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Bündnis Entwicklung Hilft

Gemeinsam für Menschen in Not.

NEW
Completely revised WorldRiskIndex

WorldRiskReport 2022

Focus: Digitalization

WorldRiskReport 2022

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Preface

The armed conflict in Ukraine is shaping the year 2022 like no other crisis. Millions of people have lost their lives or are displaced. The long-term consequences of the conflict for the international system, far beyond Ukraine, are serious; people all over the world are suffering from exploding food and energy prices. Especially in the countries at the Horn of Africa, multiple crises are currently overlapping, forming a toxic mixture that poses an existential threat, in particular to the poorest and most vulnerable. Four missing rain seasons led to a devastating drought and the decimation of livestock by up to 70 percent. In consequence, many families lost their only source of income and could no longer afford to buy food, especially as food had already become scarcer and thus more expensive as a result of the Covid-19 pandemic. The collapse of agriculture in Ukraine, considered the 'breadbasket of the world,' is now continuing this trend. Meanwhile, around 17 million people are starving in East Africa.

The complexity and overlapping of crisis situations, as we have observed in recent years, also has an impact on the way we calculate disaster risks. This is one of the reasons why we decided to fundamentally revise the concept of the WorldRiskIndex. This year, the time has come: With the WorldRiskIndex 2022, we are presenting a more precise, differentiated, and transparent model that allows greater flexibility in integrating new factors. Thus, the new model of the WorldRiskIndex provides an important building block for the long-term analysis of current disaster risks.

Like every year, the WorldRiskIndex 2022 is complemented by a focus topic. This year we are looking at digitalization. Based on qualitative research, the authors analyze the great importance of digital solutions for disaster risk reduction and anticipatory humanitarian action, for example in the context of early warning, the processing of complex data sets for needs assessment, and the transmission of 'cash transfers.' However, the authors also clarify that digitalization is accompanied by many unsolved problems to which solutions are yet to be found. From the perspective of science and practice, the report develops demands on national and international politics for a sustainable and socially just digitalization.

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Bündnis Entwicklung Hilft is formed by 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 member organizations provide short-term 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 2011–2021 can be downloaded there as well.

Contents

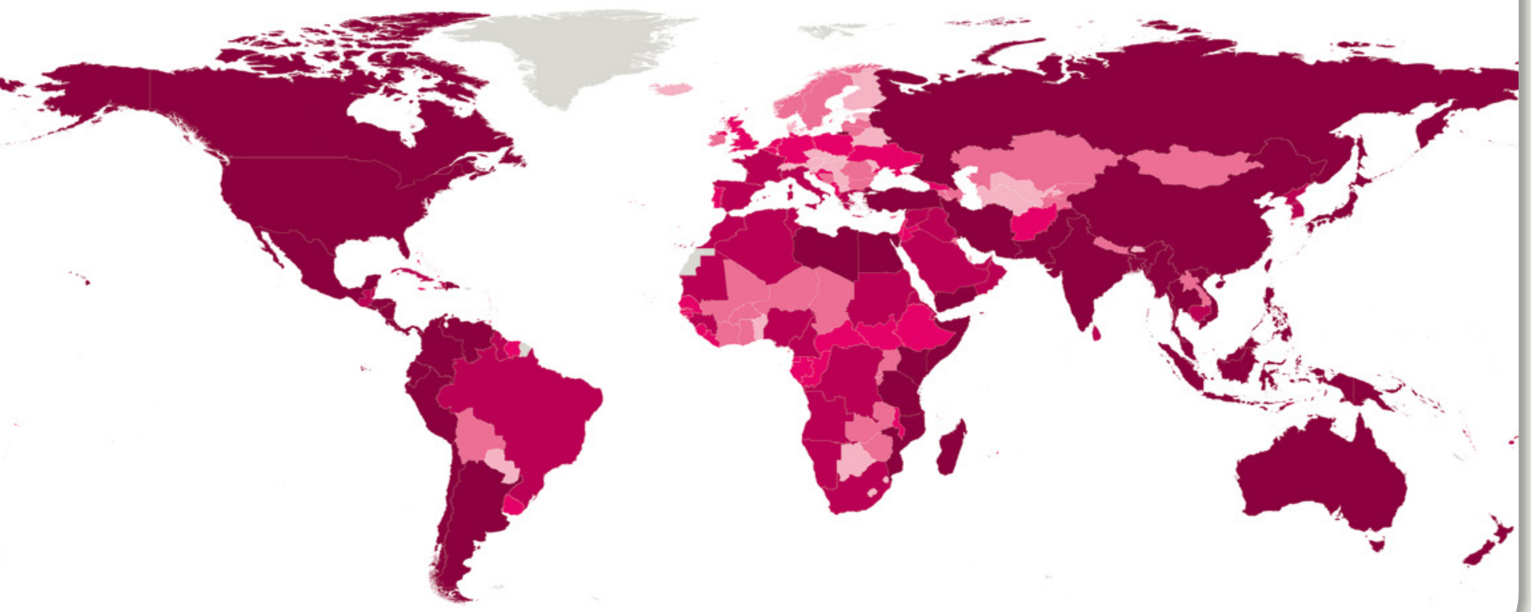


Figure 1: The WorldRiskIndex 2022

Key Findings

WorldRiskIndex 2022

The WorldRiskIndex 2022 assesses the disaster risk for 193 countries. This covers all UN-recognized countries and over 99 percent of the world's population. The WorldRiskIndex is to be continuously expanded and updated in the future.

+ The countries with the highest disaster risk worldwide are the Philippines (WRI 46.82), India (WRI 42.31), and Indonesia (WRI 41.46).
+ Nine of the 15 countries with the highest disaster risk are among the 15 most populous countries in the world.
+ Many island states are no longer at the top of the risk ranking due to this year's recalculation of the WorldRiskIndex. This is partly because now both absolute and percentage figures of the population at risk are included in the calculation. This avoids a distortion due to population size.
+ China has the highest exposure, followed by Mexico and Japan. The most vulnerable country in the world is Somalia, followed by Chad and South Sudan.
+ In the overall ranking, Germany is in the global average and ranks 101st in the WorldRiskIndex with a score of 3.92. As a result of the redesign of the WorldRiskIndex, Germany is no longer in the lowest risk category.
+ The examples of South Korea, Italy, and Greece illustrate the principle that low or very low vulnerability can reduce disaster risk even when exposure is very high. However, the examples of DR Congo, Nigeria, Sudan, and Iraq show that very high vulnerability can lead to high disaster risk even with medium exposure.
+ The Americas is the continent with the highest disaster risk. Asia is in second place, followed by Africa and closely after that Oceania. Europe has by far the lowest risk in a global comparison.
+ The continent with the highest overall vulnerability is Africa. 13 of the 15 most vulnerable countries in the world are located there.

Focus: Digitalization

- Digitalization has significantly changed disaster preparedness and management. Information and communication technologies (ICT) are used in all phases of disaster management for knowledge acquisition, information dissemination, communication, as well as control. Examples include the use of global databases for risk analysis, digital early warning systems, apps for recording damage, and communication with those affected via social media platforms.

- Prerequisites for the application of ICT in a disaster context include access to an ICT infrastructure, digital literacy, uniform guidelines regarding data protection and accountability, particularly in cooperation with private-sector tech companies, the provision of open data and scalable digital applications, and an orientation toward the needs of the affected persons whom the applications are intended to serve.

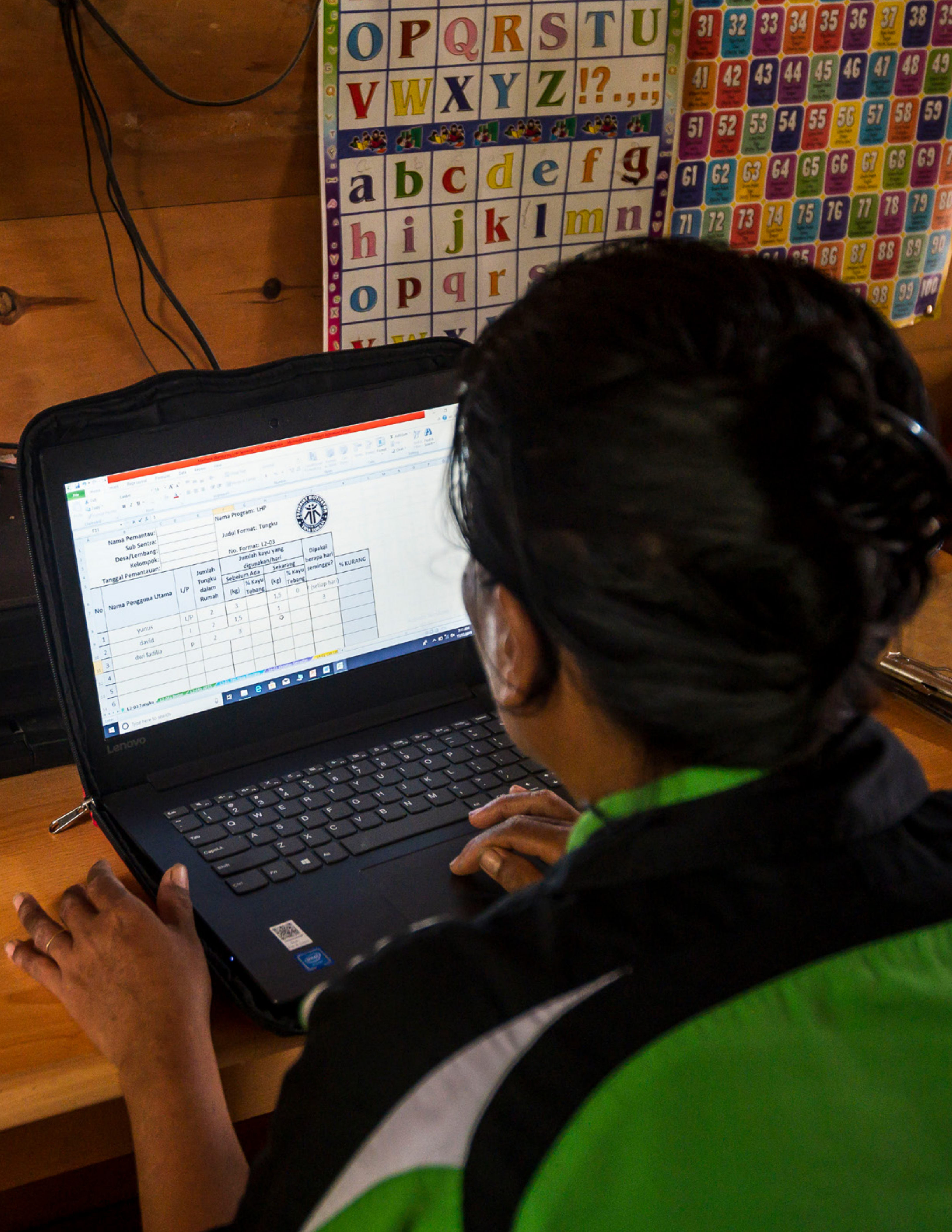
- Digital risks that arise in the course of the digitalization of disaster management are many and diverse. They can arise in connection with the design, use, and regulatory environment of technologies. Critical for risks is the interplay between technology, policy, and human factors. While some risks are inherent in the technology itself, such as the susceptibility of digital infrastructure to extreme natural events, other risks arise only through the human factor, such as data misuse or disinformation. All these risks can significantly impact the use and effectiveness of digital apps in disaster management.

- Depending on age, gender, social and geographical origin, ICT are not equally accessible, usable, or producible for everyone. In the context of disasters, this digital divide can lead to a reproduction or exacerbation of global and local power structures. Thus, vulnerable groups are at risk of being further marginalized if the possibility of such effects are ignored by humanitarian organizations.

Rank	Country	Risk
1.	Philippines	46.82
2.	India	42.31
3.	Indonesia	41.46
4.	Colombia	38.37
5.	Mexico	37.55
6.	Myanmar	35.49
7.	Mozambique	34.37
8.	China	28.70
9.	Bangladesh	27.90
10.	Pakistan	26.75
11.	Russian Federation	26.54
12.	Vietnam	25.85
13.	Peru	25.41
14.	Somalia	25.07
15.	Yemen	24.26
...		...
101.	Germany	3.92
...		...
179.	Maldives	1.02
180.	Nauru	1.00
180.	Czech Republic	1.00
180.	Slovakia	1.00
183.	Hungary	0.97
184.	Bahrain	0.95
185.	Malta	0.94
186.	Belarus	0.83
187.	Singapore	0.81
188.	Liechtenstein	0.79
189.	Luxembourg	0.52
190.	Sao Tome and Principe	0.48
191.	San Marino	0.38
192.	Andorra	0.26
192.	Monaco	0.26

Figure 2:
Excerpt from the WorldRiskIndex 2022

- With the rapid digitalization of disaster management, new weak spots and vulnerabilities are inevitably emerging. To counter this new vulnerabilities and to maintain the integrity of disaster relief, proactive leadership, digital security training, technical legal knowledge, and cybersecurity investments are essential. Issues around data privacy, accountability, and ethics are particularly significant at the moment.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1 Digitalization and Disaster Management

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Program Officer Content & Information, Bündnis Entwicklung Hilft

Climate change and its consequences have changed the requirements for disaster management. Adapted to the changing circumstances, the WorldRiskReport 2022 contains the WorldRiskIndex with a revised concept for the first time since its publication in 2011, which is still based on the interaction between exposure and vulnerability. With this year's focus on digitalization, the report highlights changes brought about by digital technologies in disaster preparedness and response, as well as associated risks.

The consequences of climate change are also evident this year. Climate change not only influences the frequency and intensity of extreme natural events and their effects on populations, but also how we perceive and assess them. As a result, disaster management today has a different status than it did ten years ago. To better capture both these further developments and changing risk profiles, we have extensively revised the concept of the WorldRiskIndex. Digitalization – this year's focus topic of the report – is a key driver for providing the data basis. At the same time, digitalization offers potential for the actions of states and humanitarian organizations in disaster management.

New WorldRiskIndex

With its focus on the interaction of exposure and vulnerability for disaster risk, the WorldRiskIndex, first published in the WorldRiskReport 2011, complemented the scientific work on index models in disaster research published up to that point in time (Cardona 2005; Peduzzi et al. 2009). The risk model designed by Bündnis Entwicklung Hilft and the then cooperation partner, the Institute for Environment and Human Security of the United Nations University in Bonn, is now considered fundamental and served as an example for many models, such as the Index for Risk Management (INFORM), which was supplemented by other focal points and indicators.

Based on the previous work, the WorldRiskIndex 2022 represents the next major developmental step. It is the result of several years of intensive conceptual and methodological scientific work. These are the main innovations in the WorldRiskIndex (for more in-depth information on the new concept see Chapter 3):

+ Only data that not only originate from scientifically recognized sources, but are also publicly and transparently accessible without restrictions and are provided on a continous basis will be used. As a result, the Fragile States Index and the Corruption Perception Index have been replaced by several individual indicators. In total, the WorldRiskIndex now comprises 100 indicators instead of the previously used 27 indicators.

+ In the sphere of exposure, in addition to earthquakes, cyclones, floods, droughts, and sea-level rise, tsunamis are now also considered, and a distinction is made between coastal and riverine flooding. For all exposure types, both the absolute number of exposed individuals and their share in the population are now included to avoid biasing effects on exposure estimates by population size. When considering only the percentage of the population, countries with smaller population sizes have previously tended to be ranked worse, even though the absolute number of exposed individuals in populous countries may be many times higher. To give an example: In Vanuatu, which was consistently ranked first in the former WorldRiskIndex, 25.56 percent of the population is at risk of sea-level rise. In absolute terms, this is just under 65,000 people. In China, sea-level rise threatens only 0.56 percent of the population. But in absolute terms, this is almost eight million people.

+ In addition, three intensity levels per exposure type have newly been included in the calculation. Thereby it is possible to compare regions that are more frequently affected by weaker events with regions that are affected less frequently but with greater intensity.

+ In the vulnerability sphere, indicators on refugees, displaced persons, and asylum seekers, as well as people affected by conflicts and natural events over the last five years are now taken into account to better reflect the realities of life in many countries as well as the influences of migration and crises on vulnerability.

+ When indicator values are missing for a country, the new WorldRiskIndex uses a complex procedure to estimate missing values. This allows the index to represent all 193 countries member states of the United Nations.

