable and peaceful states in sub-Saharan Africa and has a stabilizing effect in a region that has been marked by numerous conflicts for decades. However, the constant annual economic growth is not enough to effectively reduce poverty, not least because of the population growth rate of around three percent. Almost half of the population lives below the international poverty line of 1.90 US-Dollar a day. Tanzania's water and sanitation systems are also inadequate. Especially people in poorer areas are forced to resort to unsafe water sources and are infected with diseases. The poor supply situation makes the Tanzanian population vulnerable to extreme natural events and the effects of climate change. Tanzania is particularly affected by droughts and the rising sea level.

Project context and activities

The island of Ijinga is located in Lake Victoria. The people on Ijinga live with the lake, which serves as the main source of water. The life with and at the lake is not harmless for them. Not only do strong storms frequently sweep over the lake, which are especially dangerous for the fishermen, but the water itself also becomes dangerous. In the water of Lake Victoria there are larvae of blood flukes, which transmit the worm disease schistosomiasis. The worm disease can damage the internal organs and in the worst case lead to death. People in Ijinga get infected unnoticed during

Water situation

23.5 %
Share of population with access to at least basic sanitation

50.1 %
Share of population with access to at least basic drinking water

5.2 billion m^3
Annual freshwater withdrawals

13.0 %
Level of water stress

personal hygiene, washing clothes or fishing. In the process, cercaria, a larval form of the parasite, bores through the human skin and develops into blood flukes. These produce thousands of eggs, which the human being excretes with excrement or urine. Due to the poor sewage system, the eggs with the feces get back into the water. In the water, lash larvae develop from the eggs and penetrate into water snails. Here the larvae become cercaria. From the snails, the cercaria, which are infectious for humans, finally get back into the water. The cycle begins anew, and those affected can reinfect themselves at any time. Without access to clean water and weakened by the consequences of the worm disease, people in Ijinga are more vulnerable and thus particularly exposed to natural hazards.

So far, Ijinga has lacked education programs that inform about the infection processes of schistosomiasis and thus break the infection cycle and reduce the infection rate. 'DAHW Deutsche Lepra- und Tuberkulosehilfe e. V.' has therefore launched an initiative together with the 'Würzburg Missionsärztliches Institut' and its Tanzanian partners. The aim is to educate the population of Ijinga about ways of protecting against schistosomiasis and to improve the supply of medicines. A study at the beginning of the project showed that 90 percent of the people on the island were affected by the disease. In the case of children, the rate was even 100 percent.

DAHW now conducts long-term research and treatment campaigns for adults and children. In large educational campaigns, community members, among others, are actively trained and involved. Furthermore, both organizations finance the construction of wells, which are carried out by local experts. More and more people are benefiting from the eight wells on Ijinga to date.

The local school has its own cistern and rainwater collection facilities. They supply the pupils and the surrounding households with clean water for cooking, washing hands and drinking. As a result, the islanders are no longer dependent on the unsecure lake water. The wells were built under difficult conditions by craftspeople using simple locally available machines and manual labor. A concrete slab for covering and a hand pump ensure that the water is not contaminated.

The island village of Kashishi also received another well. Before there had been only one well there – too little for the about 500 inhabitants. In order to obtain clean water, three boreholes had to be drilled for the new well. The population makes great use of the additional wells because long distances to fetch water are now a thing of the past and the well water tastes better than the algae-containing lake water. Local experts regularly carry out chemical and microbiological tests to document the quality of the well water.

For medical research, the adults and pupils were first registered, then measured and weighed. They also gave a stool and urine sample before being examined by ultrasound. The medical study currently continues until sufficient knowledge on the disease can be derived from the data. Based on the results, further methods will be developed that break the cycle of the disease.

Results and effects

The project has started in 2016 and will continue until the end of 2021. Other planned project activities include the construction of better sanitation facilities and a water supply via solar pumping systems to make better use of the lake water. It can be assumed that the measures already implemented and planned will significantly reduce the number of schistosomiasis diseases in the lake region in the long term.

In 2021 a comprehensive re-evaluation is planned. This will include a re-examination of the infection status of those affected as well as molecular biological investigations of the frequency of infection in the carrier snails.

With the support of the 'Else Kröner-Fresenius Foundation', it was possible to expand the project in the Mwanza region on Lake Victoria. It meets the demands of the WASH network for better sanitation and hygiene for the population and considers the fact that health is a human right.

Sabine Ludwig, Press Officer, DAHW

2.3 Sustainable Water Supply in Protracted Humanitarian Crises

Lisa Korte
Humanitarian Program Coordinator, Oxfam
Tim Forster
Technical Engineering Advisor, Oxfam
St John Day
Independent WASH Consultant

Water trucking is a preferred measure in crisis situations, to quickly provide people with essential drinking water. Humanitarian organizations then intervene to set-up temporary water supply systems for affected communities in the short to medium term. In the long-term, local structures, that can guarantee access to a more reliable supply of safe water over a longer period of time, then need to be strengthened or built up. Although there are different operational and management models that allow for more sustainable and cost-effective water supply, humanitarian organizations and donors need to show more foresight and actually apply these concepts in practice.

More and more people around the world depend on humanitarian aid – in increasingly protracted crises (UN OCHA 2018, 8). The funds available for humanitarian aid, but also the capacities of international humanitarian organizations, can hardly keep up with these growing needs. On average, only half of the United Nations' response plans for 2018 were financed (UN OCHA 2018, 8). In many crises-hit countries there is a large gap between what is needed and what can be covered by humanitarian aid.

Despite this problem, in many places the humanitarian water supply is provided for years by cost-intensive measures for various reasons. An extreme example: Although the Sahrawi refugee camps in southwestern Algeria have existed for more than 40 years, between 70 and 80 percent of the required water is still provided through so-called water trucking. Elsewhere, permanent infrastructures are being built, but often they are still operated by changing non-governmental organizations even after the end of the acute emergency phase (Day / Forster 2018, 7). Humanitarian organizations should only temporarily take over the supply of water. In the long term, local structures must be strengthened or created to ensure sustainable access to this vital resource. If this doesn't happen in long-term crises, affected people will remain reliant on external aid. The long-term provision of help also ties up the resources of humanitarian actors, so that the gap between their ability to respond and growing global needs widens.

But how can more sustainable solutions be found for water supply in refugee camps and other densely populated areas? And what needs to be done to make these solutions more effective? The answer to these questions is simple – but their actual application is more difficult: Although there are proven technical solutions for the provision of more sustainable and cost-effective water supply, the management models that underpin these water supply systems are not yet being applied and used in a consistent way. However, there are a number of promising approaches currently being developed globally that contribute towards more sustainable operation of the systems. The following article summarizes potential solutions, identifies key challenges for their application and formulates recommendations for actors in the humanitarian sector. It is based on the results of the study "Water Sanitation and Hygiene in Post-Emergency Contexts" (Day / Forster 2018).

Necessary in the short term: water trucking

In humanitarian crises, water trucks are usually used as a first measure to transport drinking water to displaced camps or densely populated areas. There is general consent in the water, sanitation and hygiene (WASH) sector that this method is suitable for the rapid delivery of sufficient quantities in the short term, but should not be continued in the long term (Wildman 2013). The costs associated with use of water trucks are enormously high. Also, when road conditions are poor, this is a very unreliable way to supply water.

Nevertheless, in many places water trucking is still used for long periods. There are many reasons for this. For example, refugee camps are often set up in inhospitable locations where it is difficult or particularly costly to access suitable groundwater sources. This is due to the fact that host countries want to emphasize the temporary character of the camps. In addition, permanent water supply systems are to some extent the interface between humanitarian aid and development cooperation. Humanitarian donors are often unwilling to finance them, while donors of development cooperation do not feel responsible working in humanitarian crises. High investments in planning and construction pay for themselves after only a short period of time, as only low costs for operation and maintenance are incurring once the construction measures have been completed. Solutions such as water trucking, on the other hand, always remain equally expensive.

Sustainable solutions: community-based and professional forms of operation

The planning, construction and long-term operation of more sustainable water systems is difficult, particularly when the state structures in those countries are also weak and hardly able to provide any meaningful support. When it comes to providing water for refugees or other marginalized groups, the political will to provide resources in the countries concerned is often lacking. In principle, the choice of a suitable water supply for an area depends not only on its size and population density, but also on the prevailing institutions and management models being used in the country.

In rural areas, humanitarian organizations usually hand over the operation of the water supply directly to communities or rural water supply agencies after its construction. Committees from the affected communities receive training from the humanitarian organizations involved in order to take over the operation and maintenance work themselves. This operating model appears sustainable as it aims to strengthen local self-organization, and increase the personal responsibility of the users themselves, which in theory should lead to more sustainable water systems.

Such community management models traditionally function on a voluntary basis, and the committees or rural water supply agencies involved often lack the required legal mandates, capacities and financial resources to assume full responsibility. As a result, it is difficult for community management models to be accountable to the community they serve, and to provide the required level of service. There is also often a lack of formal contractual arrangements with the competent government bodies that define the committees' responsibilities, the scope of their work and their limits. When humanitarian organizations exit from a particular crisis response, such community management structures can no longer count on this external support. Major repairs and other disruptive factors that exceed the capacities of these community structures therefore often lead to supply shortages or even to a complete breakdown (Lockwood / Le Gouais 2015).

Infrastructure in densely populated areas, such as cities and refugee camps, is generally much more complex than in less populated rural areas. Here, humanitarian organizations can end up operating the water supply schemes for decades. If community management models already have reached their limits in rural areas, they are hardly suitable for managing large systems. Consequently, humanitarian actors must fall back on professionalized management models to ensure the longer-term operation. In a study conducted in 2017 (World Bank 2017), the World Bank identified three common professional forms of operation for urban and peri-urban water supply:

+ direct operation by government agencies
+ operation by a public service company with its own personnel
+ the operation by a private service provider controlled by the community.

According to this study, direct operation by public authorities has proved to be rather unsuitable. One reason is that the income from the distribution of water goes to other areas of the responsible body and thus affects the financial viability of the operation. However,

depending on the context, the other two forms can also be viable solutions for the sustainable operation of water infrastructure in humanitarian crises.

Example: Water supply in Gambela

In August 2018, more than 900,000 refugees from five countries were registered in Ethiopia (UNHCR 2018a). In addition, in September 2018, the United Nations High Commissioner for Refugees (UNHCR) counted 2.8 million internally displaced persons (IDPs) throughout the country (UNHCR 2018b). Given this, the water and sanitation supply is under pressure: WASH activities are mainly coordinated by the State Administration for Returnee and Refugee Affairs (ARRA) and relevant UN agencies. The measures are primarily financed by international donors.

The Gambela region, located in the southwest of Ethiopia, has received the largest number of refugees in the country. In recent years, several camps with almost 400,000 residents have gradually been set up here. When new refugees from South Sudan started arriving in 2014, the coordinating actors calculated that the construction of permanent water systems for the refugee camps of Kule and Tierkidi as well as for the nearby towns of Itang and Thurfam would be the same cost as providing two years of water trucking (UNHCR 2017, 20). With the support of various donors, a permanent water supply system, that could also be extended to new camps, was constructed.

As a result of this forward-looking planning, a more cost-effective and reliable water supply scheme is ensured now and in the future in the surrounding of the camps. However, it is still unclear whether a more sustainable model for its operation can successfully be put in place. To date, non-governmental organizations have guaranteed the operation and maintenance of the water systems in Gambela. However, UNICEF, with the support of the Regional government and UNHCR is currently putting in place a public utility, to take over and run the water supply on a long-term basis. The Itang Water Utility would then be responsible for 30,000 people in Itang and Thurfam as well as for almost 230,000 people in the camps Tierkidi, Kule and Nguenyyiel.

Given that the registered refugees in the camps will not be able to pay for the water provided, UNHCR will be obliged to subsidize the supply. It remains to be seen whether the planned public enterprises will actually be able to meet the high expectations placed on them.

Example: Water supply in Juba

In the southern Sudanese capital Juba, the public water supply is chronically unreliable. The existing infrastructure dates back to the 1930s and is becoming increasingly susceptible to failure due to its inadequate maintenance. In addition, the piping system only covers the city center and only reaches 17 percent of the population inside the city. Although the public South Sudan Urban Water Corporation (SSUWC) has been commissioned by the state to ensure the supply in the country's urban centers, it does not have the capacity to maintain and expand the existing systems. As a result, over 70 percent of the people in Juba are forced to obtain their water from alternative sources (Matoso 2018). Because of the economic crisis caused by the war, hyperinflation, and the chronic shortage of fuel, the price of water has more than doubled since 2016. Studies show that private households now must spend an average of almost 30 percent of their income to buy water. Looking at research on this issue, an amount of 3 to 5 percent of household income is considered to be the limit for the supply of drinking water (Smets 2009, 2).

In order to improve the availability of clean water and to avoid Juba's inhabitants having to rely more and more on contaminated water from the Nile, humanitarian organizations have built several decentralized water treatment facilities. These include the Gumbo waterworks built by Oxfam in one of Juba's poorest districts, which is regularly affected by cholera outbreaks. Under optimal conditions, the plant can provide 300 m^3 of clean water per day, meeting the needs of around 20,000 people. It is powered exclusively by solar energy. The running costs are much lower than for conventional plants, which require fuel and regular

maintenance. In order to extend the range and increase income, the waterworks not only supplies private households. Around 30 retailers who sell water from their bicycles out of a small tank and up to 13 drivers of tankers also buy their water here.

Originally it was planned to hand over the operation of the plant to an honorary committee. This committee was supposed to monitor the daily operation of the plant and carry out all routine maintenance measures as well as ensure financial management, i.e. determine the sales price and record the operating costs. However, given the technical complexity of the plant and the measures needed to ensure its economic sustainability, it quickly became clear that the Committee could not perform the above tasks properly without support. In 2017, the Gumbo Water Cooperative Society (GWCS) was set up as a hybrid form of operation combining external professional support and community-based management. The waterworks generates sufficient income from the sale of water to cover the operating costs. Within the framework of GWCS, the committee is no longer directly responsible for operation, but forms a supervisory body for the newly created operational unit. In addition, it offers a contact point for users in the event of dissatisfaction. GWCS has contracted an operational team for daily operation and maintenance. Its members have contractually regulated tasks and receive a monthly salary. The members of the committee also receive financial compensation for their time and effort.

Oxfam supported the foundation of GWCS with the development of a business plan, which was the basis for setting up the new company. Among other things, it contains detailed information on the legal foundations of water management in Southern Sudan, the ability and willingness of the customers to pay, as well as calculations on the economic viability of the business. The water prices for the different user groups are based on detailed cost planning.

In addition, a study examined whether private households living in the vicinity of the plant are willing and able to pay for clean water. The study found that more than 90 percent of families currently using untreated river water for domestic purposes, would be willing and able to pay between 5 and 10 Southern Sudanese pounds (about 3 to 7 Euro cents, as of July 2019) per canister. The calculations drawn up as part of the business plan show that a very low water price would be sufficient to cover the monthly operating costs if transparent and effective processes for handling cash revenues were used. And that's not all: GWCS could also set up a reserve fund for major repair work, and could even generate a profit. This could flow into a revolving fund to finance other activities for the benefit of the people in in Gumbo.

It remains to be seen whether the GWCS operating form will prove itself in practice and whether those involved will be able to establish an effective and trustworthy management system. Initially, the company will continue to rely on external support to perform its technical and business management tasks.

Conclusions and recommendations for action

There is great potential to be able to optimize water supply to refugee camps and cities. Humanitarian organizations and donors need to be more forward-looking both in choosing the most suitable technical solutions and in establishing sustainable management models for the operation of water supply schemes. It is crucial to identify the requirements for a successful handover to local actors at a very early stage and to devote more time and effort to building the necessary capacities.

Immediately after the end of the acute emergency phase, humanitarian organizations must begin to develop a viable business model for the long-term operation and maintance of the water supply scheme. For this purpose, it is often also necessary to reduce the number of actors involved in order to create a manageable framework. For the economic viability of the water supply schemes it is necessary to keep the costs for operation and maintenance as low as possible.

Humanitarian donors should therefore regularly consider financing the construction of

Ways of Water Supply in Case of Disaster

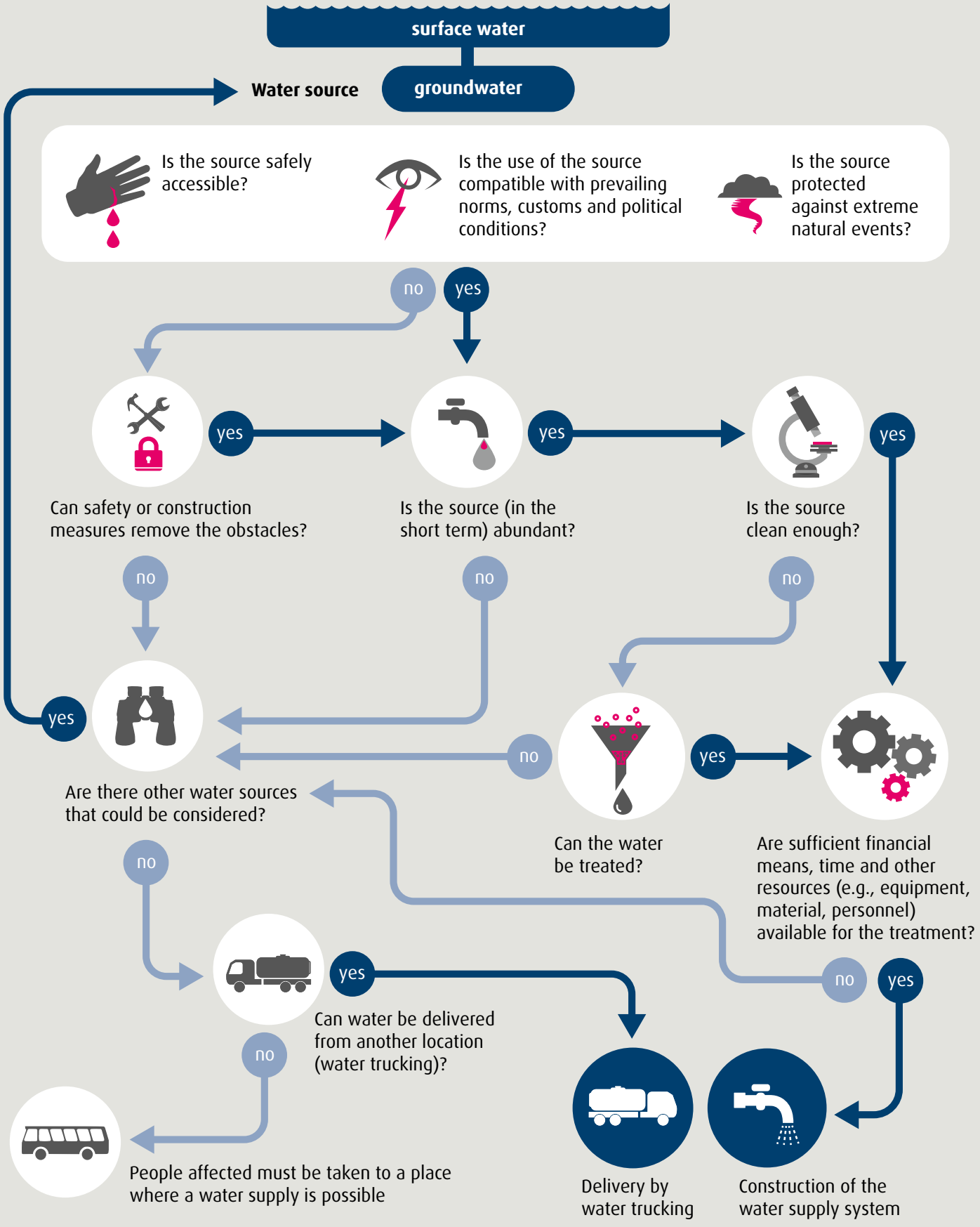


Figure 7: Ways of water supply in case of disaster

robust infrastructures where this is likely to be more cost-effective. The lower running costs associated with well-designed water supply schemes make it easier to develop more realistic cost recovery models. As in the case of the Gumbo waterworks in South Sudan, expanding the number of users, to include more solvent community groups, can be an option.

Donors should also pay more attention to supporting government or other local structures with capacity building, as early on as possible. Promising business models for the water supply are based on a solid analysis of the context (see figure on page 38).

These include:

+ The political environment and the question which supply model would gain the maximum support from responsible government;
+ The financial framework: What state resources are available for water supply? What other sources of income can be used to cover the costs?
+ The personnel and technical capacities in the area of water supply on the part of the responsible state authorities: How well are they able to support water supply in the long term? How much more external support is needed? Can capacities be built up in government agencies and what support do they need?
+ Responsibility and accountability to users: setting standards for water supply and measures to monitor compliance;
+ User acceptance: For which forms of operation are they prepared to pay for the water within the limits of their possibilities?
+ The drawing up of contingency plans: What happens if the supply structures are no longer needed or need to be expanded further.

Humanitarian organizations should invest more in developing and building the capacities of the structures that take over their operations. Moreover, it is not enough to set up water supply systems and to just hand them over. Instead, there is a need for longer-term technical support for the water supply providers. The most suitable management model for a particular water supply system will depend very much on both the country and local context. The transition from a life-saving intervention to a more sustainable and financially viable business model will only succeed if a culture of joint responsibility can be established not only amongst the target groups, but also amongst the responsible state authorities in order to cover the costs coming with water supply.

Uganda

With User-Centered Design to Better Sanitary Facilities

Rank 57 in WorldRiskIndex 2019	
WorldRiskIndex	8.71
Exposure	12.85
Vulnerability	67.81

Country profile

The East African landlocked country of Uganda is one of the poorest states in the world. Thanks to its location at Lake Victoria and in the Nile Basin, Uganda has access to sufficient fresh water. However, there is a lack of sustainable management of water resources and comprehensive water supply for the almost 40 million inhabitants. In addition, Uganda is repeatedly affected by extreme drought. Following the severe drought in 2017, also this year until mid-2019 less rain has fallen than usual at this time of the year. Due to the extreme heat and lack of rainfall, arable land is lying fallow, dams are drying out and the risk of forest fires is increasing.

With over 1.2 million refugees, Uganda is home to the largest refugee population in Africa and the third largest in the world. Although the country pursues a progressive refugee policy that attempts to provide at least a minimal degree of self-sufficiency for the refugees, the continuing drought increases the conflict potential in the Ugandan refugee camps. Many camps are also overcrowded, increasing pressure on supply structures, surface and groundwater reserves. There is a lack of financial means to further expand the supply. Some camps do not have enough latrines and there is a lack of washbasins and soap to meet hygiene standards. Such hygienic conditions increase the risk of spreading water-borne diseases. This makes

Water situation

19.2 %
Share of population with access to at least basic sanitation

38.9 %
Share of population with access to at least basic drinking water

0.6 billion m^3
Annual freshwater withdrawals

5.8 %
Level of water stress

people less resilient and more vulnerable to recurrent droughts.

Project context and activities

In 2017, the Humanitarian Innovation Fund provided funding for the development of a sanitation concept in a freely chosen emergency aid context following a user-centered design (UCD) approach. UCD is a process in which the design of products and services gradually approaches the needs and preferences of the users. They will be involved in the design process from the beginning. Normally, UCD processes take a lot of time – time that is missing in the emergency help context. Developed solutions of the user-centered community engagement should therefore be tested in this emergency aid project already after twelve weeks.

Together with the British design agency Snook, Welthungerhilfe took up the challenge. Welthungerhilfe had previously worked with participatory development cooperation approaches. Snook plans services in the public and private sector and had the task of incorporating the preferences of the users into the design of the latrines.

The organizations applied the UCD approach in two refugee camps in northern Uganda: the Bidibidi camp in Yumbe and the Imvepi camp in Arua. The office of the Prime Minister of Uganda supported the project and enabled Welthungerhilfe and Snook to visit the camps for the first time. The two organizations prepared the user's previous experiences with latrines (user journey) and compiled an overview of the feelings and needs of the users (empathy map). For example, they were asked how they feel when they go to the toilet at night. In this way, the helpers developed a better understanding of the context, behavior and needs of the beneficiaries and were able to incorporate this knowledge into the planning and construction of the latrines.

Results and impact

As a result, two different types of household latrines were built, one for ordinary family use and one for people with disabilities. Pit latrines were built for family use. They were changed based on feedback regarding light, ventilation, room size and the size of the squatting device. For the people with disabilities, the most important thing was the accessibility of the household latrines. Welthungerhilfe therefore equipped all latrines for people with disabilities with easily accessible handrails and locks. Ramps were installed to ease the access to the latrines. Some structural changes to the latrines were made on a case-by-case basis. For example, Welthungerhilfe installed metal rails for a blind person on their way so that the person could find the latrines better with their walking stick. In another case, a person with an amputated leg asked to install a seat in the latrine, as this is easier and less degrading for the person to use it.

An external evaluation by Oxfam International concluded that there was evidence of improved design, particularly in household latrines for people with disabilities. The UCD process was difficult to follow in the construction of the regular latrines as the camp management was in a hurry.

A budget of 237,500 Euros was used for the project. Employees of Welthungerhilfe and the local partners gave a particularly positive assessment of the UCD process with regard to the involvement of the local people. The procedure and the quality of the community surveys had gone far beyond earlier, more technically oriented attempts at participation due to the empathic approach. UCD offers clear advantages for Welthungerhilfe: With this method, humanitarian organizations can take the feedback of the population into account more systematically and consistently from the beginning and thus better align the design and implementation of humanitarian programs with the needs of the users. At the same time, UCD enables solutions to be adapted at any time to the experiences and evolving needs of the people concerned. In the long term, UCD processes can also improve the accountability of humanitarian organizations to the affected population.

Stephan Simon, Consultant for Water, Hygiene and Sanitation, Welthungerhilfe

3 The WorldRiskIndex 2019

Katrin Radtke
Professor for Humanitarian Action and Disaster Preparedness, IFHV, Ruhr University Bochum
Daniel Weller
Research Assistant, IFHV, Ruhr University Bochum

The WorldRiskIndex 2019 indicates the disaster risk for 180 countries in the world. This means that eight more countries are included in this year's index than in the previous year. The index model includes exposure to extreme natural events such as earthquakes and cyclones, as well as sea-level rise. In addition, the model operationalizes the ability of a society to react to such events. As in previous years, the WorldRiskIndex 2019 shows once more that island states, in particular, have a very high risk. This is mainly due to their high exposure to extreme natural events and because they are particularly affected by sea-level rise caused by global warming. If one compares the risk of the continents, Oceania ranks first. The situation is somewhat different considering the ability of societies to deal with extreme natural events: The countries with the highest vulnerability are predominantly located in Africa.

In spring 2019, Cyclone Idai devastated a huge area in Mozambique, Malawi, and Zimbabwe. Idai was the worst disaster for years in Southern Africa. Around three million people were and still are in urgent need of help (SADC 2019). The causes of this disaster are numerous: Cyclones are one of the typical weather phenomena in the region and their frequency has not increased in recent years. As a result of climate change, however, their effects have increased in some cases. Rising sea levels, higher wind speeds and heavier rainfall, among others, are causing tidal waves and spring tides to rise ever higher during storms. It is particularly bitter that the disaster caused by Idai could reach such magnitude, because Mozambique, for instance, considerably expanded its civil protection after the great flood in 2000 and equipped the port city of Beira with a new sewer system and retention basin. In addition, a disaster control authority was established and community-based disaster prevention was strengthened. However, these measures were far from sufficient. They have indeed saved Beira's inner city from worse. But the informal settlements that had emerged around the city as a result of the impoverishment process in the countryside were without any protection against the storm and the flood (Böhm 2019). Mozambique's, but also Zimbabwe's and Malawi's, very high vulnerability is decisive for the fact that these countries ranked 46, 52 and 55 in the upper third of the WorldRiskIndex.

The concept

The WorldRiskIndex is based on a model for calculating the risk of disasters arising directly from earthquakes, cyclones, floods, droughts or sea-level rise. The WorldRiskIndex does not provide a prediction of the probabilities or timing of the next disasters, but provides important information for assessing the general risk of countries falling victim to a disaster caused by extreme natural events. In 2019, the index was calculated for 180 countries.

The development of the model can be traced back to the work of scientists from the Institute for Environment and Human Security at the United Nations University in Bonn and employees of Bündnis Entwicklung Hilft from 2009 to 2011 (Bündnis Entwicklung Hilft 2011, Welle / Birkmann 2015). Since 2017, the model has been revised and continuously adapted by the Institute for International Law of Peace and Armed Conflict at the Ruhr University Bochum and Bündnis Entwicklung Hilft on the basis of new findings in the field of risk analysis and current changes in the data situation.

The WorldRiskIndex is based on the understanding that disaster risk is not determined solely by the occurrence, intensity and duration of extreme natural events, but that social factors, political conditions and economic structures are also responsible for whether or not a disaster occurs in connection with extreme natural events. This assumes, that every society is in a position to take direct or indirect precautions to reduce the effects of natural hazards. Some examples of such precautions are the enactment of adequate building regulations, the establishment and maintenance of an effective disaster management or a consistent reduction of extreme poverty and inequality among the population (Bündnis Entwicklung Hilft 2011; IPCC 2018).

To show the interaction of natural events and social factors, the WorldRiskIndex multiplies the values of two dimensions: exposure and vulnerability. The terms and components of the WorldRiskIndex are described below (Bündnis Entwicklung Hilft 2011):

+ **Risk** is understood as the interaction of hazard and vulnerability, in other words, the interaction of exposure to extreme natural events and the vulnerability of societies.

+ **Hazard / Exposure** means that a particular object of protection, e.g. a population or an area, is exposed to the effects of one or more natural hazards – earthquakes, cyclones, floods, droughts or sea-level rise.

+ **Vulnerability** is composed of the components susceptibility, lack of coping capacity and lack of adaptation capacity and refers to social, physical, economic and environmental factors that make people or systems vulnerable to the effects of natural hazards, the negative impacts of climate change or other processes of change. Vulnerability also includes the ability of people or systems to cope with and adapt to negative impacts of natural hazards (Birkmann et al. 2011).

+ **Susceptibility** is understood as the likelihood of generally suffering damage in the event of an extreme natural event. Susceptibility describes structural characteristics and framework conditions of a society.

+ **Coping** with natural hazards includes various abilities of societies to minimize negative impacts of natural hazards and climate change by means of direct actions and available resources. Coping capacities include measures and capabilities that are immediately available during an incident to mitigate damage. For the calculation of the WorldRiskIndex, the opposite value, in other words, the lack of coping capacities, is used.