Overall, these conceptual and methodological adjustments also mean that some countries' risk scores have changed very significantly from the results of previous editions. For example, the United States of America, instead of being at low risk as in previous editions, now has a very high risk in the new index. These different ratings also demonstrate the limitations: any index model is only a modeling of reality, cannot capture all influencing variables holistically, and is dependent on available data. With the revisions, we have now created a model that allows more precise and differentiated risk analyses and can be easily expanded and adapted. For example, one of our goals is to integrate heat and cold waves in exposure as well as material protection in vulnerability, which have not yet been included due to a lack of indicators. Hopefully, digitalization can help fill these gaps in the future.

Focus on Digitalization

Digitalization has an impact on our daily life: it shapes the way we live together, our communication, our work, and our consumption. As in everyday life, it has also become indispensable in disaster preparedness and response. Digital elements have found their way into all processes in disaster management and, in addition to opportunities, also bring new risks that need to be examined and understood.

To break down digitalization, two levels need to be considered: the technological and the societal. The technological level describes the process that converts, stores, processes, and combines information into machine-processable data and transforms it into recordable formats such as writing, speech, or images. Through computers and the internet, these processes are automated and networked. The societal level describes the interplay of these technologies with the people who shape, control, develop, and use them and thus develop their effects (Müller-Brehm et al. 2020). Information and communication technologies (ICT) are a central part of this.

Rapidly advancing since the 1990s, digitalization and its further development often stand as both a symbol and a prerequisite for progress. While digitalization initially brought primarily joy about new technical possibilities, quickly became accessible to many people and made them dream of a better, fairer world, the risks have now also clearly emerged. Digital technologies enable more people to participate in

Digital Technologies in Disaster Management

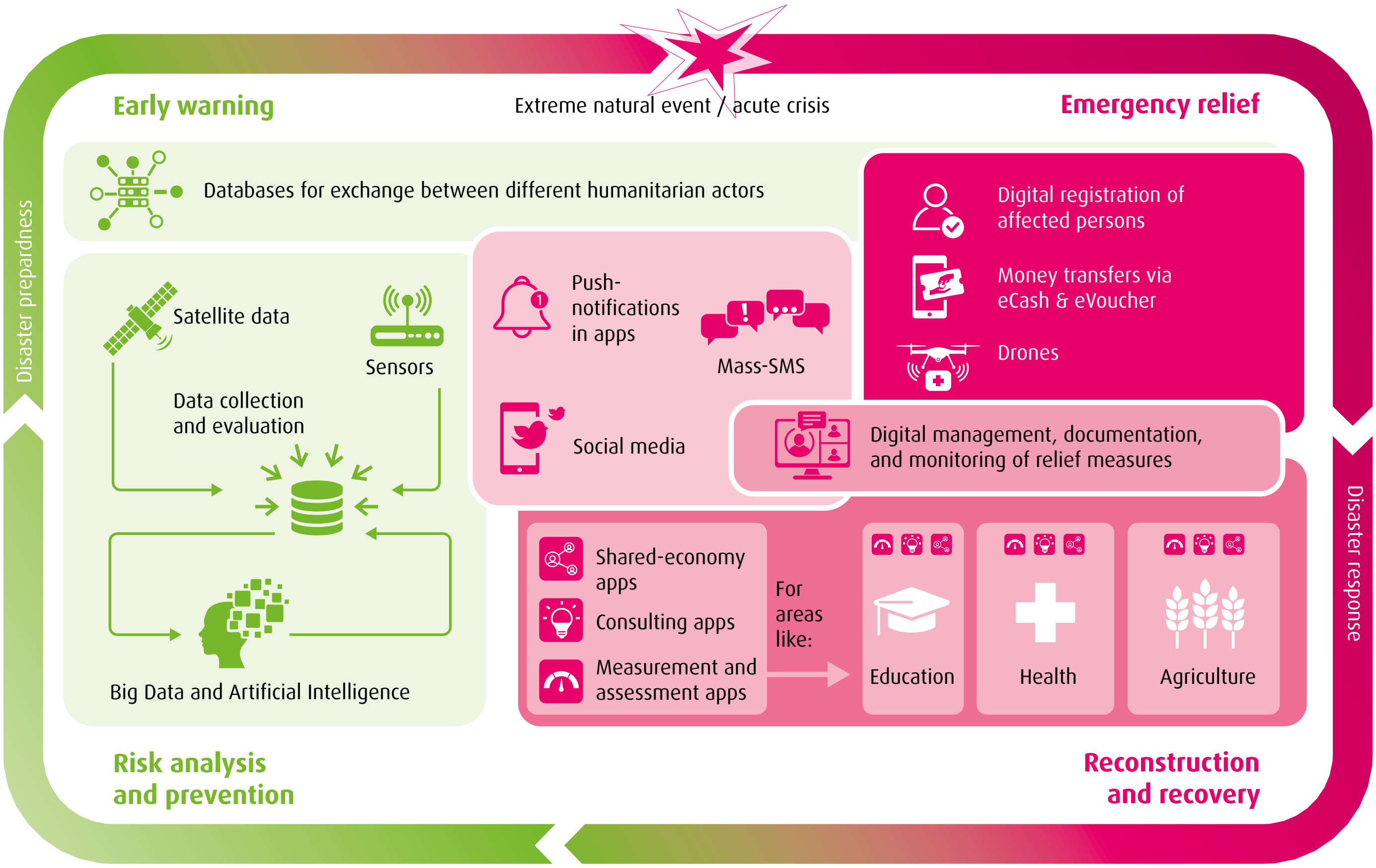

Figure 3: Utilization of information and communication technologies for analysis, assessment, coordination, and implementation in the phases of disaster management

society, organize politically, and express their opinions. Nonetheless, they are misused for hate speech, manipulation, and the authoritarian preservation of power. They provide freely available information at any time and allow knowledge to be shared easily. Access to it, however, requires the necessary infrastructure as well as the skills to consume, process, and communicate knowledge. Unequal participation in digitalization threatens to entrench existing power inequalities. On the one hand, they form the basis for innovations and the economic rise of diverse business models, on the other hand, giant tech corporations predominantly from the Global North dominate the market, set their own standards, and threaten to escape state control. Digital technologies for the rapid and accurate recording of environmental conditions enable precise predictions of impending natural events and their effects and form the basis for new protective measures such as weights on roofs controlled by algorithms to protect against earthquakes (Sauer 2022). Fewer car trips and flights due to digital working also contribute to a lower carbon footprint. On the other hand, digitalization requires massive amounts of energy as well as raw materials and accounts for around four percent of CO2 emissions worldwide – with a rising tendency. Often short-lived technical devices require quantities of raw materials, production facilities consume energy and pollute the environment with harmful substances (Grefe 2020).

The list of opportunities and risks makes it clear that digitalization is neither a perfect enabler of equality, participation, prosperity, or climate neutrality, nor a superfluous modernization process with no potential for social change. Its ambivalent impact must be viewed from different angles. An active political shaping of digitalization is indispensable in order to manage it and its effects. Central questions must be: What are the benefits of digitalization, who benefits from it, and at what price?

Digitalization in the context of disasters

What applies to digital technologies in general is also evident in the context of disasters: Digitalization has created new opportunities in all phases of disaster management – but not without downsides. ICTs used by people provide important data for risk analysis, make essential information available in the event of an emergency, and accelerate the start of relief measures. They also provide tools in the fight against hunger, poverty, and social inequality, as well as for improved healthcare and educational opportunities, and consequently also for sustainable development and reduced vulnerability. At the same time, the increasing use of, and thus dependency on, digital technologies leads to challenges and risks. Digital infrastructure is susceptible to damage from extreme natural events, digitized data on aid recipients can be more easily misused, and disinformation can undermine protective measures in the event of a disaster. Digitalization has also changed the way humanitarian actors communicate, implement projects, and collaborate. The digitalization of disaster management therefore refers to changes brought about by, first, the integration of ICT into the daily operations of humanitarian actors, second, the massive datafication of disasters, that is, the transfer of information on disasters and disaster relief into machine-processable formats, and third, the provision of digital technologies, such as drones and digital money.

The following articles on the focus topic also concentrate on these very changes. They explain which technologies are already being used in disaster management, highlight existing challenges as well as emerging risks in their use, and identify areas for action. While Atwii (Article 2.1) describes which types of ICT are already being used for which purposes in practice, Paragi and Sandvik (Article 2.2) offer a holistic overview of the risks of digitalization in disaster management and warn of “endless new vulnerability.” Schneider (Article 2.3) analyzes unequal access to ICT and illustrates how digital divide(s) limit the potential of digitalization for localizing disaster response and instead entrench existing power inequalities.

What's more?

Digital technologies are not per se beneficial, nor do they automatically contribute to a reduction in vulnerability. They bring with them challenges and risks that must be addressed. ICT should be used in a targeted manner where it brings added value and not out of pure pressure to digitize and innovate. We can assume that the use of ICT will also continue to expand in disaster management. The following therefore applies in particular to humanitarian organizations: they must align the design and deployment with the interests of those affected. Such digitalization can only be implemented in a more local, socially just, and climate-conscious – and possibly gentler – way. Whether a new digital world order, negotiated primarily in the circle of the G7, is the right way to achieve this is at least questionable (Hilbig 2022). As will become clear from the following articles, there is plenty of need for action, and civil society still has the task of critically accompanying the process, facing up to the ethical debates, and acting accordingly.

The Concept of the WorldRiskReport

Figure 4: The WorldRiskIndex and its spheres

Concept of 'risk' and approach

The risk assessment in the WorldRiskReport is based on the general notion that the emergence of a disaster not only depends on how severely natural hazards hit a society, but also on how vulnerable society is to their effects.

Risk assessment

The WorldRiskReport includes the WorldRiskIndex, which Bündnis Entwicklung Hilft developed in in cooperation with the United Nations University in Bonn and published in 2011 for the first time. This year, Bündnis Entwicklung Hilft and the Institute for International Law of Peace and Armed Conflict (IFHV) of the Ruhr University Bochum, which is co-publisher since 2018, present the WorldRiskIndex in a fundamentally revised form (more on this in Chapters 1 and 3). The calculation of disaster risk is done for 193 countries worldwide and based on the interaction between the spheres of exposure and vulnerability (see also Figure 4 above):

+ **Exposure** to earthquakes, tsunamis, cyclones, coastal floods, riverine floods, drought and sea-level rise
+ **Susceptibility** depending on socio-economic development, social disparities and deprivations, and the weakening of the population through violence, disasters, and diseases
+ **Lack of coping capacities** related to social shocks, political stability, health care, infrastructure, and material security
+ **Lack of adaptive capacities** related to developments in education and research, reduction of disparities, investments, and disaster preparedness.

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, discrepancies in data quality between different countries may occur if data is only gathered by national authorities and not by an independent international institution.

In addition to the data section, the WorldRiskReport always contains a focus chapter examining background and context from a qualitative perspective – this year's topic is "digitalization".

The aim of the report

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

2 Digitalization

2.1 Digitalization: Trends in Disaster Relief

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Team Innovation,
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Digitalization has become an integral part of disaster relief: Satellites provide data on extreme weather events, warnings of disasters are integrated into apps, and information on disaster management is provided via mass SMS and social media. Based on practical experience, the article gives an overview of a variety of digital technologies already used in disaster relief and, by the example of trends in data collection, interaction with affected people, and cooperation with other actors, shows how disaster relief has changed as a result of these digital technologies and the challenges which their use entails. In addition to evaluations by Welthungerhilfe and expert discussions with staff, the perspectives of those affected have also been incorporated into this article through individual interviews.

Increasing digitalization is changing the way disaster relief is delivered worldwide (Akhmatova et al. 2020, 1), promising an increase in efficiency and effectiveness. Disasters are on the rise - especially those caused or exacerbated by climate change. The gap between required and available financial resources for disaster relief is growing, making it essential to optimize relief services without making access to aid too complex for affected persons (Veron 2022, 1). Currently, three digitalization trends can be identified in the sector, which will be discussed in more detail below: (1) improved data collection and analysis for forecasting and disaster response, (2) digitalization in interaction with affected people, and (3) the indispensable expansion of cooperation in the digital field with known and new actors.

Improved data collection and analysis

The exponential growth of information and communication technologies (ICT), such as sensors to automatically monitor environmental impacts, publicly accessible data collections, and new Big Data analysis techniques with artificial intelligence enable far-reaching possibilities in predicting disasters (Bettini et al. 2020, 8-11; Veron 2022, 2). Potential disaster vulnerabilities and the needs of communities can be assessed, which allows early counteracting with preventive measures and consequently a reduction of the impact on those affected (Veron 2022, 2). Decisionmakers are equipped with more reliable forecasts to allocate resources accordingly (Ranasinghe 2019, 149).

A major challenge for the development of more reliable forecasting models is the collection and storage of high-quality data over longer periods of time. Often, one source of information alone, such as satellite data, is not sufficient, but must be combined with, for example, soil data (Cheney 2021). At this point governmental and non-governmental actors often reach their technical limits. Data science is a highly specialized field, and many professionals prefer jobs in the private sector as they often offer higher salaries. One example: In 2016, the Cambodian Disaster Management Committee lost 70 percent of all data collected between 1996 and 2013 in their disaster information system 'CamDI', which was considered a pioneer until then. The data had not been adequately backed-up due to limited staff knowledge during a technical transition (Bettini et al. 2020, 8; NSTC 2016).

ICTs using the Internet of Things, biotechnological innovations, cloud computing, drones, sensors, and robotics have great potential for providing the data required for predictive models for use in agriculture. These ICTs generate tremendously valuable data daily that can be used for predictive models. Although there are signs that their use for agriculture continues to grow globally, the technologies can currently not be widely deployed due to high costs, especially by smallholder farmers, particularly in Africa (Jellason et al. 2021, 1-7). In forecast-based humanitarian action, which is steadily increasing, such geodata is already being used to initiate targeted measures to combat damage caused by extreme natural events at an early stage (see box page 21).

Another problem is that data generated by ICTs is often not publicly available. Only developers and users of the technologies have access (Grain 2021). A positive development is that innovative ways have been initiated to close data gaps. One example is the NASA Harvests 'Helmets Labeling Crops'-project, which uses vehicle-mounted cameras to collect geodata on the condition of crops. However, such geospatial data is only as valuable as the accompanying actions taken to use its insights. There is often a lack of powerful computers and data scientists who translate data into recommendations for action (Cheney 2021).

In addition to using data for forecasts, various digital data collections are also used in actual disaster situations. Drones, for example, are increasingly used to get an overview after an extreme natural event (Akhma tova et al. 2020, 3). Mobile phone data is increasingly being used to model migration flows. Every call over the mobile network from people in danger areas generates a data record with phone number, time stamp and cell tower. Currently, such data is mostly analyzed after a crisis, but real-time analyses as well as algorithm-based predictions will be available in the future (Bettini et al. 2020, 11f). Furthermore, mobility reports generated by Google since the beginning of the coronavirus pandemic provide an overview to monitor measures implemented by governments (Google 2022). However, as mobile patterns are culturally diverse, data can sometimes be nonspecific. Examples include single mobile devices being used by multiple people, devices being turned off for long periods of time, or certain features such as GPS or mobile data usage being disabled. In general, the use of mobile data in humanitarian action is highly controversial, especially where anonymity is important for vulnerable groups (Bettini et al. 2020, 11-16; see also Article 2.2).

Another trend in disaster data collection is crowdsourcing, whereby people in the affected area deliberately provide data themselves – usually via social media and micro blogs – which is then used in analyses. After the earthquake in Haiti in 2020, for example, information provided by users about the extent of the damage and the aid already received was used to coordinate relief efforts. In the same year, real-time flood mapping was created in Jakarta based on Twitter feeds. One challenge of crowdsourcing in disaster management is the lack of sufficiently available technical skills in most relief organizations (Bettini et al. 2020, 8f).

Digitalization in the interaction with affected persons

Driven primarily by donors, aid organizations are using digital registration of affected persons more frequently, as this promises greater transparency and accountability. As a result, digital registration is increasingly becoming a prerequisite for accessing aid. Registration software is continuously more linked to e-cash or e-voucher systems, allowing efficient processing of aid. As donors often have preferences and one system alone cannot handle all forms of aid, aid organizations often use multiple digital systems (Akhmatova et al. 2020, 2). For example, Welthungerhilfe uses

‘SCOPE’, ‘RedRoses’, and ‘GenTag’ settlement systems that enable registration, cash transfers, and voucher processing. In addition, a proprietary database was developed in-house for refugee projects in Turkey, but it is being replaced by a new standard monitoring system because the software is becoming too costly to maintain and was designed for a single project, making it difficult to scale (interview with Ausama Almorei).

In addition to processing systems, aid organizations use digital software to monitor aid activities. With programs such as ‘Field Buzz’, ‘AkvoFlow’, and ‘Kobo Toolbox’, measures, for example the distribution of relief supplies, are registered directly via a smartphone and can be tracked centrally via a dashboard. Furthermore, by collecting survey results in apps, the impact of and satisfaction of affected persons with aid measures provided can be evaluated. Digital enrollment of individuals also provides access to a digital identity for people who do not have identification documents. Linked with biometric information, these digital ID capabilities increase processing speed and reduce fraud.

Significant optimizations in registration and processing systems are expected in the coming years, and crosslinking with additional digital apps will improve the impact of aid. For example, Welthungerhilfe is developing the ‘Child Growth Monitor’, which will allow an assessment of children's nutritional status using visual data. Coupled with registration and processing systems, such an application in disaster settings can help identify children whose nutritional status is critical at the time of initial registration.

Instead of individually developing new software for specific projects, donors, or contexts in-house, greater emphasis should be placed on standardizing functions on a modular basis in the long term. Here, a balance must be found between the digital mapping of all processes and the scalability of the software. It should be possible to choose between different price models, because not every organization can afford biometric data capture or has expert staff. In addition, requirements for data protection conditions – which can change abruptly within a country – make it difficult to use different software products within an organization at the same time (Veron 2022, 5; interview with Sherinah Ngabo). Therefore, software providers for the humanitarian sector who understand how to implement the requirements of internal and external data exchange, data backup, and modular adaptability by third-party providers are likely to prevail in the coming years.

Moreover, the provision of aid has also changed through digital technologies. For example, in-kind assistance in the form of relief goods is increasingly being replaced by voucher- or cash-based aid. Such payments are more efficient and strengthen agency of affected people as well as local markets (Burton 2020; Cohen / Salaun 2017, 158f). To ensure both, inclusion of all affected people and data protection, agility in implementation as well as continuous adjustments of measures are needed. Furthermore, new competencies need to be built within the team to manage financial flows (Burton 2020; Cohen / Salaun 2017, 158ff). Collaborating with private sector actors in finance and technology for the further development of apps requires adjustments to organizational processes in aid organizations which change the internal distribution of power, resource allocation, and performance evaluation. At the same time, traditional in-kind support for affected people will continue to be needed where local markets do not provide sufficient goods, or the technological infrastructure does not work. In-kind support is optimized through digital innovations – particularly in supply chain monitoring (for example ‘TraceRX’) and the expansion of sharing economy options (Cohen / Salaun 2017, 170ff). For example, Welthungerhilfe's ‘AgriShare’ app in Zimbabwe, Uganda, and Malawi offers the option of booking transport through locally registered truck drivers, who can also be mobilized quickly in the event of a disaster.

Digital communication channels are also expanding and modifying the exchange of information and forms of interaction with those affected. During the Covid-19 pandemic, it was possible to reach over 30,000 households in Zimbabwe in a very short time via mass SMS and to send audio messages with information about the virus and preventative measures via WhatsApp (interview with Nigel Gambanga). This was only possible because the Welthungerhilfe country team had already established phone lists and WhatsApp groups in advance of the coronavirus pandemic. In order to use digital approaches for communication in times of crisis, the required digital skills must already be developed and integrated into prevention programs with those affected.

In Uganda, Malawi, and Zimbabwe, Welthungerhilfe makes use of three agricultural extension apps, which have a combined total of over 100,000 users, and tries to link those apps to early warning systems in the countries in order to facilitate a timely dispatch of alert messages in an emergency. Integrating the concerns of refugees into such apps by translating content into different languages is beginning to bear fruit in Uganda. This is particularly useful in the case of long-term crises when adaptation strategies need to be developed.

Cooperation and new technology partners

Coordination and cooperation are essential for disaster management. Lack of communication between humanitarian actors can lead to obstacles. As the expertise of experts, practitioners and researchers from different disciplines is required in the event of a disaster (Badarudin / Ibrahim 2021, 13), shared information systems and knowledge management are indispensable. However, elaborate organizational processes can complicate immediate aid, which is why also digital processes in a project must be geared to the well-being of the affected people and are subject to the 'do no harm' principles (Badarudin / Ibrahim 2021, 13; Steinacker et al. 2021, 107; Veron 2022, 5). To this end, digitalized systems must have internal control mechanisms that continuously evaluate the consequences of their use and intervene in the event of possible (unintended) negative consequences and include a right of complaint for affected persons (Steinacker et al. 2021, 107).

Digital Registration

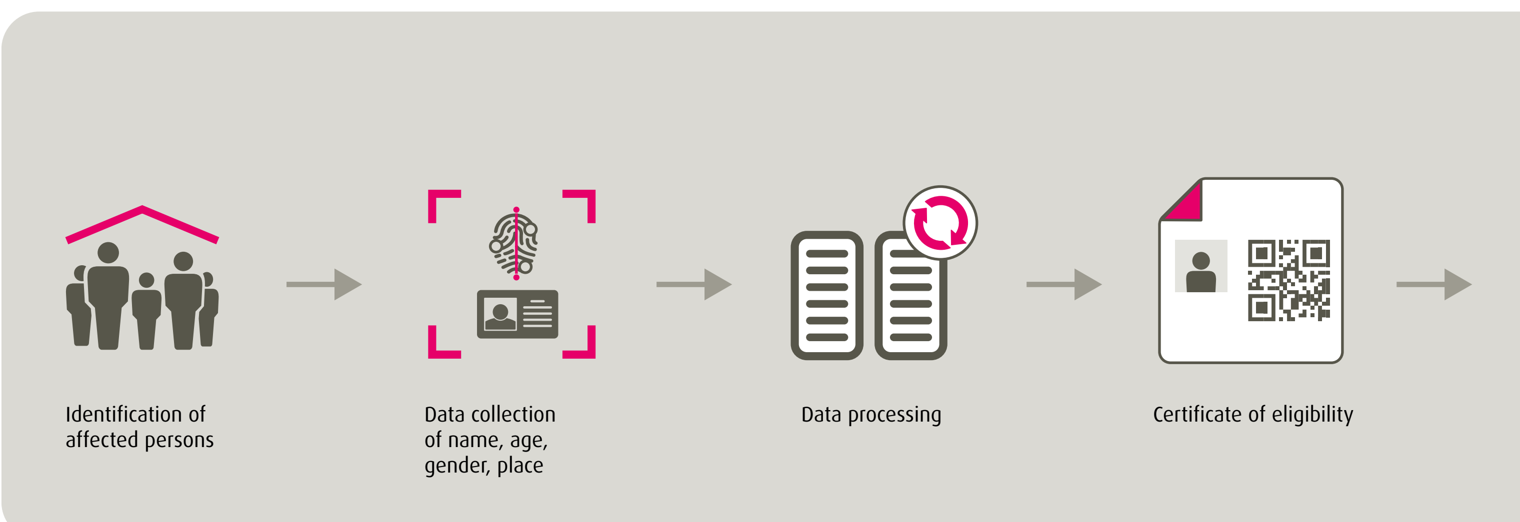


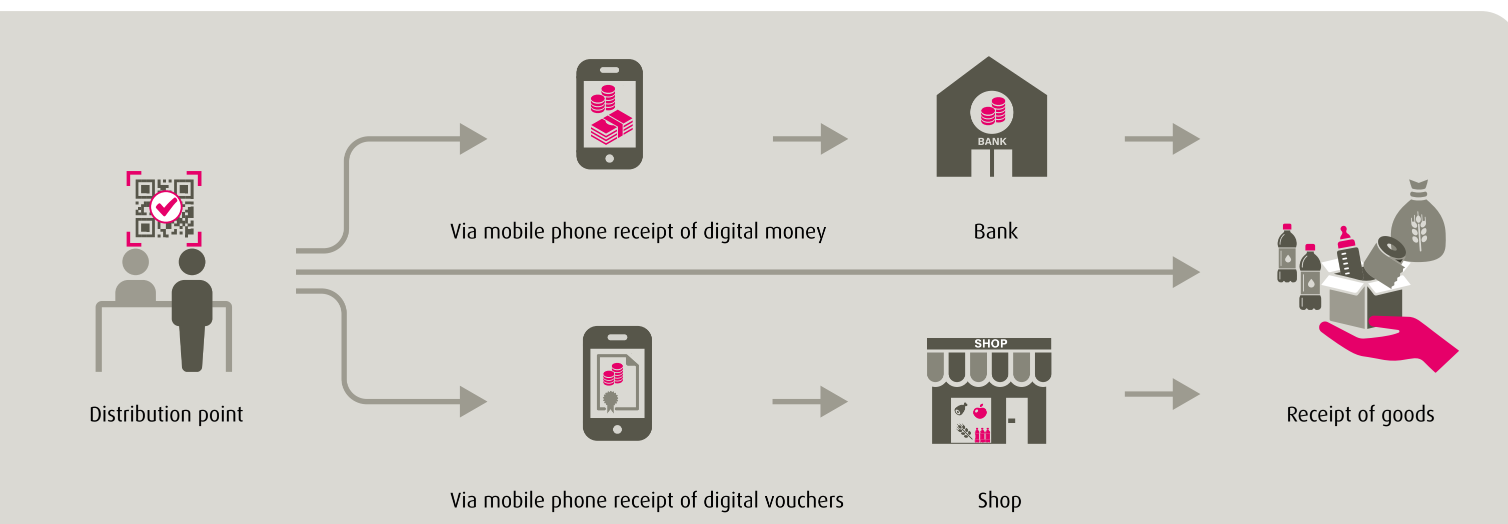
Figure 5: Registration of affected persons in digital systems for access to relief measures

In cooperation with other actors, the use of digital technologies can lead to inefficiencies, for example, if data sets are not compatible with the system used by an organization and, as a result, data collected by one organization cannot be used by another. People affected by a disaster may be listed twice if different registration systems are not reconciled (Veron 2022, 5). Data-sharing platforms such as HDX, where status reports, analyses, and datasets on humanitarian operations are readily available for all actors, need to be promoted and further developed to make them usable across organizations.

Attempts by disaster relief stakeholders to standardize data protection requirements have led to the creation of various initiatives such as the Humanitarian Data and Trust Initiative, DigitHarum, the ID 2020 Alliance, and the Harvard Humanitarian Initiative. However, instead of unifying, a multitude of non-interlocking guidelines are currently available, with partly different information. Unified privacy standards in the humanitarian sector would also be an important step towards collaborating with partners like Microsoft and Amazon with external new technologies on which humanitarian organizations increasingly rely. Without data protection standards that are cross-sectoral and responsive to the needs of those affected, there is a risk that technology giants in partnerships will use data inappropriately (Veron 2022, 7; Akhmatova et al. 2020, 1; Grain 2021). At the same time, without collaborating with such technology partners, humanitarian organizations cannot adequately leverage the potential created by their provision of data and calculation of forecasts (Grain 2021; Veron 2022, 8). Therefore, it is important that the sector agrees on a data protection standard as soon as possible and enforces it consistently.

Conclusion

The (further) development of early warning systems and disaster management requires more open data (Grain 2021). Instead of developing digital solutions within the organization, aid organizations should rely on shared systems managed by competent technology partners (Veron 2022, 7). The utility of generated information is dependent on the quality of the data when it is fed into the system.



Interviews conducted by the author (order as in the text):

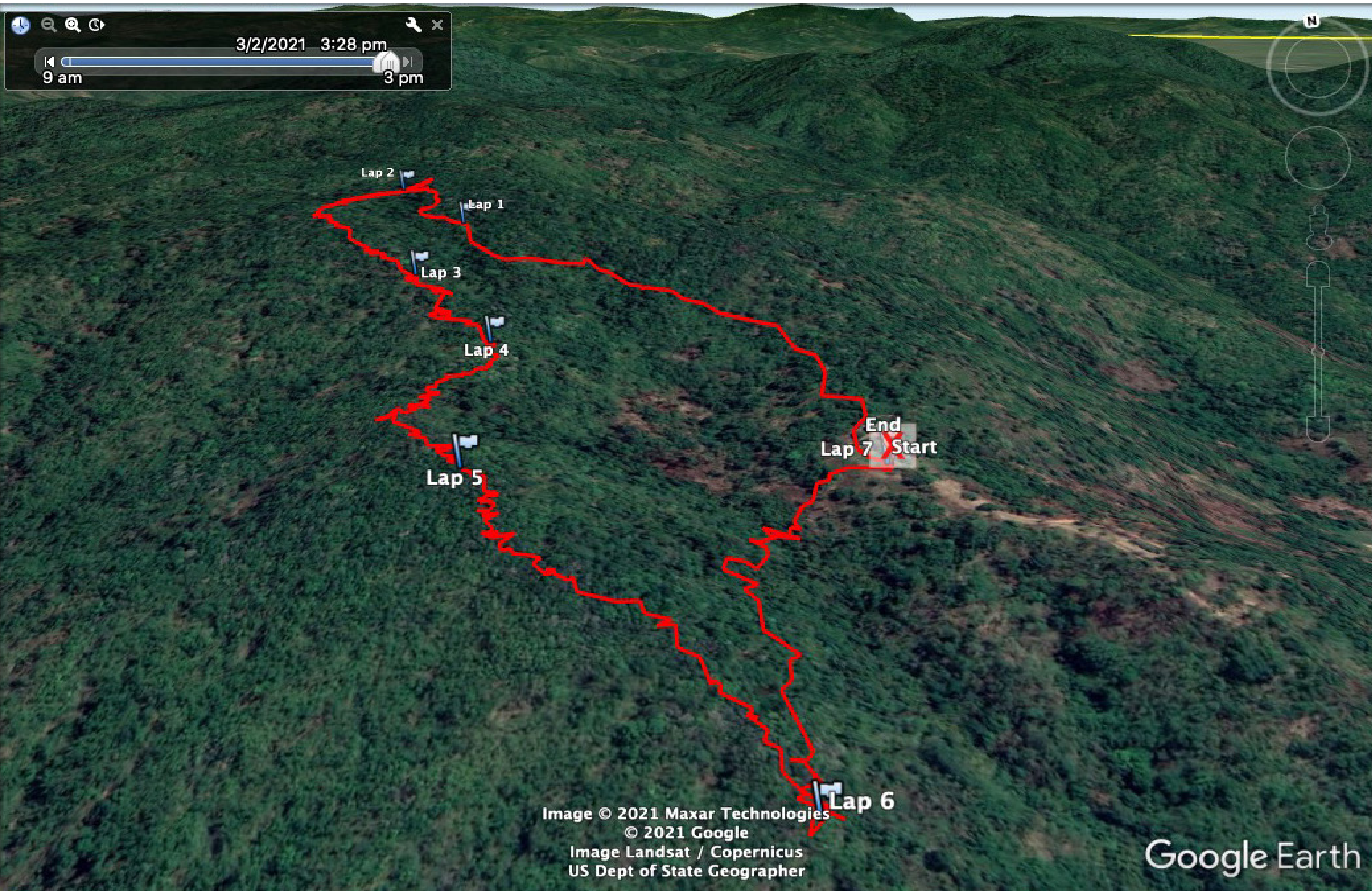
Online interviews with Ausama Almorei, IT lead Welthungerhilfe Turkey, 04/19/2022 and 04/25/2022.

Online interview with Sherinah Ngabo, ICT4D consultant Welthungerhilfe Uganda, 04/19/2022.

Online interview with Nigel Gambanga, ICT4D communications consultant Welthungerhilfe Zimbabwe, 03/29/2022.

Online interview with Dominik Semet, Program Coordinator Forecast-based Action Welthungerhilfe, 03/29/2022.

Therefore, agile co-development of the software by organizational units that enter the data and those affected is required. The software must be aligned with the needs of those who will ultimately benefit from the software and not be solely based on the information required from the perspective of the aid organizations (Bettini et al. 2020, 9; Grain 2021). Findings about which digital techniques work in which contexts need to be systematically documented so that they can continue to be used and, if necessary, in a more targeted way (Veron 2022, 8). Here, donors, in particular, play a crucial role. They must provide the resources to drive the expansion of digital technologies and their application for rapid and effective disaster relief (Veron 2022, 1; interview with Dominik Semet). This will require more flexibility in future aid funding, based increasingly on forecasts and data generated in the field.