+ In contrast to coping, **adaptation** is understood as a long-term process that also includes structural changes (Lavell et al. 2012; Birkmann et al. 2010) and includes measures and strategies that deal with the negative impacts of natural hazards and climate change in the future. In analogy to coping capacities, the lack of adaptive capacities is included in the WorldRiskIndex, which is the value 1 minus adaptive capacities.

In total, the WorldRiskIndex is calculated from 27 indicators, distribution and weighting are shown in Figure 8. Only indicators from scientifically recognized and publicly accessible data sources (e.g. World Bank, UNESCO, etc.) are taken into account in order to comply with the principles of transparency and verifiability. Based on the model, values in the range from 0 to 100 are obtained for each component of the WorldRiskIndex, enabling the countries to be divided into five classes (quantile method) and the results to be presented graphically in

the form of maps using geographic information systems (GIS). In this way, a comparison of the 180 countries for each component of the WorldRiskIndex is possible and the results are more easily accessible and discussable.

Updating the WorldRiskIndex

Following updates of the WorldRiskIndex in 2017 and 2018 due to changes in the availability of data (Radtke et al. 2018), the exposure data from the PREVIEW Global Risk Data Platform of the United Nations Environment Programme (2018) have been updated this year based on the LandScan data from Oak Ridge National Laboratory (2018). This results in two advantages: Firstly, all exposition data refer to the same population data set (LandScan 2017), which means that for the first time since 2012 it was possible to update population figures for all types of exposure. Secondly, the very high resolution of the data means that it is now possible to evaluate the exposure down to the regional level (e.g. provinces).

In 2019, vulnerability indicators, for the most part, were only updated with new data provided that more up-to-date values were available in the data sources. The only exception in this dimension is the indicator for material coverage, for which the data set and the methodology for calculating the insurance coverage were changed to allow more precise evaluations. The new score gives the mean of the annual ratios of insured losses to total losses over the last 15 years. Only ratios from years in which natural events caused damage are taken into account for calculating the average. The long comparison period of 15 years results in a stabilization of the volatile conditions on the one hand and allows for a minimum of two ratios per country on the other, which makes it possible to calculate averages of the annual ratios. In addition, a new procedure for dealing with missing indicator data has been established so that the WorldRiskIndex could be calculated for eight additional countries (Antigua and Barbuda, Democratic Republic of Congo, Federated States of Micronesia, Maldives, Montenegro, St. Lucia, St. Vincent and the Grenadines, São Tomé and Príncipe). This new procedure replaces the previous estimation procedure for missing values and is described in the methodological notes available at **www.WorldRiskReport.org/#data**. Generally, only countries that have received less than six values from a total of 27 indicators through statistical estimates are included in the calculation of the WorldRiskIndex. This reduces the index's dependence on statistical methods to a minimum.

The described updates and additions in the dimensions of exposure and vulnerability have a significant impact on the index value of individual countries. The update of the exposure data is particularly noteworthy here, because since the last update significant changes have occurred in population numbers and distributions, which are reflected in the exposure values. As a consequence, a direct comparison of the results with earlier WorldRiskIndex results is only possible to a limited extent. In the tradition of the issues of the WorldRiskReports since 2011, all information on the indicators is also available on the website **www.WorldRiskReport.org**.

Results of the WorldRiskIndex 2019

Global disaster risks are very heterogeneous and strongly linked to aspects of poverty and inequality. Island states bear a particularly high risk: With Vanuatu, Antigua and Barbuda, Tonga, Solomon Islands, Papua New Guinea, Brunei Darussalam, Philippines, Cape Verde, Fiji and Timor-Leste, a total of ten island states are among the 15 countries with the highest

Calculation of the WorldRiskIndex

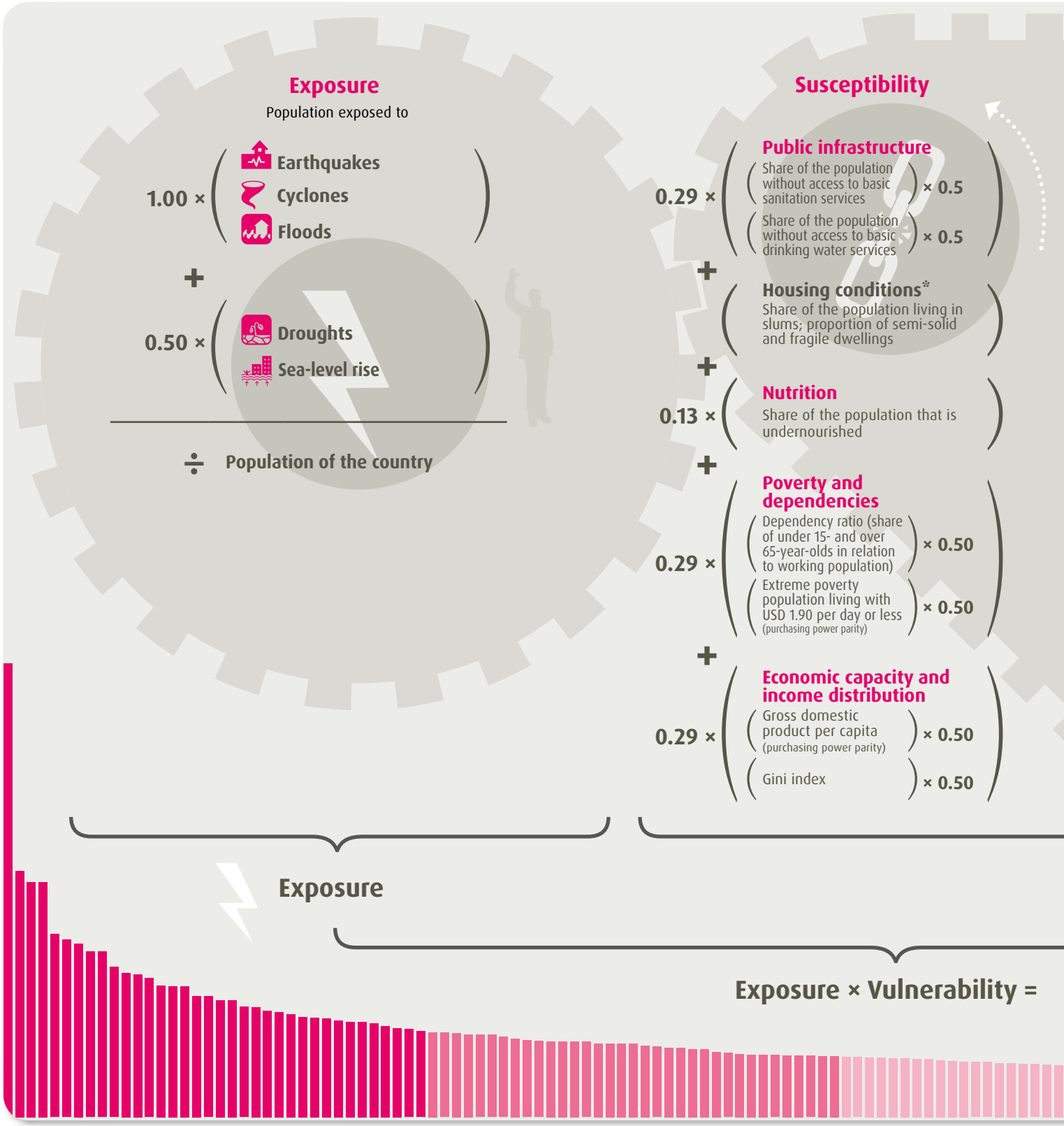


Figure 8: Calculation of the WorldRiskIndex

Coping

0.45 ×

- **Government and authorities**
  - Corruption Perception Index × 0.50
  - Fragile States Index × 0.50

+

- **Disaster preparedness and early warning***
  National disaster risk management policy according to report to the United Nations

+

0.45 ×

- **Medical services**
  - Number of physicians per 1,000 inhabitants × 0.50
  - Number of hospital beds per 1,000 inhabitants × 0.50

+

- **Social networks***
  Neighbors, family, and self-help

+

0.10 ×

- **Material coverage**
  Insurance
  (life insurances excluded)

Adaptation

0.25 ×

- **Education and research**
  - Adult literacy rate × 0.50
  - Combined gross school enrollment × 0.50

+

0.25 ×

- **Gender equality**
  Gender Inequality Index

+

0.25 ×

- **Environmental status / Ecosystem protection**
  - Water resources × 0.25
  - Biodiversity and habitat protection × 0.25
  - Forest management × 0.25
  - Agricultural management × 0.25

+

- **Adaptation strategies***
  Projects and strategies to adapt to natural hazards and climate change

+

0.25 ×

- **Investment**
  - Public health expenditure × 0.33
  - Life expectancy at birth × 0.33
  - Private health expenditure × 0.33

$$\text{Vulnerability} = \tfrac{1}{3} \times (\text{Susceptibility} + (1 - \text{Coping}) + (1 - \text{Adaptation}))$$

WorldRiskIndex

* Not incorporated because of insufficient availability of indicators.

risk in the WorldRiskIndex. The island states are particularly affected by sea-level rise, but also by cyclones and earthquakes. Among the 15 countries with the highest risk are therefore twelve countries that also belong to the group of 15 countries with the highest exposure. Nine of them are island states (Vanuatu, Antigua and Barbuda, Tonga, Brunei Darussalam, Solomon Islands, Philippines, Fiji, Cape Verde, Papua New Guinea) three countries (Guyana, Costa Rica and Guatemala) are located on the mainland.

The other countries in the group with the highest risk – Bangladesh, Timor-Leste and Djibouti – are also at very high risk with exposure ranks 16, 19 and 20.

At the same time, this year's WorldRiskIndex shows once again that a very high exposure does not necessarily mean a very high risk. For example, the countries of Japan, Uruguay and Chile, which are particularly prone to earthquakes due to their location near the edges of tectonic plates and occupy ranks 9, 13 and 14 for exposure, are in a position to significantly reduce their risk due to their low vulnerability. The Netherlands, which is particularly threatened by sea-level rise, can also limit its risk thanks to very low vulnerability. Japan and the Netherlands are among the 15 least vulnerable countries in the world. In the WorldRiskIndex, these countries rank 77 (Netherlands), 54 (Japan), 27 (Chile) and 26 (Uruguay).

Looking at the individual continents, Oceania followed by Africa, America, Asia and Europe carries the highest risk after the median values ($\tilde{x}$) of the country groups.

Oceania: With a value of 16.24 for ten countries, Oceania has the highest median of all continents in the WorldRiskIndex. This can be explained, among other things, by the high proportion of island states. Four countries of the continent – Vanuatu (rank 1), Tonga (rank 3), Solomon Islands (rank 4) and Papua New Guinea (rank 6) – are among the 15 countries with the highest disaster risk. Vanuatu is once more the country with the highest disaster risk in 2019, with a value of 56.71. In general, the countries of the continent are very heterogeneous in terms of their exposure, ranging from 99.88 for Vanuatu (rank 1) to 13.04 for Samoa (rank 94). In terms of vulnerability the differences are smaller. With the exception of Australia and New Zealand, which occupy rank 164 and 169 and are thus in a very good position, almost all other countries of the continent fall into the categories of high or very high vulnerability. The high degree of lacking coping capacity is particularly striking, as all countries, except for Australia, New Zealand and Micronesia, are also in the worst categories in this dimension. The situation is similarly poor in terms of adaptation capacity. Here, even half of the ten countries – Vanuatu, Solomon Islands, Papua New Guinea, Kiribati and Micronesia – are in the worst group of the ranking and have the lowest adaptation capacities in the world. As far as susceptibility is concerned, half of the countries are in the middle to very good range, which means that they perform relatively well.

Africa: Africa has the second-highest risk of the continents with a median of 8.94 for 53 countries. In Africa, the hotspots are in Cape Verde (18.02) and Djibouti (16.46), followed by the Comoros (14.63), Niger (13.77),

Country group	Risk $\tilde{x}$	Exposure $\tilde{x}$	Vulnerability $\tilde{x}$	Susceptibility $\tilde{x}$	Lack of coping $\tilde{x}$	Lack of adaptation $\tilde{x}$
Africa	8.94	13.57	62.98	50.30	84.39	55.04
America	7.52	16.37	44.37	23.58	74.97	33.24
Asia	5.77	12.32	44.80	23.46	76.66	36.57
Europe	3.30	11.51	30.18	16.15	57.68	20.00
Oceania	16.24	29.03	49.46	31.15	79.81	42.93
Worldwide	**6.49**	**13.16**	**45.42**	**23.77**	**75.61**	**36.41**

Figure 9: Comparison of medians of the country groups (based on WorldRiskIndex 2019)

Guinea-Bissau (13.32) and Nigeria (13.11). All these countries also have very high or high exposures. The vulnerability hotspot, however, is in the Sahel zone and the tropical regions of Africa, as the attached world map of vulnerability shows. A total of 13 of the 15 most vulnerable countries in the world are located in Africa. The Central African Republic has the highest vulnerability rate in the world, followed by Chad, Democratic Republic of Congo, Eritrea and Niger. The high-risk countries Djibouti and Cape Verde are comparatively well placed in terms of vulnerability, while Cape Verde even has the eighth best score compared with the other countries on the continent. However, Cape Verde only ranks 80th worldwide and is thus in the midfield of vulnerability. Countries of the African continent are disproportionately strongly represented in the vulnerability component. The countries of the Central African Republic, Eritrea, Madagascar, Mozambique and Chad are particularly susceptible. The lack of adaptation capacities is also very pronounced in some African countries, the countries with the lowest adaptation capacities worldwide are Niger, Liberia, Chad and Mali together with West Asian Yemen.

America: With a median of 7.52 for 32 countries, the American continent is relatively well placed in a risk comparison. But the risk is also very heterogeneous in America. Some countries in the center and south of the continent, such as Antigua and Barbuda (30.80), Guyana (22.87), Guatemala (20.69), Costa Rica (17.37), Haiti (16.34), El Salvador (15.11) and Nicaragua (13.78) bear the highest risk and are also among the countries with the highest risk values worldwide. For example, Antigua and Barbuda, which is included in the WorldRiskIndex for the first time in 2019, ranks second and Guyana fifth. Unlike this, there are also countries with very low risk in America. These include the island state of St. Vincent and the Grenadines, with a value of 0.8 (rank 178), the third-best risk value of all. Grenada, Barbados and Canada are also among the countries with the lowest disaster risk in the world. Similar heterogeneity is also evident in terms of exposure. Antigua and Barbuda, Guyana, Costa Rica and Guatemala are extremely vulnerable, while the very low risk countries already mentioned are also those with low or very low exposure levels. If we look at vulnerability, there are also large differences here. Haiti stands out as particularly vulnerable (67.56; rank 16). Many countries on the continent have medium or low vulnerability. In the class with the lowest vulnerability only the United States of America and Canada are represented.

Asia: In the risk comparison of the continents Asia ranks fourth and remains well below the global median. For 42 countries, the continent has a median of 5.77 for the WorldRiskIndex. Four Asian countries are among the highest risk countries – Philippines (20.69), Bangladesh (18.78), Timor-Leste (16.39) and Cambodia (15.13). However, numerous Asian countries also perform particularly well in the WorldRiskIndex, for example Qatar with the lowest risk worldwide. Saudi Arabia, Maldives, Singapore, Oman, Bahrain, Mongolia, South Korea and Israel also bear a very low risk. There are very large differences in exposition within Asia, which are also responsible for the different placements in the WorldRiskIndex: Philippines, Japan, Bangladesh, Timor-Leste, Cambodia and Vietnam are in the highest exposure class, while Qatar, Saudi Arabia, Maldives, Oman and Bhutan have the lowest exposures. In terms of vulnerability, the picture is mixed: Only a few Asian countries are represented among the highly vulnerable countries – including Yemen, Afghanistan and the Comoros. The majority of Asian countries have medium or low vulnerability. The example of Japan clearly shows that very low vulnerability can lead to a significant reduction in risk. Due to its low vulnerability (23.6; rank 173), despite its extremely high exposure (39.94; rank 9), Japan is ranked 54th in the WorldRiskIndex and thus not in the highest risk class. In Southeast Asia however, there is a risk hotspot, because a high exposure meets a high vulnerability.

Europe: With a median of 3.30 for 43 countries, the European continent is in the best position in risk comparison. Albania, the Netherlands, Greece, Montenegro and northern Macedonia bear the highest risk. At the other end of

the risk spectrum are Malta, Iceland, Finland, Estonia and Switzerland. Overall, Europe is characterized by a rather low exposure: Only four out of 43 countries are in the group of countries with very high exposure. In contrast, 16 countries are in the lowest exposure category. Vulnerability is also relatively low with 29 countries in the lowest vulnerability category. The countries with the highest vulnerability in Europe are Bosnia and Herzegovina, Moldova, Albania, Northern Macedonia and Azerbaijan.

Chances and limitations of the concept

The WorldRiskIndex is a tool designed to raise awareness among the public and decision-makers in all sectors of society about the important issue of disaster risk and to provide guidance for practitioners in the prevention of humanitarian crises. In particular, the focus should be on the people, countries and regions affected and an understanding should be created that the emergence of disasters also has social causes to a large extent. For this purpose, a complex situation is reduced to individual values by means of a modular structure, which will enable faster orientation, easier communication and visualization of the results. However, this high degree of abstraction always carries the risk that valuable information will not be depicted. In addition, the construction of an index reaches its limits, since the availability and quality of data are of central importance for the quality and significance of the index value (Freudenberg 2003; Meyer 2004).

Concerning the availability of data, it should be noted that current data are not available for all 193 countries in the world. Even with the new procedure for dealing with missing values, the countries Andorra, Dominica, Liechtenstein, Marshall Islands, Monaco, Nauru, North Korea, Palau, San Marino, Somalia, South Sudan, St. Kitts and Nevis and Tuvalu cannot be included in the WorldRiskIndex due to an excessive number of missing vulnerability values. This is a direct consequence of the fact that, for various reasons, global data archives do not record or obtain data of the required quality for these countries. Smaller states, such as several island states, are particularly affected. This is all the more regrettable because this year's update of the exposition data allows global analyses with a very high resolution, so that even small regions can be considered with regard to their exposure. In this respect, the updating and selection of vulnerability indicators will be a challenge for future reports in order to exploit this potential.

Another relevant aspect is that the selected data do not always show whether and if, which areas or territories (e.g. overseas territories, islands, etc.) have been included in the country data. In order to minimize this form of inaccuracies, no allocation of external territories to the respective mother country was made if possible. From a methodological point of view, there are clear doubts about the validity of such allocations for a large number of indicators. In contrast, the territories of Kosovo, Palestine and Taiwan are assigned to the territories of Serbia, Israel and China for reasons of methodological consistency, as there are differences in global data sources with regard to the treatment of these territories. A classification was necessary for methodological reasons in order to avoid major distortions of the WorldRiskIndex. For this purpose, weighted averages were calculated for indicators, provided that separate values for these territories and countries were available in the data. In these cases, populations numbers of the single areas were set in proportion to the population numbers of the entire classification areas to obtain the weights.

Finally, it should be noted that although the calculation of the WorldRiskIndex and the classification of countries using the quantile method might allow comparison of countries within the year's issue, even minimal differences in the indicators and their index levels can lead to significant changes in rank compared to previous issues although hardly any changes were observed in the country itself. In addition, the 2019 index includes more countries

than in previous years. However, despite slight disadvantages for comparability, updates and adjustments are necessary to ensure that the WorldRiskIndex is up to date.

Conclusion

The WorldRiskIndex 2019 confirms the results of recent years: The global hotspots of the risks are located in Oceania, Southeast Asia, Central America and West and Central Africa. Island states are particularly affected across all continents. In order to reduce the risk for these countries, the fatal cycle of vulnerability and disaster risk must be broken by measures at local, national and international level. Without the will of the international community to meet the climate goals agreed in Paris, disaster management agencies and local initiatives such as the planting of mangrove forests to contain coastal erosion, local early warning systems and evacuation exercises by local groups will only have limited success. As the example of Mozambique shows, measures must be implemented area-wide and be available to the poorest of the poor in particular. The relative stability of the results in the WorldRiskIndex over the years is therefore hardly surprising, because as a reflection of economic development and development cooperation, major improvements in the area of vulnerability can only be seen over longer periods of time.

4 Conclusion and Recommendations

Bündnis Entwicklung Hilft
and
Institute for International Law of Peace and Armed Conflict

Water supply is elementary – for survival, for health, for development, for security, for disaster prevention. Availability of and access to water and sanitation should not be seen as an isolated issue, but always in interaction with other sectors of society and in the global context. The challenges and the associated short-term and long-term need for action remain urgent and great: from water shortages and climate change to the sanitation crisis and the privatization of water. If the Sustainable Development Goals are taken seriously, decisive will and consistent action with regard to water for households, agriculture and industry are indispensable. Only then can the damage caused by extreme natural events be reduced and the resilience of societies be strengthened. The focus is on the following recommendations for action:

Recommendations for action for the German Federal Government:

+ In addition to positive incentives for water-saving measures in industry and agriculture, the Federal Government should above all implement the polluter pays principle: Those who overuse and pollute water should pay an equal share of the financial costs of any damage or pollution caused. Covering the costs of restoration could thus be combined with initiating the sustainable use of resources.

+ The Federal Government should protect the water resources available in Germany. To this end, the Water Framework Directive must be consistently implemented. This means that all rivers, lakes, coastal waters and groundwater must be in "good ecological status" by 2027.

Recommendations for action for associations of states:

+ The EU should introduce a directive that more strongly regulates the privatization of water supply and focuses on the common good.

+ A more community-oriented, balanced cross-border use of available water resources must be sought. Particular support should be given to projects that strengthen cooperation between neighboring states with high water stress and create mutual trust.

+ Water should be recognized internationally primarily as a public good and not as a commercial commodity.

+ The international community should ensure that the rights to water and sanitation are enforced and are therefore suable before national and international courts in the event of violations.

Recommendations for action for donors:

+ Donors should recognize the relevance of access to and the quality of, water for health, food security and education and promote projects with multi-sectoral approaches accordingly.

+ Donors should promote the coordination of both governmental and non-governmental WASH actors at the national, regional and international levels.

+ Donors should focus more on financing technically simple and cost-effective approaches with a high impact – such as washing hands with soap, introducing water filters at the household level or affordable and quickly established sanitation systems.

+ Donors should provide more funds for the construction of sustainable water infrastructure and promote the development of appropriate operating models to cover long-term costs.

Recommendations for action for humanitarian organizations:

+ Humanitarian organizations should work together with local actors to develop a concept for the continued operation of the water supply that takes running costs into account immediately after the end of the acute emergency phase.

+ The WASH-infrastructure must be designed in such a way that it can be used safely and barrier-free by as many people as possible with different needs and abilities. In addition to the purely technical aspects, social, cultural and gender-specific needs such as menstrual hygiene should be considered by all means.

+ With regard to an efficient, resource-conserving approach, humanitarian organizations should pay more attention to project approaches that are adapted to current local situations. This includes, for example, storing and using rainwater instead of generally building new, deeper wells.

+ The conservation of natural resources should be given greater attention within the framework of WASH-activities, as there are considerable risks for the environment if latrines are not properly maintained or if excessive water abstraction leads to a drop in the groundwater level.

Recommendations for action for science:

+ The scientific community should strive to further improve the availability of data in the water sector and provide highly disaggregated data, especially with regard to temporal and spatial resolution, but also with regard to socio-economic groups. Existing indicators and indices should be further improved, continuously updated and made publicly available.

+ In order to collect additional data on the water sector, new technologies should be used more intensively and new methods, approaches and procedures should be developed at the same time. This requires a stronger focus on interdisciplinary fundamental research, especially at the interfaces of engineering and human and social sciences.

+ Research should present its findings on the state of water resources and water supply more clearly for all sectors of society and at the same time identify opportunities and approaches for necessary changes in areas such as infrastructure, governance and personal behavior. This should also be reflected in a stronger participation of scientists in public discourses.

Recommendations for action for the economy:

+ Businesses must acknowledge their responsibility and increasingly independently monitor compliance with human rights relating to water and sanitation.

+ Companies should develop and market widely applicable, low-cost and sustainable technologies and instruments for the WASH-sector (e.g. for water analyses to detect fluoride and arsenic). This also includes the long-term desirable change to business models that focus on the equivalence of common good, consumer protection and corporate earnings.

Appendix

WorldRiskIndex 2019 Overview

Classification	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
very low	0.31 – 3.29	0.90 – 9.59	21.11 – 33.08	8.75 – 16.50	36.44 – 58.83	11.16 – 22.73
low	3.30 – 5.49	9.60 – 12.30	33.09 – 42.10	16.51 – 20.65	58.84 – 71.95	22.74 – 32.26
medium	5.50 – 7.51	12.31 – 14.73	42.11 – 47.91	20.66 – 28.43	71.96 – 78.62	32.27 – 38.94
high	7.52 – 10.61	14.74 – 19.61	47.92 – 61.79	28.44 – 45.05	78.63 – 84.65	38.95 – 51.52
very high	10.62 – 56.71	19.62 – 99.88	61.80 – 76.13	45.06 – 70.46	84.66 – 94.14	51.53 – 68.95

Max. value = 100, Classification according to the quantile method

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
1.	Vanuatu	56.71	99.88	56.78	35.32	84.36	50.66
2.	Antigua and Barbuda	30.80	69.95	44.03	23.38	76.65	32.05
3.	Tonga	29.39	61.41	47.86	28.19	79.92	35.47
4.	Solomon Islands	29.36	48.31	60.77	46.37	80.95	55.00
5.	Guyana	22.87	44.98	50.84	26.41	79.68	46.44
6.	Papua New Guinea	22.18	32.54	68.18	55.45	86.21	62.88
7.	Brunei Darussalam	21.68	57.62	37.62	15.26	67.14	30.45
8.	Guatemala	20.69	38.56	53.65	32.19	83.96	44.80
9.	Philippines	20.69	41.93	49.34	28.86	80.98	38.17
10.	Bangladesh	18.78	32.48	57.83	32.93	86.13	54.44
11.	Cape Verde	18.02	38.26	47.10	31.13	67.63	42.54
12.	Fiji	17.83	38.43	46.41	21.54	78.76	38.93
13.	Costa Rica	17.37	44.92	38.67	19.15	68.84	28.03
14.	Djibouti	16.46	27.04	60.87	39.36	84.39	58.87
15.	Timor-Leste	16.39	27.92	58.71	46.43	78.84	50.85
16.	Haiti	16.34	24.18	67.56	50.37	90.28	62.03
17.	Cambodia	15.13	26.82	56.42	40.89	78.92	49.45
18.	El Salvador	15.11	31.87	47.43	24.44	77.65	40.19
19.	Kiribati	14.64	25.52	57.37	40.53	82.56	49.02
20.	Comoros	14.63	23.54	62.12	44.85	83.84	57.67
21.	Nicaragua	13.78	25.95	53.11	30.35	82.88	46.11
22.	Niger	13.77	19.30	71.34	59.92	87.51	66.60
23.	Guinea-Bissau	13.32	18.92	70.42	58.48	90.58	62.19
24.	Nigeria	13.11	20.24	64.76	50.35	88.20	55.73
25.	Cameroon	12.87	20.32	63.33	45.68	89.54	54.78
26.	Uruguay	12.52	36.03	34.76	18.82	56.57	28.88
27.	Chile	12.45	34.32	36.29	17.87	62.77	28.22
28.	Benin	12.33	18.82	65.52	54.64	81.39	60.52
29.	Gambia	12.06	19.46	61.99	42.00	83.43	60.53
30.	Jamaica	11.91	26.18	45.51	24.60	74.70	37.22
31.	Chad	11.90	15.92	74.78	63.36	93.02	67.97
32.	Dominican Republic	11.72	25.39	46.18	24.59	77.59	36.36
33.	Honduras	11.39	21.43	53.14	31.76	83.48	44.18
34.	Burkina Faso	11.14	16.59	67.14	55.81	83.45	62.15
35.	Togo	10.99	16.72	65.72	55.55	86.23	55.38
36.	Mali	10.73	15.69	68.38	50.54	87.72	66.88
37.	Indonesia	10.58	21.20	49.93	26.63	79.71	43.44
38.	Angola	10.56	15.93	66.30	52.85	88.46	57.58
39.	Madagascar	10.49	15.12	69.37	65.61	86.50	56.00

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
40.	Viet Nam	10.31	22.03	46.83	25.07	77.68	37.75
41.	Kenya	10.30	16.53	62.32	50.32	86.92	49.72
42.	Burundi	10.29	14.81	69.47	61.05	91.13	56.24
43.	Cote d'Ivoire	10.03	15.55	64.52	47.18	86.12	60.27
44.	Senegal	9.82	16.48	59.59	44.89	79.89	53.97
45.	Sierra Leone	9.61	13.70	70.16	56.94	86.52	67.02
46.	Mozambique	9.50	13.50	70.44	64.80	88.05	58.46
47.	Mauritius	9.47	23.88	39.66	17.34	64.99	36.65
48.	Liberia	9.46	13.57	69.69	55.96	86.26	66.86
49.	Trinidad and Tobago	9.44	23.28	40.56	19.00	69.59	33.09
50.	Ghana	9.41	16.54	56.87	41.92	79.40	49.29
51.	United Republic of Tanzania	9.23	14.40	64.14	58.01	83.58	50.84
52.	Zimbabwe	9.21	14.72	62.58	50.30	89.12	48.34
53.	Afghanistan	9.21	13.73	67.11	49.21	92.36	59.75
54.	Japan	9.19	38.94	23.60	16.80	39.90	14.11
55.	Malawi	8.94	13.43	66.61	57.84	84.38	57.62
56.	Democratic Rep. of Congo	8.80	11.95	73.63	67.13	92.56	61.21
57.	Uganda	8.71	12.85	67.81	63.19	88.75	51.49
58.	Guinea	8.68	12.76	68.03	51.23	89.33	63.53
59.	Sudan	8.52	13.14	64.87	46.04	92.62	55.94
60.	Ecuador	8.48	18.29	46.37	24.88	77.77	36.46
61.	Albania	8.18	20.23	40.43	18.75	74.29	28.24
62.	Belize	8.02	17.14	46.78	27.21	74.19	38.96
63.	Uzbekistan	7.90	16.31	48.44	31.29	76.28	37.76
64.	Zambia	7.83	12.44	62.98	59.66	83.24	46.03
65.	Ethiopia	7.79	11.67	66.76	56.30	87.13	56.85
66.	Central African Republic	7.75	10.18	76.13	70.46	90.84	67.09
67.	Mauritania	7.72	12.29	62.82	39.25	87.72	61.48
68.	Panama	7.70	17.73	43.44	24.19	71.81	34.32
69.	Venezuela	7.68	16.25	47.25	23.59	84.96	33.20
70.	Algeria	7.66	16.76	45.71	20.88	78.35	37.89
71.	Malaysia	7.61	18.73	40.63	16.75	72.63	32.52
72.	Fed. States of Micronesia	7.52	14.72	51.05	34.11	72.11	46.93
73.	Sri Lanka	7.50	16.01	46.87	22.30	78.38	39.94
74.	Equatorial Guinea	7.48	13.13	56.98	41.38	86.46	43.10
75.	Rwanda	7.45	12.31	60.54	52.44	79.36	49.81
76.	Suriname	7.36	15.29	48.17	29.24	74.11	41.16
77.	Netherlands	7.35	31.73	23.15	14.20	41.53	13.71
78.	Kyrgyzstan	7.28	16.76	43.46	23.94	76.03	30.40
79.	Myanmar	7.27	12.91	56.34	32.54	86.37	50.11
80.	Pakistan	7.08	12.53	56.52	33.08	84.85	51.62
81.	Congo	7.05	10.90	64.71	55.29	88.56	50.30
82.	Eritrea	6.94	9.59	72.30	66.37	89.27	61.26
83.	Greece	6.89	22.82	30.18	16.94	57.68	15.92
84.	Lesotho	6.89	11.16	61.74	48.53	81.65	55.04
85.	India	6.77	12.58	53.82	34.61	78.45	48.40
86.	Gabon	6.74	13.05	51.68	32.73	75.74	46.56
87.	Peru	6.65	14.81	44.90	25.81	77.96	30.93