Open Data for Forecast-based Action

Forecast-based Action uses detailed hazard and risk analyses to identify extreme weather events such as droughts in due time and thereby enables the people at risk to respond to impending crises through early action. The financing of assistance is guaranteed by the donors before a crisis occurs. In so-called Early Action Protocols (EAP), the allocation of funds and the responsibilities of those involved are determined. This ensures rapid and efficient action before an imminent danger turns into a disaster with high damages and losses. Welthungerhilfe has been engaged in this field since 2015. With financial support by the German Federal Foreign Office and in cooperation with local partners, Welthungerhilfe is now pursuing this approach regarding droughts in multiple projects in Kenya, Madagascar, and Zimbabwe.

Data basis and data access

For Forecast-based Action in droughts, it is necessary to understand the different drought risks in the affected regions. Based on open data from global long-term observations of indicators – for precipitation amounts, soil dryness, and water availability of plants – past drought events are analyzed to generate insights for current drought monitoring. The indicator used by Welthungerhilfe is the Water Requirement Satisfaction Index (WRSI). The WRSI indicates the soil-dependent water supply level of agricultural crops over the course of the growing period. The WRSI is calculated within the framework of the GeoWRSI of the Climate Hazards Center at UC Santa Barbara, a software program performing crop-specific water-balance-modeling using satellite data. The GeoWRSI software with the satellite data is freely accessible. As a result, humanitarian organizations can even create their own long-term data sets for a historic analysis of past droughts and use the possibility of this open data themselves. Supplementary to the satellite-based WRSI data, publicly available precipitation observation data from local meteorological services is used. The combined use of these data sets helps to validate the GeoWRSI results.

Data analysis and measures

Based on the WRSI, Welthungerhilfe assesses which areas of the project countries were particularly frequently affected by drought events and how the WRSI data of the locally used staple crops have developed over the decades (10-day measuring intervals) along the vegetation period. From these analyses, WRSI thresholds are defined at which a drought event and subsequent water-related damage to staple crops and harvest losses are to be expected. These thresholds are incorporated into the respective current drought monitoring. They serve as an alert mechanism and lead to the activation and implementation of the EAPs, including the financial resources allocated for this purpose. Within the development of the EAP, vulnerability studies are conducted to analyze how harvest damages and harvest losses will affect a certain population. In Madagascar, for example, cash assistance was transferred to particularly vulnerable households when the drought threshold was reached in spring 2021, even before harvest failures led to food insecurity. The cash assistance was provided via digital transfer to accounts on mobile phones, which the households had previously received and were assisted in using. This credit can be exchanged for cash or used as a means of payment in shops. After the completion of this forecast-based drought assistance in Madagascar, the mobile phones remained in the households and communities for further use.

Dominik Semet
Program-Coordinator Forecast-based Action, Welthungerhilfe

Julia Burakowski
Advisor Forecast-based Action, Welthungerhilfe

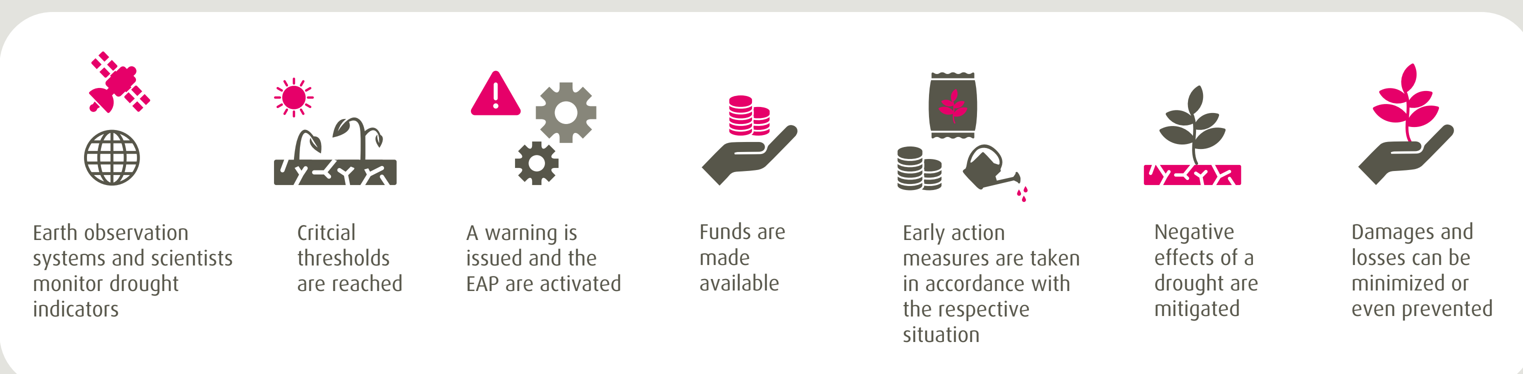


Figure 6: From traditional humanitarian aid to Forecast-based Action

WorldRiskIndex Rank 46

Risk high	11.17
Exposure high	2.08
Vulnerability very high	60.00

Cameroon

Digital Cash Transfer without Barriers

Country profile

The Republic of Cameroon, with approximately 27.2 million inhabitants, is at the crossroads between West and Central Africa. The country is shaped by different climate zones and is affected by recurring extreme events. Floods and droughts, particularly in the north and southwest, occur regularly. Cameroon is located in a seismically active region – volcanic eruptions and earthquakes also pose risks to the population. The vulnerability regarding extreme natural events is very high according to the WorldRiskIndex 2022. Especially in rural areas, the basic supply of the population is often inadequate and severe poverty is widespread. Since the 2000s, Cameroon has undergone slow and steady economic strengthening, but has suffered from increasing social, ethnic, and political tensions in recent years. Its population of the northern border region towards Nigeria is confronted with acts of violence by the Islamist terrorist group Boko Haram since 2013. In the east, the care for refugees from the Central African Republic challenges the state structures and the population. In the southwest and northwest, violent clashes between the government and separatist groups have been occurring since 2017 as a result of an ongoing socio-economic crisis. The crisis has led to massive displacement, which has severely affected children, women, elderly people, and people with disabilities.

Context of the project and project activities

Cash transfers have been established in recent years as an effective and flexible transfer modality in humanitarian emergencies, as long as local markets function sufficiently. A challenge is that

Situation on digitalization

27,224,262
Inhabitants (2020)

Mobile phone subscriptions per 1,000 persons
841.95

Broadband subscriptions per 1,000 persons
27.22

Literacy rate (>15 years)
77.1 %

Population with at least secondary education
37.3 %

people with disabilities are often excluded from these distributions due to various barriers. This is shown by analyses of the Christian Blind Mission (CBM) and self-advocacy organizations of people with disabilities. Therefore, it is of great importance to engender inclusive designs of the programs by, for example, facilitating the distribution directly at places of residence so that wheelchair users or visually impaired people must not rely on transport assistance to a bank or central distribution point.

Since 2021, CBM has been jointly providing humanitarian aid in the health and protection sectors in the Northwest Region with its local partner organization Cameroon Baptist Convention Health Services (CBCHS). One component of the project is the inclusive and digital cash distribution on mobile phones for 2,590 vulnerable persons. The cash transfer in the amount of 40 euros was provided once in March 2022 and pursues the goal of enabling the considered persons to realize their most important needs in a self-determined manner. The transfer was targeted at internally displaced persons, refugees, and members of hosting communities who are affected by the socio-economic crisis in the project region. 79 percent of the beneficiaries are women, 25 percent are persons with disabilities.

The country-specific systems required to implement the cash transfer are provided by CAMCCUL (Cameroon Cooperative Credit Union League), a local provider for financial transactions. CAMCCUL is verified and accredited by the Central African Banking Commission and has a broad representation in the communities of the project region as well as a high reputation with international funders and finance institutions. CAMCCUL transfers the credit via MTN Mobile Money, a payment system widely used in Cameroon, directly to the MTN accounts of the beneficiaries, which are linked to their mobile phone numbers. After a successful money transfer, the recipients are notified via SMS and can immediately exchange the credit for cash, forward it to other accounts or use it to pay in shops. Importantly, the easy handling does not require any prior technical knowledge. Moreover, simple mobile phones are sufficient, and the transfer is completed even if the SIM card is not inserted or the device has no mobile phone signal at the time of the transfer – although the mobile network is well developed in the Northwest Region. CAMCUUL records and manages the payments through a central database and is responsible for securing the data and transfers. CBCHS and CBM are informed when accounts are inactive and receive a full transaction report of all payments.

Results and effects

CBM and CBCHS faced challenges in the selection of the target group, implementation, and monitoring, which generated important insights for future activities. For example, about 5 percent of the selected people did not have their own mobile phone and referred to the phone number of a trusted third party – this, however, was not recorded in the data set and contradicts the objective of reaching beneficiaries directly. It should also be emphasized that the digital technologies used were not entirely barrier-free as classic mobile phones, for example, are not easy to operate for people with physical impairments such as visual impairments. Therefore, the transfer modality was individually adapted in the case of individual impairments: The amount was handed over to the affected persons at their place of residence in cash by CAMCCUL and post-recorded digitally within the billing system.

According to the component's evaluation, the inclusive cash transfer contributes significantly to the ability of the selected persons to meet their individual needs in local markets. The credit was used for, inter alia, food, medical care, and newborn care. This reduced their vulnerability regarding future crises. At the same time, it became clear that cooperation with a locally accepted service provider is essential for the digital cash transfer. The documentation and evaluation confirm that the project's approach is a suitable model for further inclusive cash transfers. To promulgate the inclusive approach and thereby contribute to an inclusive transformation of humanitarian cash transfers, the inclusive model has been presented both to the Cameroonian government and, on a continuous basis, in the Cluster System of the United Nations and Cash Working Groups. The inclusive model was presented to the Cameroonian government as well as continuously in the cluster system of the United Nations and cash working groups in order to spread the approach and thus contribute to an inclusive transformation of humanitarian cash transfers.

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2.2 Digital Risks in Disaster Situations

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Digital risks may be associated with the design, testing, deployment, operation, and use of technologies, the regulatory environment, and their impact as a result of digital transformation. This article provides a typology of digital risks, focusing on endogenous (internal), exogenous (external), and complex risks, involving the interplay between technology, politics, social practice and human involvement. As implied, risks related to digital transformation entail a radical centralization of vulnerability, in terms of the collection and consolidation of disaster response data, with unclear implications for accountability and the 'do no harm' principle.

Digital risks in disaster contexts are many and varied as strategies for disaster risk reduction and response are increasingly digitized. While risk in general refers to a situation or event involving exposure to danger, threat, harm or loss, digital risks are associated with the design, testing, deployment, operation, use and regulation of technologies, and their impact on human lives and social relations. Typical digital risks involve cybersecurity issues, privacy and data protection breaches, lack of digital literacy (on the affected user side), or lack of organizational and political leadership (on the grant making, regulatory, and implementing side).

In 2013, the IFRC World Disasters Report examined the broader dimensions of technological risks and the implications for accountability and transparency (IFRC 2013). A decade later, the focus has shifted to risks emanating from the digital transformation of the aid sector and the vast datafication of disaster preparedness and response (Al Achkar 2021). The digital risks and the ethical quandaries arising in different humanitarian emergencies, such as conflict, urban violence, or disasters overlap, but are not the same. This article focuses specifically on digital risks in the context of disasters and disaster responses, at the core of which is data.

The article argues that the collection and consolidation of disaster response data and the promulgation of vast digital infrastructures for aid centralize vulnerability and create new targets. For example, the central role of digital infrastructures in control of food systems, water management, weather forecasting as well as early warning systems for natural hazards – along with modeling for infectious disease outbreaks, oil spills and air pollution – engenders structural vulnerabilities. In case of a crisis, disaster responders may also have their operations hampered and undermined through digital manipulation and cyberattacks. Data breaches, surveillance, and the misuse of social protection schemes may have severe consequences for individuals and communities in crisis. The implications for accountability and the 'do no harm' principle are unclear.

Providing a three-part taxonomy of digital risks in the context of disaster response, this article supports practitioners and policymakers in developing analytical frameworks for recognizing and addressing digital risks and engaging in processes of ethical reflection. We divide risk into three overarching and to some extent overlapping 'ideal-type' categories: endogenous (or internal) risks are embedded in the technology itself. Exogenous (or external) risks originate outside of the technology and are determined by the regulatory environment. Complex risks go beyond the digital space to include the interplay between technology, politics, and social practice.

The problems of technology: risks associated with design and functionality

Endogenous or internal risks are risks embedded in the technology itself by design, features, and functionality, so they can be eliminated only by delinking from the internet (in general) or not having or using a technology (in particular). They may be latent in the physical infrastructure enabling access to the internet and the use of digitalized technologies, the design of source codes, algorithms, or that of artificial intelligence (AI) – or they may result from intended or unintended events, such as cyber-attacks, lightning, power failures, etc. An inventory of such risks includes, but is not limited to the following:

Digital infrastructures affected by damage to physical infrastructure (towers, cables, devices) and problems related to internet security, operability and accessibility pose risks to the functionality of other dependent technologies. Extreme natural events may result in the partial or complete collapse of terrestrial telecommunications infrastructures. This disrupts last mile deliveries and, by undermining connectivity, makes access to internet impossible and people in need unavailable to rescuers. For example, it took five weeks to reconnect Tonga after the volcanic eruptions in 2021 ruined the undersea networks enabling internet access (Scarr et al. 2022). In case of satellite internet, ground terminals or dishes can also be destroyed, even if satellites providing access to internet signals are in space. Similarly, early warning systems fail if measurement stations are destroyed, and as a result, data is not transmitted in due time.

System failures or downtime can occur for a diverse set of reasons (cyberattacks, human error, poor connectivity) and may endanger the normalcy of IT-operations at any business, preventing contact between individuals and relief workers. Disturbances in digital humanitarian supply chains, breakdowns or shutdowns of IT as well as Internet of Things (IoT)-based systems (UNOCHA 2021, 26) lead to delays in access for disaster responders, which can be particularly problematic in case of famine (Jaspars et al. 2022, 11).

Cloud storage risks refer to a weakening control over or unauthorized access to (personal) data, unintended loss or leakage of data, the use of shared servers and related conflicts of interests.

Login options and access rights coupled with the multiplicity or diversity of entry points to the IT systems, the dearth of proper authentication procedures and BYOD (bring your own device) practices may engender digital risks by providing open doors in case of cyberattacks.

The risks of automation include errors or deficiencies in training data, inadequate human understanding of source codes and algorithms, compatibility problems across systems – but also increasing reliance on machine learning (ML) or AI in decision-making processes. Algorithmic bias may result in (un)intentional or incorrect exclusion from or limited access to assistance, reinforcing ethnic, gender, or socio-economic inequalities and strengthening existing power structures/imbalances (UN OCHA 2021, 10). With respect to the emergent requirement of explainability, especially with regards to AI, there will be an increasing gap between users' human comprehension and the skills needed to understand how ML / AI works and how tech-based decisions are made.

Technology at work: risks related to the regulation, adoption and integration of digital tools

Exogenous, or external risks result from how technology, its design, use and deployment is regulated, adopted, organized and integrated into disaster response. These risks are co-constituted through legal regulation, and the behavior of state/government and market actors. In particular, this concerns the governance of critical digital infrastructure.

Compliance risks for responders are diverse as digital transformation cannot be separated from the legal and political context. The complexity of the regulatory-legal environment and the inconsistencies across various jurisdictions as well as the inadequate or insufficient understanding of laws regulating organizational standards entail risks for disaster responders. Breaches of privacy and personal data, those of national (cyber)security regulations, may entail reputational hazards, fines, penalties, or even the suspension of operation. Specific regulatory access issues affect certain technologies, for example drone-access to civil airspace.

Coordination and communication problems between partners, or between the IT department and other organizational units overseeing the core activities within a humanitarian organization, may entail hidden risks. Reliance on understaffed IT departments to identify digital risks and develop solutions without adequate situational awareness, contextual understanding, participation by affected groups can also create digital vulnerability. Similarly, digital shortcuts implemented in the name of emergency or urgency can reinforce vulnerabilities.