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
88.	Montenegro	6.62	17.80	37.18	17.49	67.97	26.06
89.	Colombia	6.59	14.74	44.72	23.24	77.66	33.27
90.	Swaziland	6.49	11.13	58.28	43.12	82.25	49.47
91.	Thailand	6.48	14.75	43.93	17.73	79.23	34.84
92.	South Africa	6.40	13.55	47.27	31.42	73.56	36.83
93.	Tajikistan	6.24	13.01	47.98	32.66	77.19	34.10
94.	Samoa	6.19	13.04	47.50	25.52	79.70	37.27
95.	Mexico	6.01	14.18	42.34	20.74	75.85	30.43
96.	Iraq	5.95	10.54	56.47	29.82	88.53	51.04
97.	Syrian Arab Republic	5.92	10.80	54.80	26.09	90.32	47.98
98.	China	5.84	14.41	40.52	21.86	72.67	27.05
99.	Morocco	5.83	12.23	47.66	25.53	78.88	38.58
100.	Namibia	5.82	11.39	51.14	41.85	73.47	38.08
101.	The former Yugo. Rep. of Macedonia	5.81	14.67	39.63	19.48	69.87	29.55
102.	Tunisia	5.74	13.06	43.99	20.69	75.48	35.79
103.	Azerbaijan	5.73	14.48	39.59	17.01	72.66	29.11
104.	Armenia	5.72	14.69	38.96	19.63	71.10	26.14
105.	Cuba	5.70	16.49	34.56	18.73	55.48	29.46
106.	Turkmenistan	5.69	12.33	46.18	28.78	72.91	36.85
107.	Romania	5.65	15.37	36.79	19.60	62.78	27.97
108.	Yemen	5.50	8.03	68.47	42.32	94.14	68.95
109.	Georgia	5.48	14.08	38.93	23.10	64.14	29.55
110.	Lebanon	5.27	11.70	45.01	19.45	78.52	37.04
111.	Serbia	5.17	13.50	38.32	19.51	69.34	26.11
112.	Seychelles	5.17	12.50	41.38	17.77	66.74	39.62
113.	Turkey	5.06	12.30	41.11	17.91	75.19	30.23
114.	Hungary	4.94	15.29	32.33	15.47	58.25	23.27
115.	Iran	4.92	11.04	44.58	19.62	81.72	32.40
116.	Nepal	4.92	8.71	56.48	35.99	84.60	48.85
117.	Bolivia	4.91	9.62	51.05	34.06	82.35	36.74
118.	Brazil	4.79	11.34	42.28	21.79	74.74	30.29
119.	Bosnia and Herzegovina	4.71	11.22	41.98	18.05	74.10	33.80
120.	New Zealand	4.67	17.72	26.35	15.45	45.06	18.53
121.	Italy	4.57	15.14	30.21	16.58	59.76	14.29
122.	Lao People's Democratic Rep.	4.53	8.19	55.25	33.22	82.94	49.58
123.	Saint Lucia	4.52	10.24	44.15	21.72	75.19	35.55
124.	Australia	4.49	18.13	24.78	14.84	43.65	15.85
125.	Kuwait	4.49	12.49	35.96	13.54	70.13	24.22
126.	Ireland	4.37	16.75	26.10	15.14	47.87	15.28
127.	Bahamas	4.31	11.85	36.36	18.31	58.71	32.05
128.	Botswana	4.28	8.77	48.79	36.76	72.04	37.58
129.	Bulgaria	4.08	11.87	34.40	20.00	60.47	22.74
130.	Jordan	4.08	9.23	44.23	22.97	70.51	39.22
131.	Republic of Moldova	3.98	9.60	41.41	22.66	68.94	32.64
132.	Croatia	3.96	12.03	32.94	16.54	62.20	20.09
133.	United States	3.76	13.20	28.46	15.20	50.52	19.67
134.	United Arab Emirates	3.66	11.07	33.10	9.47	63.26	26.58
135.	Kazakhstan	3.56	9.59	37.16	17.12	67.17	27.20

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of coping capacities	Lack of adaptive capacities
136.	Argentina	3.53	9.59	36.78	19.76	61.81	28.75
137.	Russia	3.52	9.59	36.74	18.04	66.12	26.07
138.	Spain	3.46	11.75	29.42	15.74	57.26	15.25
139.	Portugal	3.44	11.60	29.70	16.53	52.07	20.50
140.	Slovenia	3.34	11.62	28.77	14.46	55.95	15.90
141.	Libyan Arab Jamahiriya	3.34	7.37	45.32	21.34	82.09	32.53
142.	Paraguay	3.32	7.05	47.11	23.56	79.18	38.58
143.	Bhutan	3.31	6.89	48.03	24.51	72.93	46.65
144.	United Kingdom	3.30	12.60	26.17	15.72	47.21	15.58
145.	Israel	3.24	9.51	34.02	18.59	64.42	19.03
146.	Slovakia	3.20	10.08	31.73	14.10	58.87	22.23
147.	Korea, Republic of	3.08	11.32	27.20	13.06	51.36	17.18
148.	Canada	3.03	10.38	29.14	14.72	57.36	15.35
149.	Mongolia	3.00	7.11	42.24	28.94	64.10	33.68
150.	Czech Republic	2.99	10.77	27.80	14.42	50.91	18.07
151.	Poland	2.97	9.50	31.27	15.35	58.44	20.02
152.	Latvia	2.93	8.86	33.01	17.83	58.51	22.70
153.	Bahrain	2.89	7.32	39.51	15.26	77.04	26.24
154.	Austria	2.87	13.18	21.75	13.63	39.27	12.34
155.	Cyprus	2.87	8.55	33.52	14.58	64.51	21.45
156.	Belgium	2.79	11.42	24.39	14.29	45.26	13.61
157.	Oman	2.74	6.74	40.63	22.51	67.72	31.66
158.	Ukraine	2.66	6.92	38.50	17.75	66.96	30.78
159.	Denmark	2.65	11.79	22.49	14.50	40.32	12.65
160.	Belarus	2.59	7.84	33.00	16.30	58.86	23.83
161.	Singapore	2.51	9.00	27.93	11.59	54.21	17.99
162.	São Tomé and Príncipe	2.49	4.53	54.93	43.21	76.00	45.58
163.	Germany	2.43	11.51	21.11	14.30	36.44	12.60
164.	France	2.37	9.57	24.79	16.15	44.30	13.93
165.	Luxembourg	2.36	9.58	24.67	11.91	46.03	16.07
166.	Norway	2.34	10.60	22.06	13.29	39.21	13.68
167.	Lithuania	2.29	7.66	29.87	17.41	52.84	19.36
168.	Sweden	2.20	8.84	24.95	15.03	45.31	14.49
169.	Maldives	2.08	4.92	42.18	19.58	70.65	36.29
170.	Switzerland	2.05	9.00	22.73	13.43	39.05	15.73
171.	Estonia	2.04	6.78	30.06	16.40	53.77	20.00
172.	Finland	1.94	8.34	23.32	15.03	40.28	14.65
173.	Egypt	1.84	3.91	46.98	21.45	82.57	36.92
174.	Iceland	1.71	7.16	23.88	13.82	46.66	11.16
175.	Barbados	1.35	3.67	36.86	20.58	58.31	31.68
176.	Saudi Arabia	1.04	2.91	35.85	13.31	69.44	24.79
177.	Grenada	1.01	2.26	44.58	28.05	70.49	35.20
178.	St Vincent and the Grenadines	0.80	1.88	42.86	27.70	70.92	29.95
179.	Malta	0.54	1.91	28.14	14.24	52.44	17.75
180.	Qatar	0.31	0.90	34.35	8.75	66.29	28.01

WorldRiskIndex 2019, Countries in Alphabetical Order

Country	WRI	Rank
Afghanistan	9.21	53.
Albania	8.18	61.
Algeria	7.66	70.
Angola	10.56	38.
Antigua and Barbuda	30.80	2.
Argentina	3.53	136.
Armenia	5.72	104.
Australia	4.49	124.
Austria	2.87	154.
Azerbaijan	5.73	103.
Bahamas	4.31	127.
Bahrain	2.89	153.
Bangladesh	18.78	10.
Barbados	1.35	175.
Belarus	2.59	160.
Belgium	2.79	156.
Belize	8.02	62.
Benin	12.33	28.
Bhutan	3.31	143.
Bolivia	4.91	117.
Bosnia and Herzegovina	4.71	119.
Botswana	4.28	128.
Brazil	4.79	118.
Brunei Darussalam	21.68	7.
Bulgaria	4.08	129.
Burkina Faso	11.14	34.
Burundi	10.29	42.
Cambodia	15.13	17.
Cameroon	12.87	25.
Canada	3.03	148.
Cape Verde	18.02	11.
Central African Republic	7.75	66.
Chad	11.90	31.
Chile	12.45	27.
China	5.84	98.
Colombia	6.59	89.
Comoros	14.63	20.
Congo	7.05	81.
Costa Rica	17.37	13.
Cote d'Ivoire	10.03	43.
Croatia	3.96	132.
Cuba	5.70	105.
Cyprus	2.87	155.
Czech Republic	2.99	150.
Democratic Republic of Congo	8.80	56.
Denmark	2.65	159.
Djibouti	16.46	14.

Country	WRI	Rank
Dominican Republic	11.72	32.
Ecuador	8.48	60.
Egypt	1.84	173.
El Salvador	15.11	18.
Equatorial Guinea	7.48	74.
Eritrea	6.94	82.
Estonia	2.04	171.
Ethiopia	7.79	65.
Federated States of Micronesia	7.52	72.
Fiji	17.83	12.
Finland	1.94	172.
France	2.37	164.
Gabon	6.74	86.
Gambia	12.06	29.
Georgia	5.48	109.
Germany	2.43	163.
Ghana	9.41	50.
Greece	6.89	83.
Grenada	1.01	177.
Guatemala	20.69	8.
Guinea	8.68	58.
Guinea-Bissau	13.32	23.
Guyana	22.87	5.
Haiti	16.34	16.
Honduras	11.39	33.
Hungary	4.94	114.
Iceland	1.71	174.
India	6.77	85.
Indonesia	10.58	37.
Iran	4.92	115.
Iraq	5.95	96.
Ireland	4.37	126.
Israel	3.24	145.
Italy	4.57	121.
Jamaica	11.91	30.
Japan	9.19	54.
Jordan	4.08	130.
Kazakhstan	3.56	135.
Kenya	10.30	41.
Kiribati	14.64	19.
Korea, Republic of	3.08	147.
Kuwait	4.49	125.
Kyrgyzstan	7.28	78.
Lao People's Democratic Rep.	4.53	122.
Latvia	2.93	152.
Lebanon	5.27	110.
Lesotho	6.89	84.

Country	WRI	Rank
Liberia	9.46	48.
Libyan Arab Jamahiriya	3.34	141.
Lithuania	2.29	167.
Luxembourg	2.36	165.
Madagascar	10.49	39.
Malawi	8.94	55.
Malaysia	7.61	71.
Maldives	2.08	169.
Mali	10.73	36.
Malta	0.54	179.
Mauritania	7.72	67.
Mauritius	9.47	47.
Mexico	6.01	95.
Mongolia	3.00	149.
Montenegro	6.62	88.
Morocco	5.83	99.
Mozambique	9.50	46.
Myanmar	7.27	79.
Namibia	5.82	100.
Nepal	4.92	116.
Netherlands	7.35	77.
New Zealand	4.67	120.
Nicaragua	13.78	21.
Niger	13.77	22.
Nigeria	13.11	24.
Norway	2.34	166.
Oman	2.74	157.
Pakistan	7.08	80.
Panama	7.70	68.
Papua New Guinea	22.18	6.
Paraguay	3.32	142.
Peru	6.65	87.
Philippines	20.69	9.
Poland	2.97	151.
Portugal	3.44	139.
Qatar	0.31	180.
Republic of Moldova	3.98	131.
Romania	5.65	107.
Russia	3.52	137.
Rwanda	7.45	75.
Saint Lucia	4.52	123.
St Vincent and the Grenadines	0.80	178.
Samoa	6.19	94.
São Tomé and Príncipe	2.49	162.
Saudi Arabia	1.04	176.
Senegal	9.82	44.
Serbia	5.17	111.

Country	WRI	Rank
Seychelles	5.17	112.
Sierra Leone	9.61	45.
Singapore	2.51	161.
Slovakia	3.20	146.
Slovenia	3.34	140.
Solomon Islands	29.36	4.
South Africa	6.40	92.
Spain	3.46	138.
Sri Lanka	7.50	73.
Sudan	8.52	59.
Suriname	7.36	76.
Swaziland	6.49	90.
Sweden	2.20	168.
Switzerland	2.05	170.
Syrian Arab Republic	5.92	97.
Tajikistan	6.24	93.
Thailand	6.48	91.
The former Yugo. Rep. of Macedonia	5.81	101.
Timor-Leste	16.39	15.
Togo	10.99	35.
Tonga	29.39	3.
Trinidad and Tobago	9.44	49.
Tunisia	5.74	102.
Turkey	5.06	113.
Turkmenistan	5.69	106.
Uganda	8.71	57.
Ukraine	2.66	158.
United Arab Emirates	3.66	134.
United Kingdom	3.30	144.
United Republic of Tanzania	9.23	51.
United States	3.76	133.
Uruguay	12.52	26.
Uzbekistan	7.90	63.
Vanuatu	56.71	1.
Venezuela	7.68	69.
Viet Nam	10.31	40.
Yemen	5.50	108.
Zambia	7.83	64.
Zimbabwe	9.21	52.

Countries not included in the WorldRiskIndex due to incomplete data:

Andorra, Dominica, Liechtenstein, Marshall Islands, Monaco, Nauru, North Korea, Palau, San Marino, Somalia, South Sudan, St. Kitts and Nevis and Tuvalu.

Bibliography

ALLOUCHE, J. / NICOL, A. / MEHTA, L. (2011): Water Security: Towards the Human Securitization of Water? In: The Whitehead Journal of Diplomacy and International Relations, 12(1), 153–172.

BDEW [Federal Association of the German Energy and Water Industries] (2019): Entwicklung des personenbezogenen Wassergebrauches in Litern pro Einwohner und Tag, Deutschland. https://bdew.de/media/documents/Entwicklung_des_personenbezogenen_Wassergebrauches_ab_1990_o_online_j_Ott_03042019.pdf (accessed 31.05.2019).

BIRKMANN, J. / BUCKLE, P. / JAEGER, J. / PELLING, M. / SETIADI, N. / GARSCHAGEN, M. / FERNANDO, N. / KROPP, J. (2010): Extreme Events and Disasters: A Window of Opportunity for Change? Analysis of Changes, Formal and Informal Responses after Mega-Disasters. In: Natural Hazards, 55(3), 637–669.

BIRKMANN, J. / WELLE, T. / KRAUSE, D. / WOLFERTZ, J. / SUAREZ, D.-C. / SETIADI, N. (2011): WorldRiskIndex: Concept and results. In: Bündnis Entwicklung Hilft (ed.), WorldRiskReport 2011. Berlin: Bündnis Entwicklung Hilft, 13–41.

BMZ [German Federal Ministry for Economic Cooperation and Development] (2017): BMZ Wasserstrategie. Schlüssel zur Umsetzung der Agenda 2030 und des Klimaabkommens. https://bmz.de/de/mediathek/publikationen/reihen/strategiepapiere/Strategiepapier404_06_2017.pdf (accessed 03.06.2019).

BODEN, K.S. / SUBBAN, C.V. (2018): A road map for small scale desalination. An overview of existing and emerging technology solutions for cost-efficient and low-energy desalination in South and Southeast Asia. Oxfam: Oxfam International.

BÖHM, A. (2019): Warum kann Mosambik seine Bürger nicht schützen? In: Die Zeit, 14/2019, 28.03.2019.

BPB [German Federal Agency for Civic Education] (2017): Wasser. https://bpb.de/nachschlagen/zahlen-und-fakten/globalisierung/52730/wasserverbrauch (accessed 24.07.2019).

BÜNDNIS ENTWICKLUNG HILFT (2011): WorldRiskReport 2011. Berlin: Bündnis Entwicklung Hilft.

CESCR [Committee on Economic, Social and Cultural Rights] (2002): General Comment No. 15, The Right to Water, UN Doc. E/C.12/2002/11.

CHIRWA, D. M. (2019): Access to Water as a New Right in International, Regional and Comparative Constitutional Law. In: von Arnauld, A. / von der Decken, K. / Susi, M. (eds.), The Cambridge Handbook of New Human Rights. New York: Cambridge University Press.

CRED [Centre for Research on the Epidemiology of Disasters] / UNISDR (2015): The human cost of weather-related disasters: 1995-2015. Brussels: CRED.

DAY, ST. J. / FORSTER, T. (2018): Water, Sanitation and Hygiene in Post-Emergency Contexts. A study on establishing sustainable service delivery models. Oxford: Oxfam / UNHCR.

DE SOYSA, I. (2002): Paradise is a Bazaar? Greed, Creed, and Governance in Civil War, 1989–1999. In: Journal of Peace Research, 39(4), 395–416.

ESTY, D. C. / GURR, T. R. / LEVY, M.A. / SURKO, P.T. / GOLDSTONE, J. / HARFF, B. / DABELKO, G.D. / UNGER, A.N. (1999): State Failure Task Force Report: Phase II Findings. In: Environmental Change and Security Project Report, 5(5), 49–72.

FAO [Food and Agriculture Organization of the United Nations] (2019): AQUASTAT Main Database. http://www.fao.org/nr/water/aquastat/data. (accessed 01.08.2019).

FINK, G. / GUNTER, I. / HILL, K. (2011): The effect of water and sanitation on child health: evidence from the Demographic and Health Surveys 1986–2007. In: International Journal of Epidemiology, 40(5), 1196–1204.

FRECHEN, F.B. (2019): Waterbackpack Paul. http://waterbackpack.org/ (accessed 24.07.2019).

FREUDENBERG, M. (2003): Composite Indicators of Country Performance: A Critical Assessment. OECD Science, Technology and Industry Working Papers. 2003/16. OECD Publishing.

FRINGS, M. / LUTZ, J. (2017): Endlich ein Durchbruch? Zur Wiederbelebung des gemeinsamen israelisch-palästinensischen Wasserkomitees. In: Konrad-Adenauer-Stiftung e.V. (eds.), Auslandsinformationen, 33(3), 8–21.

GERMAN ENVIRONMENT AGENCY (2014): Wassersparen in Privathaushalten: sinnvoll, ausgereizt, übertrieben? Fakten, Hintergründe, Empfehlungen. Reihe Hintergrundpapier. https://umweltbundesamt.de/publikationen/wassersparen-in-privathaushalten-sinnvoll (accessed 26.06.2019).

GERMAN FEDERAL GOVERNMENT (2016): Deutsche Nachhaltigkeitsstrategie. Neuauflage 2016. https://bundesregierung.de/resource/blob/975274/214552/bc6c3313d40dd1da060732d16310677a/2016-05-31-download-nachhaltigkeitsstrategie-entwurf-data.pdf?download=1 (accessed 03.06.2019).

HAUGE W. / ELLINGSON, T. (1998): Beyond Environmental Scarcity: Causal Pathways to Conflict. In: Journal of Peace Research, 35(3), 299–317.

HOMER-DIXON, T. F. (1999): Environment, Scarcity, and Violence. Princeton: Princeton University Press.

IPCC [Intergovernmental Panel on Climate Change] (2018): Summary for Policymakers. In: Masson-Delmotte, V. et. al. (eds.), Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Geneva: World Meteorological Organization.

KURTZ, A. (2014): Niere – Ausscheidung von Wasser und Elektrolyten. In: P. Heinrich, M. Müller, L. Graeve (eds.), Löffler / Petrides Biochemie und Pathobiochemie. 9th edition. Berlin / Heidelberg: Springer Verlag.

LASKOWSKI, S. (2010): Das Menschenrecht auf Wasser: Die rechtlichen Vorgaben zur Sicherung der Grundversorgung mit Wasser und Sanitärleistungen im Rahmen einer ökologisch-nachhaltigen Wasserwirtschaftsordnung. Recht der nachhaltigen Entwicklung, Vol. 7. Tübingen: Mohr Siebeck.

LAVELL, A. / OPPENHEIMER, M. / DIOP, C. / HESS, J. / LEMPERT, R. / LI, J. / MUIR-WOOD, R. / MYEONG, S. (2012): Climate Change: New Dimensions in Disaster Risk, Exposure, Vulnerability, and Resilience. In: IPCC (ed.), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaption. A Special Report on Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge / New York: Cambridge University Press, 25–64.

LEITHEAD, A. (2019): The 'water war' brewing over the new River Nile dam. https://bbc.com/news/world-africa-43170408 (accessed 15.05.2019).

LOCKWOOD, H. / LE GOUAIS, A. (2015): Professionalising community-based management for rural water services. Briefing notes – Building blocks for sustainability series. The Hague: IRC.

MATOSO, M. (2018): Supporting sustainable water service delivery in a protracted crisis: Professionalizing community-led systems in South Sudan. https://policy-practice.oxfam.org.uk/publications/supporting-sustainable-water-service-delivery-in-a-protracted-crisis-profession-620464 (accessed 03.06.2019).

MEYER, W. (2004): Indikatorenentwicklung. Eine praxisorientierte Einführung. 2nd edition. CEval-Arbeitspapiere 10. Saarbrücken: Centrum für Evaluation.

OAK RIDGE NATIONAL LABORATORY (2018): LandScan 2017 High Resolution Global Population Data Set. https://landscan.ornl.gov.

RADTKE, K. / MANN, H. / WELLER, D. / KIRCH, L. / PRÜTZ, R. (2018): The WorldRiskIndex 2018. In: Bündnis Entwicklung Hilft / IFHV (eds.), WorldRiskReport 2018. Berlin: Bündnis Entwicklung Hilft, 35–43.

RAHAMAN, M. M. (2012): Water Wars in 21st Century: Speculation or Reality? In: International Journal of Sustainable Society, 4(1), 3–10.

SADC [Southern African Development Community] (2019): SADC Regional Humanitarian Floods Appeal in Response to Tropical Cyclone IDAI, 11 April 2019. https://reliefweb.int/sites/reliefweb.int/files/resources/SADC_Humanitarian_Appeal_2019_-_English.pdf (accessed 16.07.2019).

SMETS, H. (2009): Is drinking water affordable for all? Paper presented in 5th world water forum, Istanbul. 16–22 March 2009.

SPHERE ASSOCIATION (2018): The Sphere Handbook. Humanitarian Charter and Minimum Standards in Humanitarian Response. 4th edition. Geneva: Sphere Association.

STEININGER, S. (2018): What's Human Rights Got To Do With It? An Empirical Analysis of Human Rights References in Investment Arbitration. In: Leiden Journal of International Law 31(1), 33–58.

THEISEN O. M. / BRANDSEGG, K. (2007): The Environment and Non-State Conflicts in Sub-Saharan Africa. Paper Contribution to the 48th Annual Convention of the International Studies Association, Chicago.

THIELBÖRGER, P. (2009): The Human Right to Water Versus Investor Rights: Double-Dilemma or Pseudo-Conflict? In: Dupuy, P. M. / Petersmann, E. U. / Francioni, F. (eds.), Human Rights in International Investment Law and Arbitration, 487–511.

THIELBÖRGER, P. (2014): The Right(s) to Water, The Multi-Level Governance of a Unique Human Right. Berlin / Heidelberg: Springer.

THIELBÖRGER, P. (2015): Re-Conceptualizing the Human Right to Water: A Pledge for a Hybrid Approach. In: Human Rights Law Review, 15(2), 225–249.

THIELBÖRGER, P. (2019a): Something Old, Something New, Something Borrowed and Something Blue: Lessons to be learned from the Oldest of the "New" Rights – The Human Right to Water. In: von Arnauld, A. / von der Decken, K / Susi, M. (eds.), The Cambridge Handbook of New Human Rights. New York: Cambridge University Press.

THIELBÖRGER, P. (2019b): Water Security. In: Geiss, R. / Melzer (eds.), Oxford Handbook on the International Law of Global Security. Oxford: Oxford University Press (in press).

THIELBÖRGER, P. / ACKERMANN, T. (2017): A Treaty on Enforcing Human Rights Against Businesses: Closing the Loophole or Getting Stuck in a Loop: In: Indiana Journal of Global Legal Studies, 24(1), 43–79.

TUCHMAN MATHEWS, J. (1989): Redefining Security. In: Foreign Affairs, 68(2), 162–177.

TULLY, S. (2005): A human right to access water? A critique of General Comment No. 15. In: Netherlands Quarterly of Human Rights, 23(1), 35–63.

UN (2015): UN Development Goals Report 2015. http://un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf (accessed 15.05.2019).

UN (2016): Goal 6: Ensure access to water and sanitation for all. https://un.org/sustainabledevelopment/water-and-sanitation/ (accessed 24.07.2019).

UN (2018): Sustainable Development Goal 6: Synthesis Report 2018 on Water and Sanitation. New York: United Nations.

UN (2019): Billions globally lack 'water, sanitation and hygiene', new UN report spells out. https://news.un.org/en/story/2019/06/1040701 (accessed 24.07.2019).

UNDP (2018): Global Human Development Indicators. http://hdr.undp.org/en/countries (accessed 24.07.2019).

UNEP (2013): Standing Wealth. Pastoralist Livestock Production and Local Livelihoods in Sudan. Khartoum: United Nations Environment Programme.

UNEP (2018): PREVIEW: Global Risk Data Platform. Database. http://preview.grid.unep.ch.

UNHCR (2017): Working towards inclusion. Refugees within the national systems of Ethiopia. Geneva: United Nations High Commissioner for Refugees.

UNHCR (2018a): Ethiopia country data. https://data2.unhcr.org/en/country/eth (accessed 21.05.2019).

UNHCR (2018b): Ethiopia. Operational Update from UNHCR, the UN Refugee Agency, September 2018. https://reliefweb.int/sites/reliefweb.int/files/resources/66333.pdf (accessed 30.05.2019).

UNICEF / WHO (2019): Progress on household drinking water, sanitation and hygiene 2000–2017. Special focus on inequalities. New York: United Nations Children's Fund / World Health Organization.

UN GENERAL ASSEMBLY (2015): A/RES/70/1–Transforming our world: the 2030 Agenda for Sustainable Development. New York: United Nations.

UN OCHA (2018): Global Humanitarian Overview 2019. https://unocha.org/sites/unocha/files/GHO2019.pdf (accessed 03.06.2019).

UN WATER (2018): Sustainable Development Goal 6. Synthesis Report 2018 on Water and Sanitation. Geneva: UN-Water.

WELLE, T. / BIRKMANN, J. (2015): The World Risk Index – An Approach to Assess Risk and Vulnerability on a Global Scale. In: Journal of Extreme Events, 2(1).

WELTHUNGERHILFE (2019): Sanitäre Anlagen, sauberes Wasser und 35 US-Dollar. https://welthungerhilfe.de/informieren/laender/demokratische-republik-kongo/sanitaere-anlagen-und-sauberes-trinkwasser-fuer-nobili/ (accessed 24.07.2019).

WHO (2019): Fact Sheets. https://who.int/news-room/fact-sheets (accessed 18.07.2019).

WILDMAN, T. (2013): Technical Guidelines on Water Trucking in Drought Emergencies. https://policy-practice.oxfam.org.uk/publications/technical-guidelines-on-water-trucking-in-drought-emergencies-301794 (accessed 03.06.2019).

WINKLER, I. (2012): The Human Right to Water. Significance, Legal Status and Implications for Water Allocation. Oxford: Hart Publishing.

WINKLER, I. (2016): The Human Right to Sanitation. In: University of Pennsylvania Journal of International Law, 37(4), 1331–1406.

WISNER, B. / ADAMS, J. (2002): Environmental Health in Emergencies and Disasters. A Practical Guide. World Health Organization Nonserial Publication. Geneva: World Health Organization.

WOLF, A. (1999): 'Water Wars' and Water Reality: Conflict and Cooperation Along International Waterways. In: Lonergan, S.C. (eds.), Environmental Change, Adaptation, and Security. Dordrecht: Springer, 251–265.

WORLD BANK (2017): Sustainability Assessment of Rural Water Service Delivery Models: Findings of a Multi-Country Review. Washington DC: World Bank.

WORLD SUMMIT FOR SOCIAL DEVELOPMENT (1995): World Summit for Social Development: the Copenhagen Declaration and Programme of Action. New York: United Nations.

WWAP [United Nations World Water Assessment Programme] (2017): United Nations World Water Development Report 2017: Wastewater, The Untapped Resource. Paris: The United Nations Educational, Scientific and Cultural Organization.

WWAP [UNESCO World Water Assessment Programme] (2019): United Nations World Water Development Report 2019: Leaving No One Behind. Paris: The United Nations Educational, Scientific and Cultural Organization.