The involvement of private actors is radically reshaping disaster response and carries a diverse set of digital risks. Whether they act as contractors, suppliers, or service providers, their involvement may compromise the security of the IT infrastructure by increasing the digital vulnerabilities with the humanitarian organizations. Intellectual property rights, competition concerns, and commercial interests held by Big Tech – even in disaster contexts – means that how technologies work, and how personal data is protected is not subjected to meaningful public scrutiny. However, transferring personal data between humanitarian organizations, private sector developers and their donors (Kuner / Marelli 2020) may entail additional risk for data subjects depending on the circumstances (Fast 2022). Furthermore, the presence of immature startup tech companies with little or no disaster risk reduction (DRR) experience acting irresponsibly or illegally in disaster space may hinder effective response and engender mistrust in the community. When humanitarian organizations introduce experimental technology without adequate tools to measure, monitor, or correct the failures that result, this may exacerbate the burden on communities. For example, in the immediate aftermath of the late 2014 Ebola outbreak in West Africa, a range of humanitarian, academic, and technology organizations called for access to mobile network operators' databases to track and model the disease. Several organizations got access to those databases – what turned out to be both illegal and ineffective (Sandvik et al. 2017).

Thus, in a disaster-context where critical infrastructure is coupled with a struggling regulatory environment, the risk of technological failure increases. It can lead to situations where neither private sector actors, state agencies, humanitarian organizations, or providers of digital goods and services themselves acknowledge accountability for risks and breaches – nor can they be legally held responsible.

Complex digital risks: the human-technology interaction

When more digital transformation is the solution, this also shifts problem framings to problematizations serving the comprehension, intentions, interests, skills and capacities of technology stakeholders. Yet, technologies designed to enable aid organizations to work more effectively may also create risk for responders, individual users, and communities. This section highlights a set of complex digital risks arising from the human-technology interface.

Mapping crises by using various forecasting / predicting technologies (GIS: geographic information system, the location data of mobile phones, drone, or satellite images and by creating dashboards) enhances situational awareness and may make humanitarian operations better prepared and more efficient (UNOCHA 2021, 17-18). Yet, 'anticipatory crisis information' (Givoni 2021) increases the risk that aid is channeled only towards datafied areas and populations, whose needs have been already quantified and analyzed (Sandvik et al. 2014, 229; Slim 2022).

Cyberattacks or systematic digital / computerized warfare with the objective of extortion, disruption, or destruction targeting the systems or databases of humanitarian responders is an increasing operational risk, if not threat. IT-security breaches, such as ransomware, malware (viruses, worms), hacking or phishing as well as certain denial-of-service events (DoS, DDoS-attacks) could easily hamper operability (IFRC 2013, 149). System failures may also result from social engineering, manipulation of ignorant employees, or misuse by employees with system access. Actors, even governmental actors, may use kill switches intentionally in order to disrupt the operation of internet or an internet-based technology as quickly as possible, which can undermine food security when the supply chain is digitized (Jaspars et al. 2022).

The misuse and loss of (personal) data may equally mean the abuse and exploitation of (personal) data and the (internal) use of data for purposes without a documented legal basis. For example, in January 2022, it became known that the International Red Cross Committee (ICRC)'s Restoring Family Links tracing database had been targeted. While hackers entered the system in November 2021, the breach was only discovered months later (ICRC 2022). The hack affected the work of 62 Red Cross or Red Crescent national societies (of 192 in total) and compromised the data of more than half a million people (missing people and their families, unaccompanied or separated children, detainees, and irregular migrants) including personal data such as names, locations, and contact information. The loss of access had practical ramifications: When the databases were closed down, reunifications were put on hold (ICRC 2022). In conflict-ridden and fragile settings, the provision of data about the body (biometrics) is increasingly a precondition for receiving humanitarian aid (UNOCHA 2021, 20). However, personal data collected for humanitarian purposes may also entail lawful access claims by governments, where organizations or private sector partners are required to share it for non-humanitarian purposes too (UNOCHA 2021, 14). This causes reputational and compliance risks for organizations, but also violates the integrity, dignity, and human rights of affected users. Digital infrastructure containing ID registers or any kind of government entitlement program – hardware as well as software – may also be appropriated by hostile armed actors, such as in the case of the suddenly abandoned digital bodies in Afghanistan (Jacobsen and Steinacker 2021). Also, in the context of disasters, the leakage, loss, or unintended disclosure of personal data, perhaps by losing or deliberately abandoning digital devices in the context of a hasty evacuation may endanger users.

(Bio)Surveillance over populations, communities and people and their movement relies on large-scale collecting and processing of personal (biometric) data. Humanitarian organizations using those data may contribute to an increasing control over and policing of vulnerable groups by sharing them with certain national or local authorities (UNOCHA 2021, 20-22) or by expecting refugees to regularly show up for demonstrating that they have not left. A relevant surveillance risk embodied in digitalized assistance – acute in the context of famine – is exclusion. Exclusion can be politically motivated or arbitrary, if aid distribution is based on centralized digital beneficiary identification systems. However, if assessments are done remotely, people can also be easily excluded either because they do not have mobile phones or do not answer calls from unknown numbers for cultural reasons or fear (Jaspars et al. 2022, 2, 15, 19-20).

Misinformation, disinformation, and fake news can harm humanitarian actors by influencing both safety and efficiency of their operations or harming their credibility and reputation (Pearn / Verity 2022; Jaspars et al. 2022, 8). Real world complexities, political motivations or business interests may contribute to posting and sharing fake news, generating legal misinformation or misinterpretation (UNOCHA 2021, 14). Hate speech (whether individual/manual or automated) and false rumors about the intentions, actions and posts published on social media coupled with the challenges of content moderation endangers aid workers. The Ebola epidemic in the Democratic Republic of the Congo gave rise to conspiracy theories and political manipulation, which hampered efforts to treat patients and fight the virus' spread. This required extensive investments by humanitarians and public health workers to try to control the narrative and counter misinformation (Fidler 2019; Spinney 2019). On a global scale, the Covid-pandemic spawned an 'infodemic', that is, an overabundance of information – some accurate and some not – making it hard for people to find trustworthy sources and reliable guidance (WHO 2020). As a result, people in need can reject solutions depending on their (digital) literacy skills.

Narratives around crisis communication entail an important but insufficiently recognized risk factor. (Mis)representation refers to the extent to which the design and functionality of technologies reflect how a real-world problem is perceived, conceptualized and operationalized in digital / tech terms by Western / Northern corporations / companies, humanitarian organizations and their staff or individual entrepreneurs testing their tech skills in disaster situations. As a result, tech solutions may only selectively integrate human rights and local user perspectives. Combining a mix of utopianism, tech saviorism, and instrumentalization of technology, so-called digital humanitarianism has also contributed to exclude the voices and achievements of local actors. Similar to Haiti in the wake of the 2010 earthquake, the Philippines are often mentioned in discourses regarding open-source mapping in the context of crisis mapping. Typically, the narrative would go like this:

> "After typhoon Haiyan smashed into the Philippines on 8 November, an army of volunteers mobilized and worked around the clock to help guide relief efforts. But these were no boots on the ground. Instead, they were citizens from around the world who quickly analyzed satellite imagery and other data, generating maps to provide relief agencies with invaluable crowd-sourced information" (Butler 2013).

Many of these early pronouncements, with their air of hyperbole and tech saviourism now sit uncomfortably with contemporary efforts to decolonize, localize, and democratize humanitarian aid and disaster response. Yet, as recently as in 2020, the airing of an episode on the Amazon innovation-series 'Now Go Build' focusing on the Philippines encountered sharp criticism by members of the local OpenStreetMap (OSM) Philippines community. They issued 'A Call to Correct Narratives about Geospatial Work in the Philippines' protesting lack of mention, recognition, and rigor reiterating that "[f]rom a feminist perspective, the problematic discourse and gaze in the episode is so familiar: the white man goes to save a tropical and capricious island paradise" (OSM Philippines 2020).

Conclusion

Digital risks must be anticipated, calibrated, and calculated distinctively depending on the kind of emergency and response provided. Different digital risks arise before, during, and after a disaster and compromise both DRR and response. Yet, this requires a good understanding of what digital risks are, the type of ethical issues that arise and the type of tradeoffs involved, for example between accessibility and surveillance – and freedom.

Importantly, risks arise when digital interventions fail, but also when they succeed. The digital transformation of disaster reduction and response entail a radical centralization of vulnerability, in terms of the collection and consolidation of personal data. In sum, responders now need to grapple with the infinite vulnerability of highly digitized infrastructures: 'infinite' speaks both to the undetermined types of harm that may occur and the unpredictable scope and impact of harm. While proactive leadership, digital security training, techno-legal literacy, and investments in cybersecurity are central to maintaining the integrity of disaster reduction and response operations, they do not remove this vulnerability. The fact that the disaster response system as a whole is in the process of embedding this infinite vulnerability at the heart of their operational infrastructure, generates fundamental questions about the distribution of responsibility, the direction of accountability and the calibration of the ethical imperative of doing no harm.

Thailand

Digital Approaches in Community-based Disaster Risk Reduction

WorldRiskIndex Rank 23

Risk very high	20.91
Exposure very high	14.32
Vulnerability high	30.53

Country profile

The predominantly Buddhist Kingdom of Thailand is a constitutional monarchy with the central government based in the capital Bangkok. While Thailand was never colonized, its political stability has repeatedly been undermined by military coups. Nonetheless, due to an export-led economic model and a strong tourism industry, the nation has evolved into an upper middle-income country. Like other Mekong countries, Thailand regularly faces natural hazards. Especially the northern province of Chiang Rai is affected by climate change-related risks including droughts, wildfires, and floods. Until today, many of the hilly and dense forest areas have little or no ICT-infrastructure. In case of a disaster, governmental and private organizations fail to reach and warn the affected communities in time, and even if they do, the natural hazards often strike them ill-prepared. As a result, damages from disasters are intensified by the lack of awareness and preparation. While the central Thai government has access to high tech instruments and use them for disaster risk reduction (DRR), local authorities often lack IT hardware, technical know-how, and budget for specified capacity building. Since the Covid-19 outbreak, DRR focused strongly on the pandemic and funding resources have been reallocated thereafter.

Project context and activities

Children are among the most vulnerable, especially in terms of emotional distress and trauma. Both governments and the civil society need to provide child-friendly

Situation on digitalization

69,950,844
Inhabitants (2020)

Mobile phone subscriptions per 1,000 persons
1,666.10

Broadband subscriptions per 1,000 persons
164.45

Literacy rate (>15 years)
93.8 %

Population with at least secondary education
45.9 %

material for schools, communities, and families in order to prepare children with adequate safety measures and psycho-social support. However, children are not only victims: they play an important role for DRR by participating and leading actions relevant to their families and communities.

The Thai Mirror Foundation is a non-governmental organization working with ethnic minorities in the field of community based DRR. The foundation successfully channels their grassroot-experience into advocacy on local, national and regional levels. With the support of terre des hommes Germany, the Mirror Foundation implemented a project for children and community participation in climate change adaptation and disaster risk reduction in Northern Thailand from 2015 to 2018. In order to strengthen awareness and preparedness in the affected communities, the project aimed at changing attitudes towards active citizenship and community-based disaster response and establishing a strong network for children, youth, and local residents in civil society organizations.

20 civil society organizations, five local authorities, and five schools cooperated with 3,265 local children and adults in establishing a digital database that enables the communities to respond to emergency situations. It provided up-to-date information on frequently occurring risks and disasters, access to multilingual awareness raising material for both adults and children, a map of disaster risk areas, an overview of laws and policies, and a list of volunteers, organizations, and agencies working on DRR. An open accessible website was established to host this database. Also, existing databases were linked, which made information available for a great number of people. Furthermore, several facebook groups were set up to provide a platform for exchange and immediate alert.

Due to a hacker attack as well as the lack of budget and human resources due to the pandemic, the database was put on hold while other components of the project have successfully been taken over by the communities and are active until today. The database will continue once funding is available. In the meantime, the focus lays on wildfire response and risk reduction with the use of thermal cameras and drone detectors, coordinated by the app "DJI Ground Station Pro" and visualized with "AFIS WildFire Map". Youth groups, especially of the hill-tribes, have trained their abilities in using those drones and other technologies and now play an active role within the response teams. One lesson learned so far is, that (digital) spaces for participating communities need ongoing technical support, protection, and active moderation. Local governments and organizations are required to find the means for such long-term support.

Results and impact

The project successfully triggered a mindset of community based DRR and response. Communities are now better organized, well informed, and continue finding solutions to problems specific to their locality. Children and young people play an important role in the participatory DRR research. They identify vulnerable groups and areas, set up action plans in which elder children are responsible for the evacuation of younger ones, and continue to do local advocacy work. Schools and authorities in the area are now responsible for safety measures and the curriculum for children's disaster preparedness, review plans of action annually in cooperation with the civil society. Digital tools continue to allow for early warnings and access to information for effective response to local disasters.

The project created a model that is developed and applied in Laos and Myanmar in addition to Thailand. The network leads a continuous learning process to exchange knowledge and develop cooperation in DRR and to keep pace with the frequency and severity of disasters in the region. In Southern Thailand, for instance, the early warning system and digital technology for wildfire emergency response developed in Northern Thailand has been used for tsunami emergency response.

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2.3 The Digital Divide in Disaster Contexts: Challenges and Risks

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Across as well as within societies, the ability to access, use, or produce digital technologies is not distributed equally. This 'digital divide' is a reflection of broader patterns of social inequality, and at the same time, can reinforce the exclusion of communities and entire societies from meaningful social, economic, and political participation. The global and local digital divide also manifests itself in the application of digital technologies in humanitarian disaster responses. If these repercussions are not taken into account and adequately mitigated, humanitarians risk reproducing the underlying inequalities and further exacerbating marginalization. Ultimately, this might result in leaving behind the most vulnerable and putting fundamental principles like the 'do no harm' imperative at risk. This article outlines the 'digital divide' on a global and local level and discusses the implications, risks, and mitigation strategies in relation to the use of digital technologies in humanitarian disaster responses.

The rapid advancement and dispersion of digital information and communication technology (ICT), such as smartphones, digital applications, or websites, has altered the way of working across entire industries, including the professional endeavor to enable humanitarian action in disaster-affected areas. Although the global share of internet users has doubled in the last decade (ITU 2021), access to ICTs as well as the resources required to use or produce digital technologies are not evenly distributed. Instead, existing social inequalities with regard to the unequal distribution of economic, human, social, and cultural capital shape the ability, skills and motivation to (physically) access, use, and produce ICTs both across and within societies.

The term 'digital divide' has been coined to describe these persisting imbalances at the global level and between different groups of people at the local level. The digital divide, however, is not only a reflection of the underlying inequalities, but it can also reinforce them by further excluding communities and entire societies from meaningful social, economic and political participation in the digital realm. This risk is also apparent, whenever digital tools are applied in disaster contexts. For humanitarians, it is therefore crucial to take the digital divide into account and to plan and design tech-based initiatives as context-sensitive and locally-led as possible in order to mitigate the associated risks and avoid leaving behind the most vulnerable.

Background and empirical data: The digital divide

Accessing and using ICTs effectively requires resources – or in Bourdieusian terms: social, cultural, human, and economic capital. Although the overall dispersion of ICTs is on the rise, in line with existing social inequalities these resources are not evenly distributed: For example, economic capital is necessary to purchase or produce technical devices and thus determines the (technical) access to ICTs. Meanwhile, a lack of social capital constrains social support structures and guidance to transmit the skills that are necessary to, for example, effectively navigate the Internet (Hargittai 2003). Consequently, the access to the necessary means to produce and shape ICTs in the first place are limited for people and entire societies that lack these resources. Against this background, the term 'digital divide' has entered the public discourse in the

1990s to describe the unequally distributed ability to access, shape or produce ICTs both on a global and local level (Rogers 2001).

Globally, two thirds of the world's population are able to (technically) access and effectively use the Internet: While in Germany, Australia, or the United States over 90 percent of the population use the Internet, for Afghanistan, Chad, and Haiti the latest figures hovered at 18 percent, 10 percent and 35 percent respectively (ITU 2022). The general digital divide between the Global North and the Global South is also reflected in the ownership of digital devices like smartphones (for example 86 percent of the population in Sweden vs. 39 percent in Nigeria according to Taylor / Silver 2019). Furthermore, design and production of digital tools as well as digital content and infrastructures are administered mainly by tech companies, media networks, or network providers from the Global North, and also by financial or tech elites in emerging economies like India and China. It is therefore important to understand the North-South divide not (only) in regional terms, but rather as a general reflection of global political and economic imbalances, as illustrated, for example, by the fact "that there is no gradable presence of African languages online" (Moyo 2018, 140).

However, not only between societies, but also within societies does the digital divide manifest itself along the lines of socio-demographic variables (data: ITU 2021 unless otherwise stated):

Gender: Although the gender gap is shrinking on a global level, men (62 percent) still use the Internet more often than women (57 percent).

Age: People younger than 25, often called 'digital natives', are more likely to use the Internet (71 percent) than the rest of the global population (57 percent).

Area of residence: Due to more advanced digital infrastructures in cities, the urban population (76 percent) is more likely to be able to use the Internet than rural communities are (39 percent).

Economic background/class: Income and economic background determine the ability to purchase technological devices or pay for fixed-broadband or mobile-data plans. In Kenya, Nigeria, or Indonesia, for example, around half of high income households, but only 30 percent of low income households, owned a smartphone with similar statistically significant differences in nearly all countries (Taylor / Silver 2019).

Education/literacy: Higher education and literacy favor the development of digital literacy across all countries – in Brazil, the Philippines, or Tunisia, for example, social media use was twice as high among more educated than among the less educated (ibid.).

Disability: Especially visual impairments or limited hand mobility significantly constrain the ability to use (most) ICTs. A recent case study from the U.S. found that people with any disability were 16 percent less likely to own a smartphone and 10 percent more likely not to use the Internet (Perrin / Atske 2021).

Again, wherever global data is available and comparable, the respective differences between these groups are significantly higher in countries in the Global South than in the Global North (see Figure 7).

While the empirical data focuses on (technical) access and the necessary skills to use ICTs (first and second level divide), it is equally important to examine the different outcomes and implications of the (non-)use of ICTs (third level divide). These global and local implications of the digital divide clearly go "beyond mere connectivity" (Hargittai 2003, 829). In an increasingly digitalized world economy, limited access to ICTs ultimately (re-)inforces exclusion from all the potentials that these technologies imply, including digital financial infrastructures, sharing and production of knowledge and information, political and social participation, and shaping of digital content, narratives and discourses. Thus, the digital divide can quickly "evolve into a 'learning divide' or a 'content-divide'" (Rogers 2001, 100) or a ‘knowledge divide’ or an ‘economic divide’. In other words: The digital divide, as it is currently observed “[has] shown to reproduce, replicate and reinforce social inequalities while also rooted in those inequalities” (Moyo 2018, 143) with regard to (economic) perspectives and equal opportunities across and within societies.

The digital North-South divide and humanitarian disaster responses

The application of ICTs in disaster responses is often induced by actors from the Global North, such as aid agencies themselves or private companies, because the application of such tools can make humanitarian responses more (cost-)efficient and yield economic or reputational benefits for business actors (see Article 2.1). This (temporary) transfer of digital technology by actors from the North to address humanitarian crises predominantely in the Global South, however, mirrors the global digital divide in several ways.

First, the supply-driven provision of ICTs in disaster-contexts ultimately fosters power relations, especially when these technologies are designed by international humanitarian agencies (from the Global North) but used by disaster-affected populations in the Global South. Too often, the application of ICTs in these contexts is driven by considerations about what is possible from a humanitarian perspective rather than what is necessary or desirable from the recipients’ view, as illustrated by the enhanced possibilities for digital (biometric) registration of aid recipients: Although fundamental sensitivity for responsible data management and informed consent has been established in the humanitarian sector, in practice disaster-affected populations have little other choice than engaging with digital registration systems if they seek to receive assistance (Veron 2022). Aid agencies, in turn, capitalize the gathered data to facilitate reporting and accountability to donors and to secure follow-up funding in competition with other NGOs.

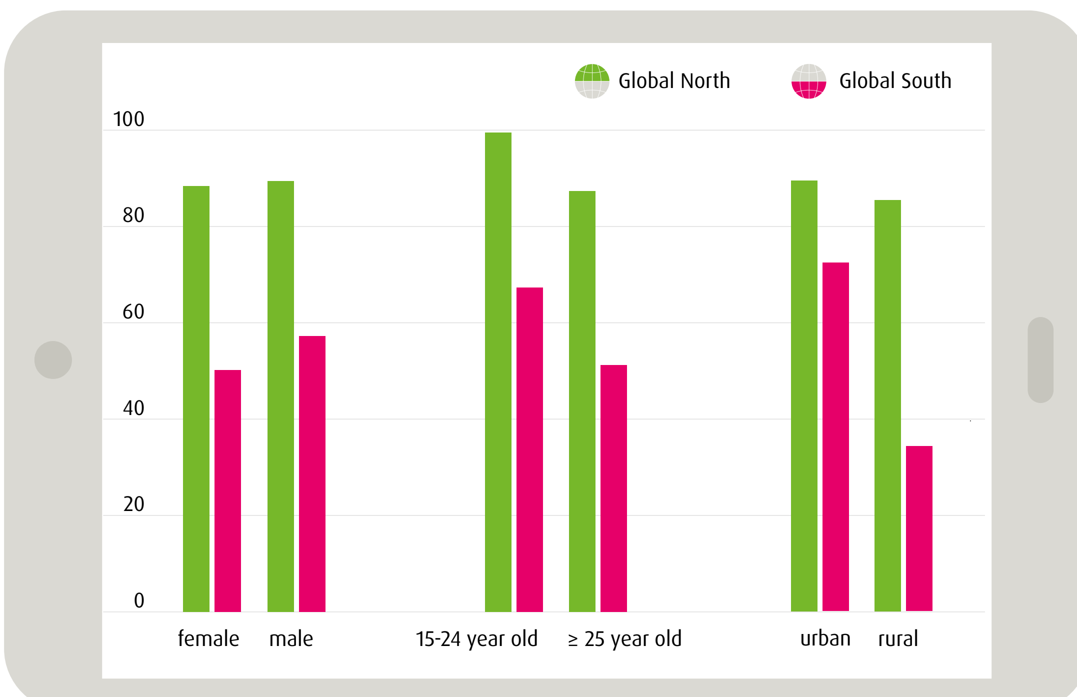


Figure 7: Global internet users as share of the total population. Own compilation based on data from ITU 2021.

This one-sided relationship is what Madianou (2019) has described as 'technocolonialism'. It follows a logic of extractivism and thus undermines meaningful participation of and accountability to disaster-affected populations.

In addition to the way in which ICTs are provided in disaster contexts, the second aspect relates to the question of who provides these tools and when: In many cases, technical solutions are delivered through public-private partnerships (PPPs) by private tech companies from the Global North. Although PPPs are necessary to address funding gaps in the humanitarian system, with regard to the digital divide, they can be problematic in two ways: First, private entities ultimately follow a business logic and are not bound to the humanitarian imperative. In the sense of 'technocolonialim', they capitalize humanitarian crises in the Global South for expected financial or reputational gains, which might inform decisions to provide a specific technology in a given context rather than needs alone.

Conversely, particularly challenging crises that receive little public attention or yield little economic potential might appear less attractive through a business lense and thus be invisibilized even further. And second, the (supply-driven) transfer of technology designed by and for actors from the Global North tends to neglect the local and national framework of a disaster, such as languages, literacy rates, energy supply, or bandwidth quality, and is thus seldomly aligned with locally present resources and conditions (Kaurin 2021). Introducing a written phone or computer-based complaint application in a country with a strong oral tradition or low network coverage, for example, not only counteracts the international localization agenda, but can impede acceptance and participation in crisis situations and ultimately undermine the effectiveness of lifesaving humanitarian action.

Finally, the "technological gold rush within humanitarianism" (Read et al. 2016, 1316) has also implied a turn towards data-driven initiatives and big data analysis. With modes for data collection and analysis being designed by (large) international agencies or outsourced to private tech firms, the gathered data not always mirrors local realities and perceptions adequately: In the context of the Rohingya crisis, for example, the UN Refugee Agency (UNHCR) digital registration form for aid recipients simply did not include 'Rohingya' as an ethnic identity (Madianou 2019, 9). Besides the obvious risk of fostering exclusive patterns, the example also illustrates the sector's susceptibility to data biases. Research has shown that these biases, even if they are detected, become extremely hard to correct down the decision-making chain (Paulus et al. 2022) and can lead to adverse humanitarian outcomes. Fully automated analysis of data through machine learning adds to this problem: If the data used to train an algorithm to, for example, identify missing family members or assess disaster impacts, is biased for the abovementioned reasons, the system will reproduce these biases, which can exacerbate marginalization (Kuner / Marelli 2017, 275–298).

Altogether, these practices of contemporary ICT application in disaster responses support the notion of a global digital divide, in which the voices and interests of companies and aid agencies from the Global North rather than humanitarian needs alone or affected populations themselves shape the design and application of ICTs. It is therefore crucial to extend the international localization to include technology as well: This implies to carefully assess any potential intervention that involves digital technologies along the lines of their functionality including the existing demands and needs, their effects with regard to local ownership, humanitarian principles and standards, and their feasibility in light of the required technical skills, capabilities and local infrastructure (EPRS 2019). If this assessment clearly predicts an added value of ICT application, demand-driven and locally-led initiatives beyond partnerships with tech giants can design digital technologies in close consultation with aid recipients and local businesses and in line with local languages, (digital) literacy rates, and infrastructure, thus contributing to both effectiveness and inclusiveness of disaster responses (Kaurin 2021). Even in this case, digital initiatives can be complemented by 'conventional' mechanisms to ensure nobody is left behind. Finally, thorough debiasing of data with the help of local experts and community-based data collection help to address data biases (Paulus et al. 2022).

The local divide: individual access to ICTs in disaster contexts

In addition, in light of significant divides within disaster-affected societies, the application of digital tools in disaster responses bares the risk of leaving behind the most vulnerable within affected communities. This is because limited access to ICTs is often based on the same sociodemographic factors that impede social, political and economic participation in general and that disproportionally increase vulnerability to disasters in particular. As outlined above, these encompass, amongst others, age, gender, economic background, or disability (Donner / Rodríguez 2011). On a practical level, this implies that, for example, digital cash transfers to sustain local economies and meet immediate needs in societies with patriarchal family structures might not reach women in need, if mobile phone ownership or internet access is reserved for male household members. Similarly, early warnings and messages on shelters that are communicated via social media might not be accessible for communities in remote rural areas. Finally, text-based digital feedback and complaint channels exclude people with visual impairments and illiterates (see case study Cameroon, page 22). These examples illustrate that digital tools as central strategies for disaster responses can not only reproduce (digital) divides within affected communities, but add another layer of vulnerability by shaping disaster impacts and determining who receives lifesaving assistance – thus, putting fundamental principles like the 'do no harm' imperative at risk.

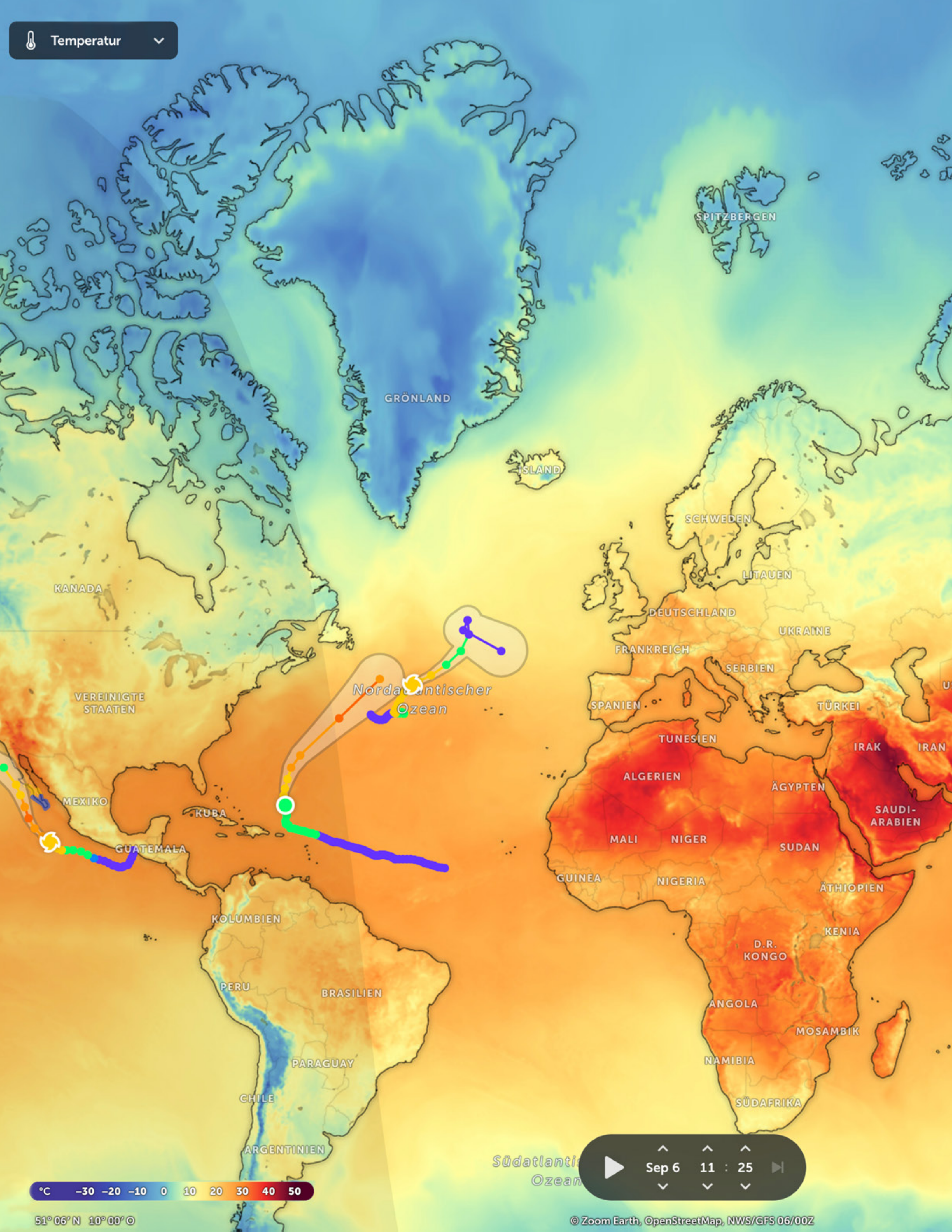
Among the disaster impacts with immediate humanitarian implications is disaster displacement that can act as an additional risk multiplier. In situations of forced displacement, often associated with psychological distress and material deprivation, ICTs fulfill important functions: As research has shown, access to (smart-)phones during displacement can serve to ease psychosocial pressure, to access information, for example on the location of shelters, flooded roads, or safe routes, as well as to connect and (self-)organize with families and fellow displaced persons (Alencar et al. 2019). Conversely, vulnerabilities can be exacerbated even further, when displaced persons are deprived of this access. This can happen because technical devices are lost during a disaster. Or in cases of cross-border and undocumented migration, in which requirements for (national) identification documents to buy SIM-cards or mobile data – that differ considerably among countries – add another barrier (Yongo / Theodorou 2020). The displaced themselves often prioritize regaining access and autonomous use even over other basic relief goods, such as clothing or food, as a study from Tanzania illustrates: Refugees were selling 30 percent of their monthly food packages to acquire mobile phone data (UNHCR 2016). However, the example also shows that humanitarian actors have been slow in aligning their practices with these preferences and the new realities of displacement in the digital age.

Finally, the digital divide manifests itself in the shaping of narratives around disasters and corresponding humanitarian responses. Theories on digital democratization suggest that the low-threshold access to social media provides equal opportunities to contribute to discourses for everybody both globally and within societies. In practice, however, the previously discussed inequalities prevent this potential from being exploited: The accounts of a flashflood produced by members of a remote community in Bangladesh will rarely translate into a Facebook timeline. Rohingya in the same country were even actively banned from digital participation through internet blackouts and restrictions on mobile SIM cards and thus faced extreme difficulties to share digital accounts of devastating fires in Cox Bazar (Kaurin 2021).

All these examples show that whenever digital tools are applied in disaster contexts, the digital divide within affected societies translates into serious challenges for marginalized groups. Again, a thorough examination of local contexts, infrastructures and vulnerabilities is key to address these challenges. Wherever people in need are excluded from the access to ICTs, digital tools need to be complemented by other instruments to assess needs and impacts, to deliver aid and disseminate information, and to collect feedback and concerns. Moreover, despite the consensus on the importance of digital connectivity in disaster contexts, humanitarian actors lag behind these findings still too often when it comes to providing stable internet connections in camps and shelters or distributing SIM cards as part of basic emergency kits. Finally, tech-based humanitarian initiatives can be connected with broader developmental programs in the reconstruction phase. The imperative to 'build back better', anchored in the Sendai Framework for Disaster Risk Reduction (UNISDR 2015), offers a useful lens to strengthen national digital infrastructures and digital literacy in disaster-affected societies in order to address broader global gaps and to enhance disaster preparedness in particular.