Photo Credits

Cover photo: Men have put hoses in a waterhole near the highway in Pesqueira in Brazil to refill their tankers. A man washes himself with the water. © Thomas Lohnes / Brot für die Welt

Page 8: A farmer is looking at the water in a cistern in the municipality of Jatobá near Carnaíba in Brazil. © Thomas Lohnes / Brot für die Welt

Page 16: The partner organization APDA provides water for drought-affected families in the southern regions of Ethiopia. © Christof Krackhardt / Brot für die Welt

Page 24: A young farmwoman is watering seedlings on a family estate in in the municipality of Barreiros in Brazil. © Thomas Lohnes / Brot für die Welt

Page 32: Local manual workers are building a well in Tanzania. © Andreas Müller / Missionsärztliches Institut Würzburg

Page 40: Toilet facilities with improved pit latrines constructed by Welthungerhilfe in the Bidibidi refugee settlement in Uganda © PAPASHOTIT / Welthungerhilfe

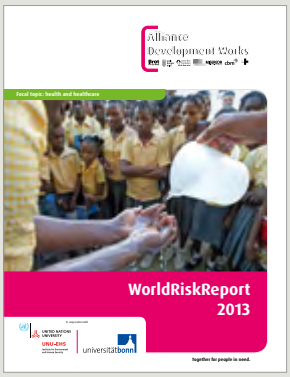
Page 42: Unrecovered damage caused by typhoon Haiyan (2013) in a coastal village near Tacloban in the Philippines in 2016 © Stephan Rumpf / Plan International

Page 52: Members of a Community Health Club at a hygiene training in the Bidibidi refugee settlement in Uganda © PAPASHOTIT / Welthungerhilfe

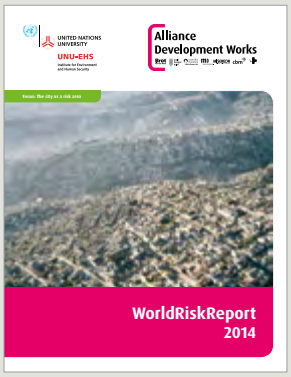
WorldRiskReports 2011–2018

Governance and Civil Society

Environmental Degradation and Disasters

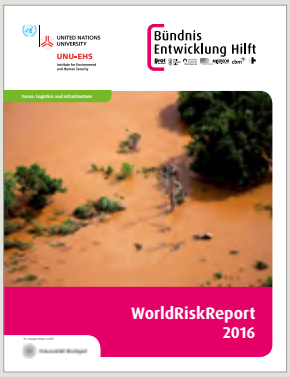


Health and Healthcare



The City as a Risk Area

Food Security



Logistics and Infrastructure

Analysis and Prospects

Child Protection and Children's Rights

All WorldRiskReports are available for download at www.WorldRiskReport.org.

Publishers

Bündnis Entwicklung Hilft –
Gemeinsam für Menschen
in Not e.V.
Schöneberger Ufer 61
10785 Berlin
Tel. +49 30 - 278 77 390
kontakt@entwicklung-hilft.de
www.entwicklung-hilft.de

Institute for International Law
of Peace and Armed Conflict (IFHV)
Ruhr University Bochum (RUB)
Massenbergstraße 9B
44787 Bochum
Tel. +49 234 - 32 27366
www.ifhv.de

In cooperation with

noha NETWORK ON HUMANITARIAN ACTION

ISBN 978-3-946785-08-8

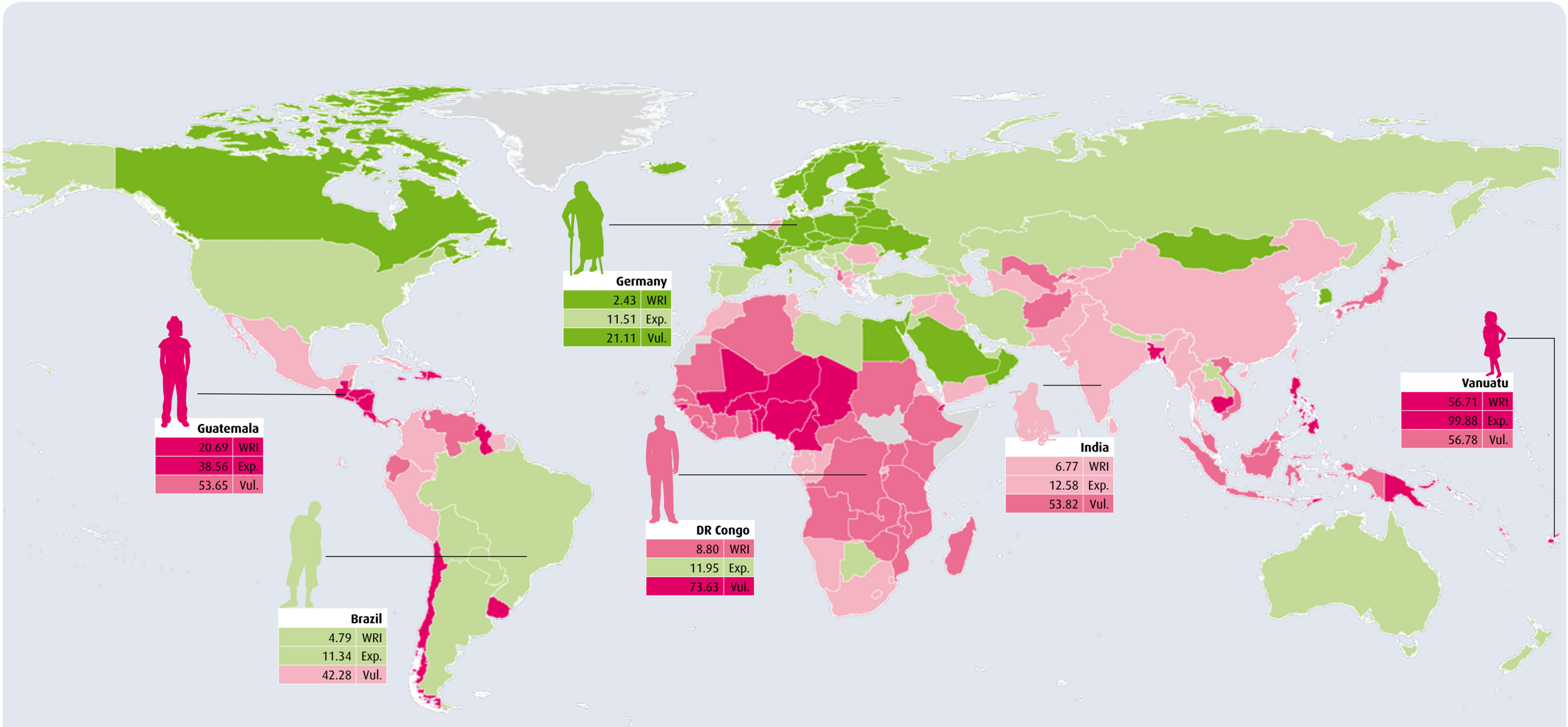
Bündnis Entwicklung Hilft

Gemeinsam für Menschen in Not.

WorldRiskIndex 2019

RUHR UNIVERSITÄT BOCHUM RUB

IFHV



WorldRiskIndex (WRI)

very low	0.31 – 3.29
low	3.30 – 5.49
medium	5.50 – 7.51
high	7.52 – 10.61
very high	10.62 – 56.71
no data available	

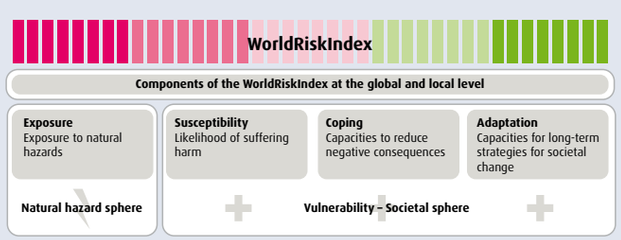
Exposure

very low	0.90 – 9.59
low	9.60 – 12.30
medium	12.31 – 14.73
high	14.74 – 19.61
very high	19.62 – 99.88
no data available	

Vulnerability

very low	21.11 – 33.08
low	33.09 – 42.10
medium	42.11 – 47.91
high	47.92 – 61.79
very high	61.80 – 76.13
no data available	

Max. = 100, Classification according to the quantile method



10 countries with highest risk	
Vanuatu	56.71
Antigua and Barbuda	30.80
Tonga	29.39
Solomon Islands	29.36
Guyana	22.87
Papua New Guinea	22.18
Brunei Darussalam	21.68
Guatemala	20.69
Philippines	20.69
Bangladesh	18.78

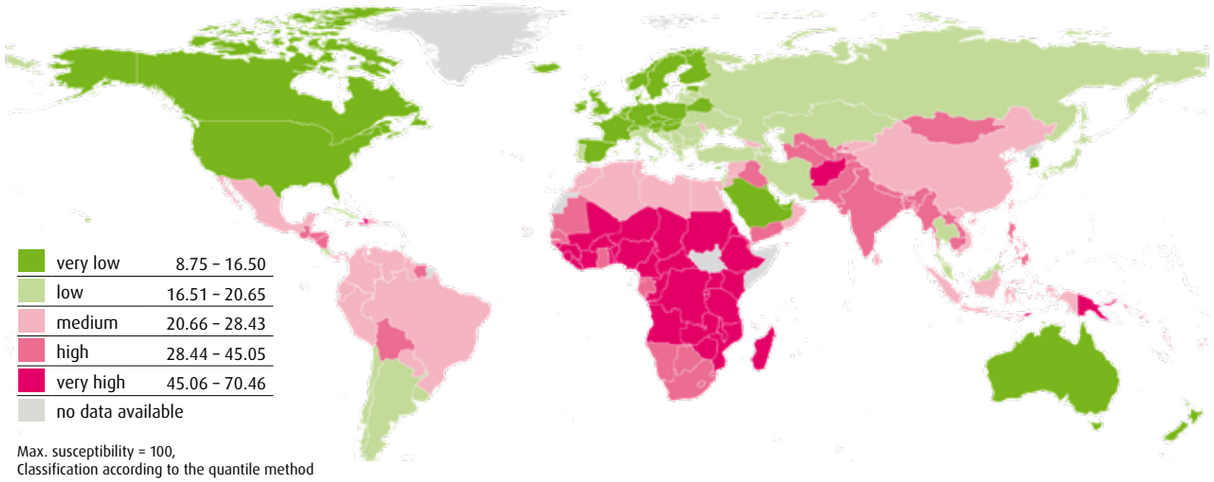
10 countries with highest exposure	
Vanuatu	99.88
Antigua and Barbuda	69.95
Tonga	61.41
Brunei Darussalam	57.62
Solomon Islands	48.32
Guyana	44.98
Costa Rica	44.92
Philippines	41.93
Japan	38.94
Guatemala	38.56

10 countries with highest vulnerability	
Central African Republic	76.13
Chad	74.78
Democratic Rep. of Congo	73.63
Eritrea	72.30
Niger	71.34
Mozambique	70.44
Guinea-Bissau	70.42
Sierra Leone	70.16
Liberia	69.69
Burundi	69.47

Data source: IFHV, based on the PREVIEW Global Risk Data Platform, Oak Ridge National Laboratory LandScan, CReSIS, CIESIN, NatCatSERVICE and global databases; detailed information at www.WorldRiskReport.org

Susceptibility

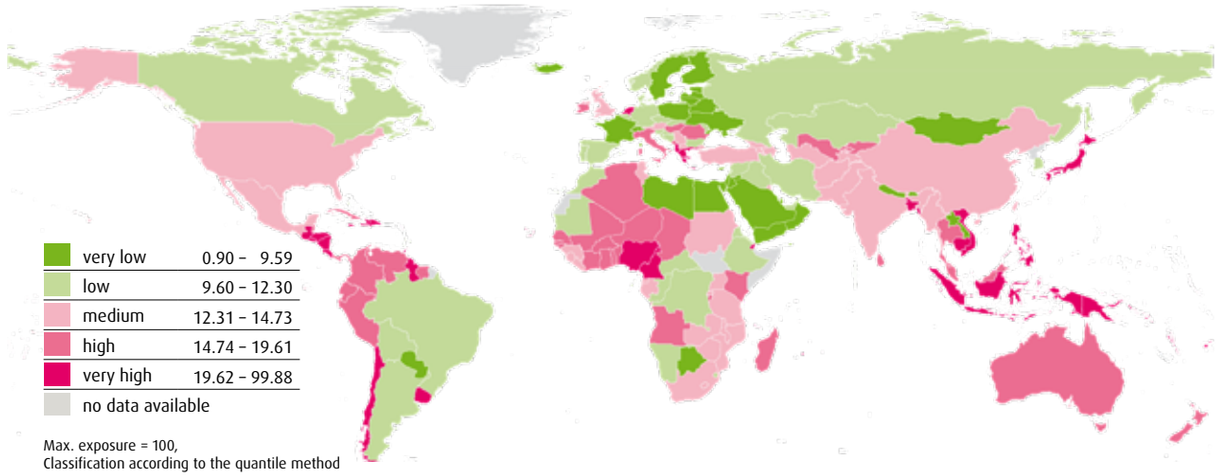
Dependent on public infrastructure, nutrition, income, and the general economic framework



Max. susceptibility = 100,
Classification according to the quantile method

Exposure

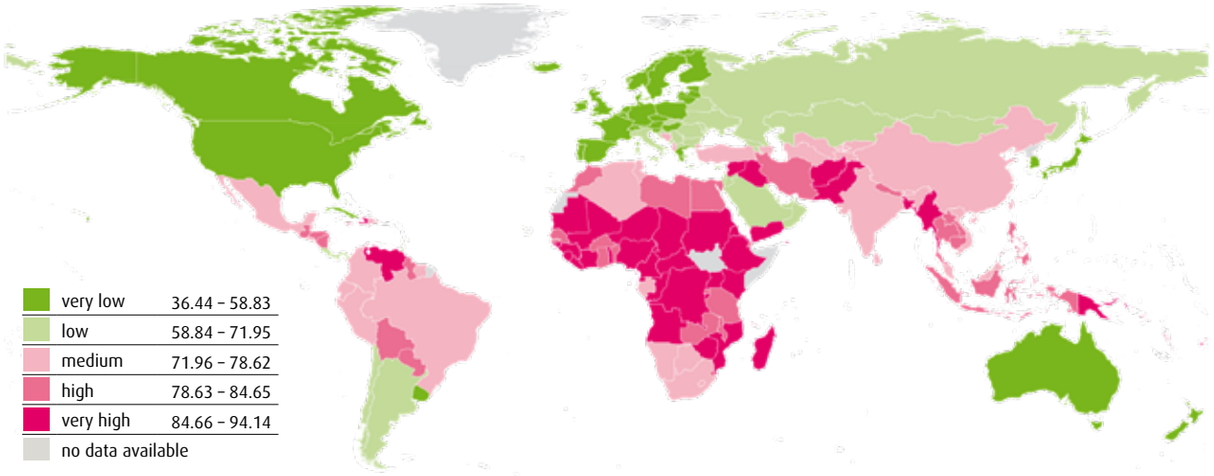
Exposure of the population to the natural hazards earthquakes, cyclones, floods, droughts, and sea-level rise.