Outlook

Inequalities structuring access, production, and use of digital technologies across and within societies manifest themselves whenever these technologies are applied in disaster contexts. If no mitigation measures are taken, the application of digital instruments by humanitarian actors can reproduce or exacerbate existing vulnerabilities with regard to global and local power structures and further marginalize the voices and interests of those most in need. However, it is also clear that the proposed measures within the scope of humanitarian actors are merely mitigative to avoid jeopardizing fundamental principles like the 'do no harm' imperative. Without broader development initiatives tackling the social inequalities that underpin the digital divide as well as a global call to localize and democratize digital technologies and infrastructures, humanitarians alone will not be able to bridge the digital divide(s) around the globe.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3 The WorldRiskIndex 2022

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In recent years, the results of the WorldRiskIndex have helped to raise awareness of the relevance of societal capacities in the emergence and progression of disasters. At the same time, the annual analyses have shown that risk profiles of countries and regions have become more diverse and complex due to the gradually noticeable impacts of climate change. As a result, new risks are emerging in regions that were not previously exposed to them, or only to a lesser degree, necessitating the formation of new societal capacities to successfully cope and adapt. For this reason, this year's WorldRiskReport introduces a new model for calculating the WorldRiskIndex, which represents the result of many years of research and incorporates new aspects into the analysis. The new WorldRiskIndex indicates the disaster risk for 193 countries.

The previous model of the WorldRiskIndex was developed by scientists of the Institute for Environment and Human Security of the United Nations University in Bonn and staff of Bündnis Entwicklung Hilft (Birkmann et al. 2011; Welle / Birkmann 2015). It represented a synthesis of various discourses and concepts on the phenomena of hazard, exposure, and vulnerability, the interaction of which is regarded as the cause of risks in disaster research (Wisner et al. 2004). Compared to earlier models (Cardona 2005; Peduzzi et al. 2009), which focused on the aspects of hazard, exposure, and damage, the WorldRiskIndex stood out by taking a holistic view of vulnerability, treating both drivers of risk, exposure and vulnerability, as equals. In doing so, the model drew on the work of Bogardi and Birkmann (2004), Cardona (1999), Birkmann (2006), and Cardona and Carreno (2011), as well as more recent discourses on coping and adaptation (Davies 1993; Lavell et al. 2012). At the heart of the model was the understanding that disaster risks are not solely shaped by the occurrence, intensity, and duration of extreme natural events, but that social factors, political conditions, and economic structures are equally responsible for whether disasters occur in the context of extreme natural events. This expressed the conviction that every society is capable of taking direct or indirect precautions, such as the establishment and maintenance of effective disaster protection to counter the effects of natural hazards or climate change.

Since 2017, the model has been continuously revised by researchers from the Institute for International Law of Peace and Armed Conflict Law (IFHV) at the Ruhr University Bochum and staff of Bündnis Entwicklung Hilft and adapted to changes in data availability and new findings in risk research. As part of these revisions, it was possible to update the exposure data annually so that population dynamics and movements could be included in the analyses (Radtke / Weller 2019). At the same time, a process for dealing with missing values was established, which allowed the number of countries in the WorldRiskIndex ranking to be increased from 173 to 181 (ibid.). Nevertheless, increasing difficulties arose concerning the availability and quality of individual indicators as well as the fact that risk profiles became and are becoming much more heterogeneous and complex.

The Redesign of the WorldRiskIndex

The new model of the WorldRiskIndex builds on these points and foundations but focuses on greater flexibility and consistency to make use of a wide range of data for risk analysis, enable faster integration of new aspects, increase the reproducibility of the analyses through clearer processes and methods, and enable the exploration of new analytical possibilities. Overall, the new model is designed to be used more easily in the planning of strategies and measures in combination with other metrics and, if necessary, to be extended by public or organizational information. It will also provide the basis for further research on exposure types that have received little attention in index models, such as landslides, heat waves, and cold waves. Accordingly, the new WorldRiskIndex continues to provide important estimates of the latent risk of countries falling victim to a disaster caused by extreme natural events and enables global comparisons of these risks. However, no predictions are made about the timing, intensity, or likelihood of the next disaster.

Terms and definitions

To implement the new model, the previous terms and definitions have been adapted and revised to align the WorldRiskIndex more closely with the terminology of the United Nations Office for Disaster Risk Reduction (UNDRR 2022) and thus achieve greater comparability with other risk concepts. The spheres, dimensions, and categories of the new WorldRiskIndex are explained in more detail below:

Risk is the interaction of the two spheres of exposure and vulnerability, which only arises where both spheres meet. In this respect, risks are only present where populations without sufficient resilience, coping or adaptation capacities live in regions, where hazards from extreme natural events or negative impacts of climate change exist.

Exposure is the extent to which populations in hazard-prone areas are exposed to and burdened by the impacts of extreme natural events or the negative consequences of climate change. Thus, exposure consists of the aspects of hazardousness, which includes the frequency and intensity of earthquakes, tsunamis, coastal and river floods, cyclones, droughts, and sea-level rise in an area (hazard zone), and populations (hazard object).

Vulnerability is the predisposition of populations to be vulnerable to damage from extreme natural events or negative impacts of climate change. As a sphere of economic, political, social, and environmental factors, vulnerability maps the capacities and dispositions of people, households, and societies and indicates how easily and to what degree they can be destabilized, damaged, or even destroyed by extreme events. It is composed of the three dimensions of susceptibility, lack of coping capacities, and lack of adaptive capacities, which are subdivided into further categories.

Susceptibility refers to structural characteristics and general conditions of societies that increase the overall likelihood of populations suffering damage from extreme natural events and entering a state of disaster. In this respect, susceptibility indicates the extent of resilience and resources of a population to mitigate the immediate consequences of extreme events.

Coping capacities refers to the abilities and measures of societies to counter adverse impacts of natural events or climate change through direct actions and available resources in the form of formally or informally organized activities and measures, as well as to reduce damage in the immediate aftermath of an event and initiate recovery. Within the model of the WorldRiskIndex, the deficits in these capacities are included, which is why it is referred to as the lack of coping capacities.

Adaptive capacities, in contrast to coping capacities, refers to long-term processes and strategies to achieve anticipatory changes in societal structures and systems to counteract, mitigate, or purposefully avoid future negative impacts. Analogous to the lack of coping capacities, the lack of adaptive capacities is included in the WorldRiskIndex.

The new structure of the WorldRiskIndex

While the conceptual changes to terms and definitions are relatively moderate, the structure and indicators of the WorldRiskIndex have been completely revised. A total of 100 indicators are now included in the calculation of the WorldRiskIndex, the structure of which is illustrated in Figure 8. In principle, only indicators coming from scientifically recognized and publicly accessible sources are considered (for example World Bank, UNESCO, WHO). Furthermore, the selection criteria have been expanded considerably: each indicator has to be precise, theoretically relevant, reproducible, comparable, understandable, consistent, and openly accessible, as well as continuously provided by its source of data. As a result, several indicators of the previous model are no longer part of the WorldRiskIndex. These significant expansions of the indicator count and selection criteria were necessary to, on the one hand, improve the accuracy and reliability of the analyses, and capture a higher degree of complexity that allows for a stronger focus on the needs of stakeholders, on the other.

Following these criteria, the new WorldRiskIndex does not include other index models (forexample HDI, FSI, EPI), as changes in their methodology would have direct consequences for the WorldRiskIndex model. Although this increases the number of indicators, it makes all elements of the model visible and excludes distortions due to hidden indicators. Compared to the previous model, the differentiation is most pronounced in the sphere of exposure, where the analysis is now based on probabilistic modeling considering multiple return periods of extreme natural events of up to 2,500 years. In addition, regional phenomena are now considered to a greater extent. Exposures causing the most fatalities or highest financial losses worldwide are no longer the only ones taken into account. This is important as extreme natural events and their consequences occur regardless of whether they bear relevance for other parts of the world or meet criteria for inclusion in disaster databases (for example EM-DAT). At the same time, three intensity levels per exposure as well as data on population numbers and proportions are now included in the analysis to specifically reflect the heterogeneity of exposure and its consequences and to avoid distortions due to the size of populations. Furthermore, all exposures are weighted equally, as any form of weighting would introduce a degree of subjectivity into the sphere of exposure and ultimately lead to biased results.

The calculation of the results

In addition to the structural changes, there are numerous changes in the calculation of the WorldRiskIndex, which are part of a multistep process ranging from the preparation of the raw data to the final aggregation of the data. This procedure consists of the following four steps:

Imputation: If indicators are lacking values for certain countries, no index values can be calculated for these countries and they would need to be removed from the analysis. To avoid this, the new model uses an algorithm that allows efficient estimation of missing values (King et al. 2001; Honaker / King 2010). It analyzes all correlations between the values of countries in an indicator (inter-object correlation), the values of a country between indicators (inter-variable correlation), and the values of a country for an indicator over time (inter-temporal correlation) to derive plausible estimates for missing values.

Compared to other approaches, the advantages of this procedure lie in the fact that, on the one hand, indicator data can be transformed

The Structure of the WorldRiskIndex

Exposure

number and share of the population regarding

Strong
Severe
Extreme
Intensity Levels

Earthquakes

Tsunamis

WorldRiskIndex =

Vulnerability

is composed of

Susceptibility

Socio-Economic Development

+ Life Expectancy At Birth
+ Life Expectancy At Age 70

+ Mean Years Of Schooling
+ School Life Expectancy From Primary To Tertiary Education

+ Gross National Income Per Capita (USD PPP)
+ Gross National Savings Per Capita (USD PPP)

+ Net Volume Of Official Development Assistance Received Per Capita (USD PPP)
+ Net Volume Of Personal Remittances Received Per Capita (USD PPP)

Societal Disparities

+ Income Gini Coefficient
+ Income Top-Bottom Decentile Ratio

+ Young Age Dependency
+ Old Age Dependency

+ Gender Disparity In Adolescent Fertility
+ Gender Disparity Of Mean Years Of Schooling
+ Gender Disparity Of School Life Expectancy From Primary To Tertiary Education
+ Gender Disparity Of Labour Force Participation Rates

Socio-Economic Deprivation

+ Lack Of Access To At Least Basic Drinking Water Services (Percent)
+ Lack Of Access To At Least Basic Sanitation Services (Percent)

+ Fixed Broadband Subscriptions Per 1,000 Persons
+ Mobile Cellular Subscriptions Per 1,000 Persons

+ Lack Of Access To Electricity (Percent)
+ Lack Of Access To Clean Cooking Fuels (Percent)

+ Prevalence Of Undernourishment
+ Average Dietary Energy Supply Adequacy

Vulnerable Populations Due To Violence, Conflicts And Disasters

+ Refugees, Asylum Seekers, Returned Refugees And Other Displaced (Total and Percent)
+ Internally Displaced Persons Due To Natural Disasters (Total and Percent)
+ Internally Displaced Persons Due To Violence And Conflict (Total and

Vulnerable Populations Due To Diseases And Epidemics

+ Prevalence Of HIV And AIDS
+ Prevalence Of Tuberculosis And Respiratory Diseases
+ Prevalence Of Neglegted Tropical Diseases And Malaria
+ Prevalence Of Other Infectious Diseases

* These dimensions are not currently considered due to insufficient availability of indicators.
The unweighted geometric mean is used to aggregate the indicator values at all levels of the WorldRiskIndex.

Figure 8: The Structure of the WorldRiskIndex

Cyclones

Coastal Floodings

Riverine Floodings

Droughts

Sea Level Rise

√ Exposure × Vulnerability

Lack Of Coping Capacities

Recent Societal Shocks

+ Population Affected By Disasters In The Last 5 Years (Total and Percent)
+ Population Killed In Conflicts In The Last 5 Years (Total and Percent)

State And Government

+ Control Of Corrpution
+ Rule Of Law

+ Government Effectiveness
+ Political Stability And Absence Of Violence And Terror

Health Care Capacities

+ Medical Doctors And Practitioners Per 1,000 Persons
+ Nurses And Midwives Per 1,000 Persons

+ Maternal Mortality Rate
+ U5 Child Mortality Rate

+ Hospital Beds Per 1,000 Persons
+ Current Health Expenditures Per Capita (USD PPP)

Infrastructure*

Social Networks*

Material Protection*

Lack Of Adaptive Capacities

Education

+ Government Expenditure On Primary And Secondary Education Per Capita (USD PPP)
+ Number Of Teachers In Primary And Secondary Education Per 1,000 Students
+ Gross Enrolment Rate In Primary And Secondary Education

Research

+ Government Expenditure On Research And Development Per Capita
+ Personnel In Research And Development Per 1,000 Persons
+ Gross Enrolment Rate In Tertiary Education

Long-Term Health And Deprivation Effects

+ Years Lost Due To Unsafe Water And Sanitation Sources
+ Years Lost Due To Particulate Matter Air Pollution
+ Years Lost Due To Child And Maternal Malnutrition

+ Children Without Third DTP Dosage (Percent)
+ Children Without Third Polio Dosage (Percent)
+ Children Without Second Measles Dosage (Percent)

Investment Capacities

+ Gross Fixed Capital Formation Per Capita (USD PPP)
+ General Consumer Price Instability (Rate)

Disaster Prepardness*

Climate Change Mitigation*

by statistical procedures (for example Yeo / Johnson 2001) in advance of the estimation to minimize the influence of outliers on the estimation and to increase the speed of the estimation, and, on the other hand, qualitative information (for example expert opinions) can be provided to the algorithm to specify logical limits and intervals for the estimates. At the same time it is possible to estimate all missing values simultaneously. Since not all indicators are published annually and extreme global events such as pandemics or recessions can lead to biased estimates if they occur at the edges of time series, the algorithm was only applied to data from 2000 to 2018. To counteract this effect, a set of 1,000 iterations was used and the mean values from these algorithmic iterations were chosen to maximize the plausibility of the estimates. To complete all indicators series, the data values of 2018 were taken as the latest data value, unless more recent data was available for the indicators. In future reports, this imputation step will be updated annually.

Transformation: Subsequently, a transformation of the indicators is necessary to prevent distortions of the calculations due to skewed distributions or outliers. In many cases, the logarithm of values with subsequent treatment of outliers is suggested (OECD / EC-JRC 2008). Deviating from this, the Ordered-Quantile-Transformation (Bartlett 1947; Van der Waerden 1969) is used for the new WorldRiskIndex, as it is superior to the logarithm in most cases and does not require any further post-treatment of outliers. Then the results are right-shifted to ensure that only values greater than zero need to be considered in the next steps.

Normalization: Before calculating the WorldRiskIndex, all indicators are normalized to the value range from 0 to 100, with higher values representing worse circumstances or initial conditions. For this purpose, either min-max normalizations are used if indicators already followed this logic (for example "Prevalence of Undernourishment"), or max-min normalizations if high values for indicators would mean a reduction of risk (for example "Gross National Income per Capita").

Aggregation: The last step of the calculation is aggregation, for which the new model always uses the unweighted geometric mean, which has the advantage over other methods (for example arithmetic mean) that balanced developments and an even reduction of deficits are rewarded at all levels of the model. To simplify the calculation, the values are rounded to the second decimal after each aggregation step.

Overall, this procedure provides values from 0 to 100 for each element of the model, allowing comparisons of the 193 countries at all levels of the WorldRiskIndex. For ease of understanding, the values of individual spheres, dimensions, and categories are divided into five classes, whose limits were calculated based on the median of the quintile limits of the past 20 years. Compared to the previous classification, this procedure allows for risk trend analyses, as the class boundaries no longer change from year to year, which made it difficult to compare earlier results. For easier visualization, the data and classes of the 193 countries are transferred to maps by a geographic information system. In addition to providing this year's results, the new model was also applied to data from 2000 to 2021 to provide users with complete time series for their analyses. As with previous publications, this data is available at **www.WorldRiskReport.org**.

The Results of the WorldRiskIndex 2022

In line with previous results, this year's WorldRiskIndex shows that global disaster risks are very heterogeneously distributed and strongly linked to aspects of poverty and inequality. Nevertheless, the new model results show clear differences from previous findings. Global

Potentials of Digitalization in Risk Analysis and Forecasting

The basic prerequisites for effective disaster preparedness and anticipatory humanitarian action are accurate assessments of disaster risks and, increasingly also, precise forecasts of extreme natural events and their effects. For this purpose, models are developed based on globally, nationally, or locally available data sets, which should enable the assessment of risks.