Max. exposure = 100,
Classification according to the quantile method

Lack of coping capacities

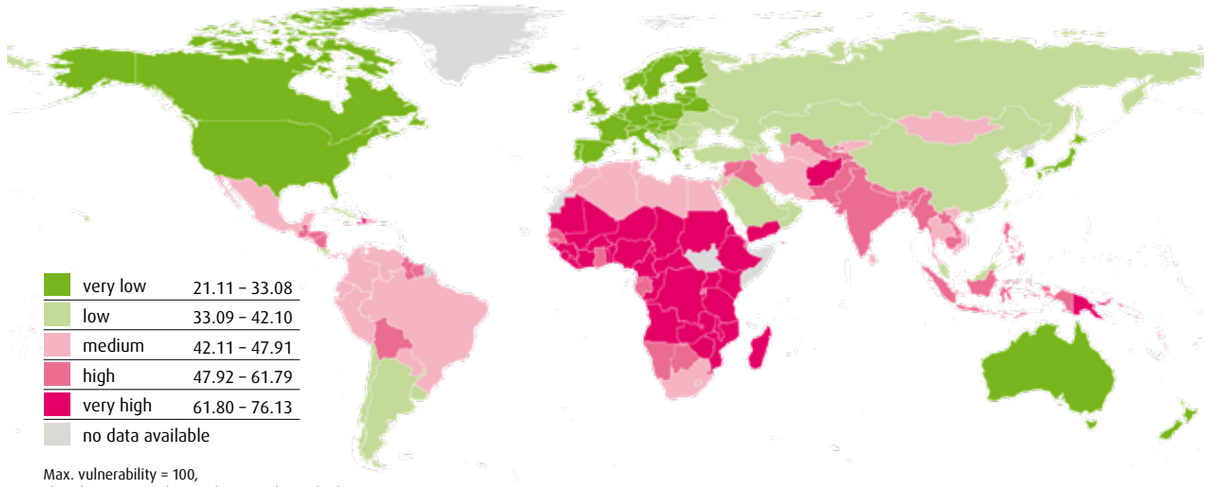
Dependent on governance, medical care, and material security



Max. lack of coping capacities = 100,
Classification according to the quantile method

Vulnerability

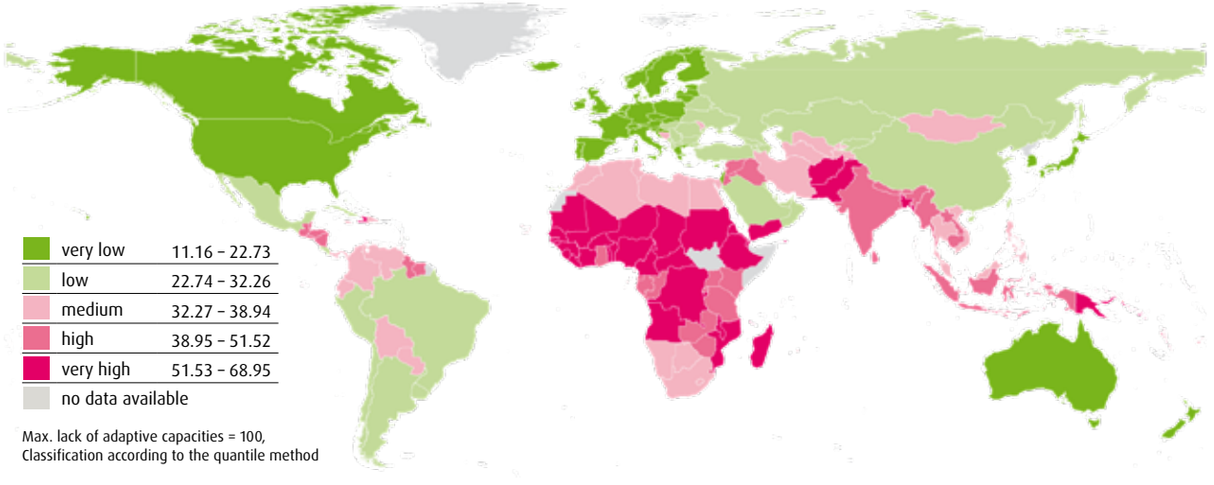
Vulnerability of society as the sum of susceptibility, lack of coping capacities, and lack of adaptive capacities



Max. vulnerability = 100,
Classification according to the quantile method

Lack of adaptive capacities

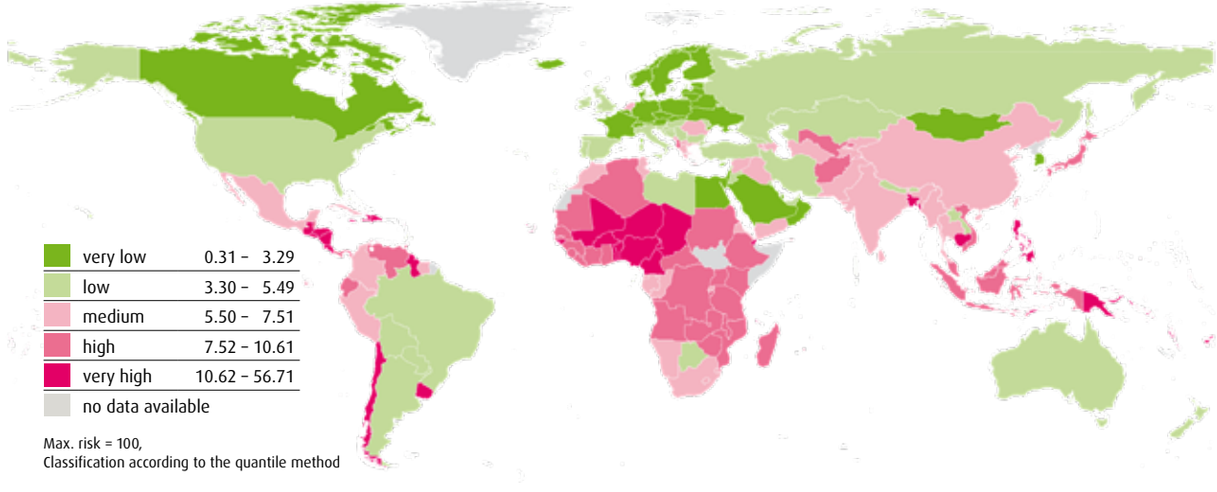
Related to future natural events and climate change



Max. lack of adaptive capacities = 100,
Classification according to the quantile method

WorldRiskIndex

WorldRiskIndex as the result of exposure and vulnerability



Max. risk = 100,
Classification according to the quantile method

Data source: IFHV, based on the PREVIEW Global Risk Data Platform, Oak Ridge National Laboratory LandScan, CReSIS, CIESIN, NatCatSERVICE and global databases; detailed information at www.WorldRiskReport.org

Bündnis Entwicklung Hilft

Gemeinsam für Menschen in Not.

How Extreme Natural Events Threaten the Water Supply

RUHR UNIVERSITÄT BOCHUM RUB

IFHV

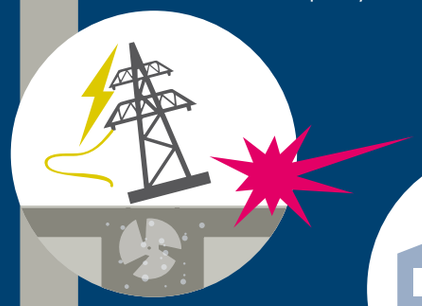
Sewerage system

Landslides and soil erosion can damage **pipes** and wash them away. Landslides may result from heavy rainfall or flooding.

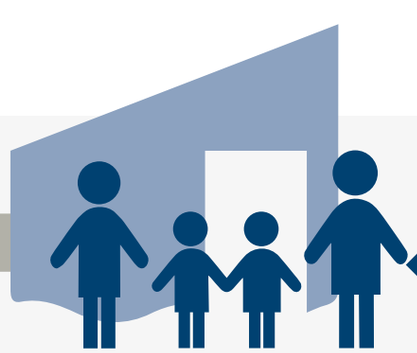
Above-ground pipelines are particularly exposed to the dangers of flooding. Floods can overload pump systems and make them unsuitable.

Wastewater treatment plants are often built near waters in order to make the water travel the shortest possible and therefore most energy-saving way back. At the same time the risk of flooding near waters and, along coastline of tsunamis, is particularly high. Both natural hazards can cause damage to electronics and thus to the functionality of the entire wastewater treatment plant.

For the transport of waste water, pipes allowing the water flowing by gravity are usually used. If this is not possible, pumps are utilized. They require a reliable power supply. Destructions as a result of extreme natural events can impair the **power supply** or cause it to fail completely.



If the entire **transport system** fails after an extreme natural event, wastewater can get to the roads. Diseases can spread through contact with feces.



In the event of a disaster, people in their **households** often have only polluted water or no water at all at their disposal.

Surface water

Groundwater

Water sources are threatened by pollution. Landslides, especially in combination with heavy rainfalls, can contaminate surface water.

Water supply system

Storms can indirectly affect **distribution networks:** Over the years, some trees have laid their roots around water pipes. If a storm uproots such a tree, the pipeline is often damaged.

Underground piping systems are particularly susceptible to earthquakes as they can be interrupted by vibrations.

As most **water storage systems** (e.g. reservoirs) are built in areas close to the water, flooding in particular poses a threat to them. If dirty water enters the reservoir, it contaminates the stored water.

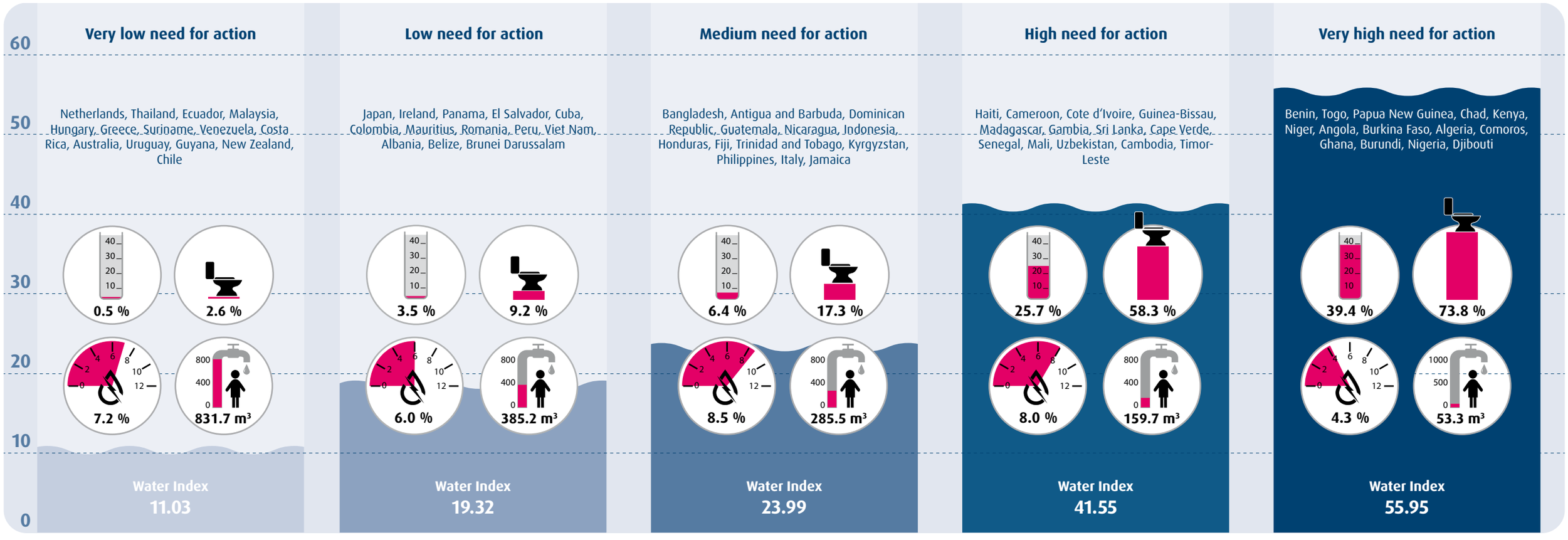
Bündnis Entwicklung Hilft

Gemeinsam für Menschen in Not.

Water Supply: Need for Action in Countries at Risk

RUHR UNIVERSITÄT BOCHUM RUB

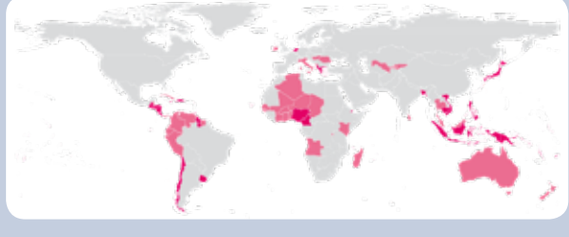
IFHV



Key		Minimum of the 67 countries	Maximum of the 67 countries
A	**Indicator A – Population without access to basic drinking water supply (WHO / UNICEF JMP)** The proportion of the population without access to basic drinking water supply in a country, where a basic supply is defined as water drawn from a safe source (e.g. water from pipelines, boreholes, protected well and spring areas, packaged bottles) within a radius of no more than 30 minutes by foot	Chile, Greece, Italy, Netherlands, New Zealand and Romania (0)	Papua New Guinea (63.40)
B	**Indicator B – Population without access to basic sanitation (WHO / UNICEF JMP)** The proportion of the population without access to basic sanitation in a country, where basic sanitation is defined as the provision of sanitation facilities (e.g. flushing and drainage pipes leading into sewers, septic tanks or latrines) for a house or land and does not need to be shared with other households	Australia, Japan, New Zealand and Uzbekistan (0)	Chad (90.45)
C	**Indicator C – Water Stress Index (FAO AQUASTAT)** The ratio of total abstraction from water sources by the population, industry and agriculture to the total amount of regenerable water resources; a measure of competition between users for water sources and resources	Papua New Guinea (0.13)	Uzbekistan (141.00)
D	**Indicator D – Annual total water withdrawal per head (FAO AQUASTAT)** Total annual water abstraction in liters per capita; a measure of the efficiency and development status of national water supply systems based on the premise that high values stand for a more efficient state of infrastructure for water supply to populations	Comoros (17.56)	Chile (2148.00)
55.95	**Water Index** The index value is calculated from indicators A-D using the following procedure: (1) calculate mean value for indicators A and B, (2) align the three basic values by transformations and min-max normalization in such a way that higher values correspond to a worse supply situation, (3) calculate mean value of the three normalizations	Chile (2.98)	Benin (60.34)

Water Index shows need for action

The extent to which extreme natural events such as earthquakes, cyclones or droughts develop into disasters also depends on the water supply of the affected population. Intact supply processes and structures can cover acute needs before an extreme natural event becomes a disaster. The world map on the right shows all 72 countries that are at high or very high risk of extreme natural events according to the WorldRiskIndex. A Water Index was calculated for 67 of them based on four indicators (see left). It indicates the current state of the water supply. Only for Kiribati, Montenegro, Solomon Islands, Tonga and Vanuatu it was not possible to analyze the water supply due to a lack of data. An overview of the indicators of the Water Index can be found at **www.WorldRiskReport.org.**



According to their ranking in the Water Index, the 67 countries were divided into five groups (quantile method) – from very low to very high need for action concerning water supply (indicated by the group medians). For example, strong improvements in water supply are needed in Benin, Togo, Papua New Guinea, Chad and Kenya, among others, as high exposure in these countries meets poor capacity. In direct comparison, Chile, for example, is similarly at high risk, but is one of the countries with the least need for action with regard to water supply.