At the global level, risk analyses provide opportunities for comparison and an overview of the distribution of global disaster risks. They are particularly useful for strategic decision-making at the program level of humanitarian organizations and in lobbying and advocacy work. Since these datasets are usually not available in high resolution, global risk analyses can rarely be used at project level. Moreover, local perceptions and assessments of disaster risks are not taken into account due to methodological limitations. At the local level, risk models can usually work with high-resolution data so that local specifics can be considered. Therefore, these risk models are highly relevant for project levels and can be used, for example, for project planning in the field of disaster preparedness and anticipatory humanitarian aid. Risk analyses at the local level are associated with high workload and require good expertise. Data gaps at the local level arise, among other things, because data is often privatized and not shared or too costly to collect. At the national level, depending on the context and country, a combination of the problems and benefits of the global and local levels can be found.

In recent years, the availability of data has increased significantly, with three developments in particular contributing to this: First, thanks to satellite technology, more and more high-resolution satellite images are available. These images can be used, for example, to close data gaps in the area of infrastructure. Among other things, they offer the possibility of identifying the condition of buildings or assess construction methods. Informal settlements can also be explored in this way and incorporated into risk analyses. It is also possible to assess the food security situation based on satellite images, for example by visualizing areas where cattle are used to plow. Second, the enormous amount of data generated as a by-product of increasing digitalization can provide important information in disaster research. For example, data on mobile phone or social media use could be used to better capture social connectivity – an area that is currently underrepresented in many indices. Third, advocacy work has increased the willingness to share data in humanitarian operations, allowing more and more data gaps to be filled, according to the Centre for Humanitarian Data. A total of 2,071 new datasets were made available by humanitarian organizations on the Humanitarian Data Exchange (HDX) platform in 2021, bringing the total to nearly 18,500 datasets. These have been downloaded 1.8 million times. In the 27 crises for which a 'Humanitarian Response Plan' (HRP) was prepared by the UN Humanitarian Country Team, 69 percent of complete datasets were available for these crises, with an additional 20 percent of incomplete datasets. Currently, data needed for anticipatory humanitarian action – current and historical data on hazards and their impacts, as well as forecasts of extreme natural events – is still available to a lesser extent. However, HDX has made access to just such data a priority for 2022 (UNOCHA 2022).

There have also been important changes in data preparation and processing in recent years. A massive improvement in computing capacities means that much larger volumes of data can now be processed (Beduschi 2022). As a result, in addition to risk analyses based on index models, it is now possible to increasingly use forecasts of extreme natural events and their impacts based on machine learning for humanitarian aid. The calculation of models, which only a few years ago took up the capacity of entire data centres, can now be performed on a desktop computer. Methodological developments in the field of machine learning have also produced a variety of promising approaches that can provide important impulses for the further development and improvement of established models.

The potential of these developments is currently not fully exploited. Not only does it open the possibility to achieve the paradigm shift from reactive humanitarian assistance to increasingly anticipatory humanitarian action, but in the long-term it also makes indices and forecast models at the global level usable for the local level and in project management. To address associated risks such as algorithmic bias or the concentration of aid in datafied areas (see Chapter 2.2), expanding the localization agenda to further develop disaster risk indices is essential. Approaches such as community-based data collection or participatory mapping already offer important starting points here (Radtke et al. 2021).

Dr. Katrin Radtke, Senior Researcher, IFHV risk hotspots are located in the Americas and Asia, which is reflected in the ten countries with the highest risk values: the Philippines, India, Indonesia, Colombia, Mexico, Myanmar, Mozambique, China, Bangladesh, and Pakistan. The risk profiles of these countries are characterized by complex interactions of multiple exposures and high intensities, which the new model was able to capture for the first time. The global risk hotspots are also evident when looking at exposure to natural hazards and adverse climate change impacts, as six countries with the highest risks also belong to the group of ten countries with the highest exposures, alongside Russia, Vietnam, Papua New Guinea, and Madagascar, which belong to the extended top group in both spheres. However, very high exposure levels do not necessarily mean very high risks, as South Korea and Italy demonstrate. Both countries can noticeably reduce their disaster risks through their medium to low vulnerabilities. To a lesser extent, this also applies to Japan, the United States of America, and Canada, whose very low to low vulnerabilities help to reduce risks despite very high exposures.

Regarding the intercontinental distribution of risks, the Americas have the highest median, ahead of Asia, Africa, Oceania, and Europe. However, if the regions of the continents are used for analysis, it becomes clear that there are also considerable differences in the risk distribution at the continental level, which can be used for more precise localisations of hotspots:

Overall, the Americas have the highest median of all continents in the WorldRiskIndex at 9.99, with a very uneven distribution of risks – only the Caribbean is below the global median, while North, Central, and South America each have a multiple of this reference value. The reason for this distribution is the fact that just under a third of all countries in the highest risk class are located in these parts of the Americas; Colombia (4th), Mexico (5th), and the United States of America (18th) as representatives of these regions are even in the top group of the risk ranking. Inversely, Paraguay (158th) is the only country on the continent in the lowest class. This heterogeneity is also reflected in the exposure, whose ranking is also led by Mexico, the United States of America, and Colombia, while Paraguay again belongs to the lowest class. However, the differences between the regions are more pronounced in terms of exposure, with North America having just under thirty times the global median. Although there is also a clear heterogeneity in terms of vulnerabilities, the differences between the regions are by no means as extreme, since just under one-third of the countries have high or very high vulnerabilities, while the majority of countries are in the medium or low class.

Asia ranks second in the global comparison. With a median of 5.93 for 47 countries, Asia is well above the global risk median. Regarding the individual components of the model, Asia is also in second place and above the global medians in each case, except for adaptive capacities. A total of seven Asian countries are in the group of ten countries with the highest risks: the Philippines, India, Indonesia, Myanmar, China, Bangladesh, and Pakistan. Uzbekistan, Brunei Darussalam, Turkmenistan, Qatar, Bhutan, the Maldives, Bahrain, and Singapore belong to the lowest risk class and consequently perform very well – especially Bahrain and Singapore, which belong to the group of ten countries with the lowest risks worldwide. In terms of vulnerability, only Afghanistan and Yemen are in the top group, but both are closely followed by Syria, Myanmar, the Philippines, Pakistan, India, Bangladesh, Iraq, and Indonesia. A common feature of these countries is that, apart from Indonesia with its medium adaptive capacity, all countries have high or mostly very high deficits across all three categories of vulnerability.

Africa ranks third with a risk median of 4.33 out of 54 countries, placing the African continent only slightly above the global median of the WorldRiskIndex. This is mainly due to the risk hotspot in North Africa, whose exposure is five times higher than the continental median and, together with the very high vulnerability, which is clearly above the global median in all regions of Africa, cumulates to a high risk. However, North Africa's risk value is significantly lower than the values of the risk hotspots in America and Asia. Overall, Africa's only representative among the ten countries with the highest risk is Mozambique. Somalia, Madagascar, Egypt, Tanzania, Libya, and Kenya are also in the highest risk class. The formative nature of vulnerability for Africa becomes evident when compared with exposure: Only about 30 percent of the continent's countries have high to very high exposures, while nearly 80 percent of the continent is in the highest two groups of the sphere of vulnerability. This is reflected in the group of ten countries with the highest vulnerabilities worldwide: Somalia, Chad, South Sudan, the Central African Republic, the Democratic Republic of Congo, Niger, Mozambique, and Ethiopia are all located in the Sahel region of Africa, joined only by Afghanistan and Yemen. Africa remains the continent with the greatest vulnerability deficits and is currently guarded against higher risk values by its relatively low exposure – against the background of climate

	WRI	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
Africa	**4.33**	**0.70**	**31.26**	**30.18**	**14.80**	**60.43**
Central Africa	4.72	0.86	51.21	33.12	58.49	62.89
East Africa	3.86	0.55	32.74	34.12	15.38	61.93
North Africa	10.21	3.91	37.38	21.72	49.12	47.74
South Africa	1.82	0.14	25.04	26.37	11.96	54.19
West Africa	3.58	0.44	29.74	30.79	13.46	61.30
The Americas	**9.99**	**4.29**	**20.39**	**16.21**	**11.08**	**44.21**
Caribbean	3.27	0.79	13.51	11.42	10.28	38.05
Central America	15.19	9.36	27.44	28.79	12.27	47.46
North America	20.86	32.74	13.49	10.99	6.94	32.45
South America	13.00	8.96	22.41	19.06	12.19	47.25
Asia	**5.93**	**1.60**	**21.99**	**15.87**	**12.98**	**43.77**
Central Asia	2.18	0.22	18.97	15.53	10.76	44.22
East Asia	11.82	9.96	12.75	15.78	11.27	16.20
South Asia	5.93	1.60	27.54	27.17	55.38	47.58
Southeast Asia	14.36	8.64	25.00	19.10	14.34	47.19
West Asia	3.79	1.02	21.06	12.94	19.89	38.06
Europe	**2.14**	**0.49**	**8.87**	**6.92**	**5.69**	**29.30**
Eastern Europe	1.73	0.21	14.07	7.77	8.91	37.67
Northern Europe	2.10	0.72	6.23	6.64	2.13	21.58
Southern Europe	2.91	0.59	10.46	7.99	7.72	25.18
Western Europe	1.14	0.17	7.41	4.99	3.14	29.30
Oceania	**4.15**	**1.23**	**13.20**	**9.85**	**10.90**	**33.39**
Australia / New Zealand	17.21	24.60	12.05	7.76	8.66	29.96
Melanesia	12.63	7.71	20.88	18.44	11.82	43.74
Micronesia	2.29	0.50	10.13	7.90	2.86	42.00
Polynesia	3.15	0.81	12.24	15.38	10.54	26.43
World	**4.11**	**1.05**	**20.39**	**15.86**	**11.77**	**44.35**

Figure 9: Comparison of the medians of the country groups (based on WorldRiskIndex 2022)

change and increasing periods of heat and drought, this is only feigned security.

With a median of 4.15, the continent of Oceania ranks just below Africa in a global comparison, but with Australia and New Zealand as well as Melanesia, it has two regions whose medians are significantly higher than Africa's highest regional value. This arises from the fact that four countries in these regions – Papua New Guinea, Australia, the Solomon Islands, and New Zealand – are in the highest risk class. On the other hand, the Poly- and Micronesian islands of Tuvalu, Palau, and Nauru belong to the lowest risk class due to their location away from cyclone and earthquake zones. Since only Papua New Guinea has a high vulnerability, while all other countries have noticeably better values in this sphere, the risk classification in Oceania is decisively shaped by exposure – this roughly mirrors the situation in Africa. In terms of exposure, Australia, Papua New Guinea, New Zealand, and the Solomon Islands also lead the continent's ranking, although it should be mentioned that Australia's exposure is almost four times higher than that of the Solomon Islands.

In a global comparison, Europe not only has by far the lowest risk but is also the only continent that is well below the global medians in all areas of the analysis. Similarly, the regions of Europe are at a very low level when viewed globally. In a regional comparison, however, differences are noticeable: Eastern and Southern Europe's vulnerabilities are up to two times higher than Northern Europe's result, while Northern Europe's exposure is only exceeded in Southern Europe. This follows, on the one hand, from the fact that most Northern European countries, except for Great Britain, have very low vulnerabilities, while with Italy, Greece, Spain, Portugal, and Albania more than a third of Southern European countries are in the highest two exposure classes. Overall, however, the results of the new model fit very well with previous WorldRiskReports' findings on Europe.

Opportunities and Limitations of the WorldRiskIndex

The WorldRiskIndex is a model that aims to raise awareness about the relevance of social capacities in disaster preparedness among the public and decision-makers in all sectors of society, to provide guidance for practitioners in the prevention of humanitarian crises, and to support decisions in the allocation and prioritization of resources. The aim is to create an understanding that the emergence and progression of disasters are highly dependent on the social conditions of the people, regions, and countries affected, to accompany the shift from reactive to proactive action.

For this purpose, a complex issue is reduced to individual values through modular structures to achieve a balance between comprehensibility and complexity. Although this offers the advantages of quick orientation, easier communication, and visualization of results, it also bears the risk that subtle information is lost or overlaid in the reduction and condensation of information.

In general, it should be noted that, like its predecessors, the new WorldRiskIndex focuses on the risk of disasters due to extreme natural events and adverse impacts of climate change. Other types of risk such as conflicts, wars, or pandemics are deliberately only partially or not at all considered, as the driving forces of these risks differ in many respects from those of risks from natural events and climate. Furthermore, it would be extremely difficult and in many cases impossible to integrate their explanatory approaches into the concepts, structures, and processes of the new model. A transfer of the new WorldRiskIndex results to these areas is therefore not possible, or only possible to a limited degree.

In addition, some vulnerability categories, such as ”infrastructure”, “social networks”, or “material security”, could not be included in the calculation despite their practical relevance due to a lack of data availability. As part of a continuous further development, these gaps are to be filled using new methods (or example geodata analysis). However, the new structure of the WorldRiskIndex already allows users to use their own data in combination with the results provided to fill ‘white spots’ in the model and to realize specific analyses.

Regarding the availability of data, it should be noted that global indicators may contain missing values as well as delays between the collection, processing, and publication for individual countries, which may distort or even prevent the calculation of the WorldRiskIndex. In these cases, the methodology of the WorldRiskIndex reaches its limits, as the completeness and quality of the indicators are of central importance for any index (OECD / EC-JRC 2008). Unfortunately, up-to-date data is not available for all 193 member states of the United Nations, which particularly affects smaller countries and countries in emergencies and crises. On the one hand, this is a consequence of the fact that databases often do not collect and provide the required data quality for smaller countries, and on the other hand, resources for collecting data in times of crisis are often made available to other areas. To account for this issue when estimating missing values, the imputation process was enriched by integrating qualitative indicators (for example potential conflict status and intensities), which significantly increased the precision of the estimates. Nevertheless, the results of the countries concerned are estimates entailing a certain degree of uncertainty. Additional information will therefore be provided in the next reports, which will simplify an assessment of the values in terms of reliability.

A last limitation of the model arises from the fact that metadata of the indicators often do not indicate for each country whether and, if so, which areas or territories (for example overseas territories, exclaves) were covered. To reduce the influence of this type of inaccuracy, an allocation of external territories to the respective sovereign was forgone wherever possible. Where this was not possible, population-weighted mean values were calculated where separate values were available for these countries and territories. For example, it was necessary to assign the territories of Kosovo, Palestine, and Taiwan to the territories of Serbia, Israel, and China for reasons of methodological consistency, as there are drastic differences in the treatment of these territories in global data sources and they are sometimes considered independent territories, sometimes part of the parent territories. It should be noted that this is done for methodological reasons only and does not reflect political positions or the acceptance of international legal and political claims.

Finally, it remains to be mentioned that the WorldRiskIndex is to be constantly expanded and updated in the future to allow risk analyses that are as precise as possible. However, this entails the difficulty that any change in the model or methodology would lead to breaks in the results. To counter this issue, one of the requirements of the new model is that any change or update must be applied to at least the past ten years to provide users with sufficient information for trend analyses in the form of time series. Overall, the new WorldRiskIndex represents an important step forward for the long-term analysis of disaster risks, as its structure and processes have been consistently designed to integrate new aspects and data quickly. Regarding complex strategy and policy decisions, however, it should be noted that, in addition to the WorldRiskIndex, qualitative approaches should also be included to obtain the broadest possible basis for decision-making and to be able to compensate for any uncertainties that might arise from the reduction in complexity.


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4 Requirements and Recommendations

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

Digitalization is continuously changing our world – with its potentials and risks, it also influences humanitarian action and development cooperation. Early warning systems in apps or advisory chatbots, as frequently used during the Covid-19 pandemic, can help prevent disasters or survive crises. However, disaster events also highlight new dependencies and susceptibilities created by advancing digitalization. An example of this is the volcanic eruption in Tonga in 2022, which destroyed the island nation's only Internet fiber-optic cable and cut off its communications with the outside world. New vulnerabilities must be given greater consideration and incorporated into digitalization strategies. In conjunction with this, there is a need for a global approach to digitalization that takes greater account of legal principles, ethical considerations, and sustainability, in addition to economic interests and technological developments. Anchoring digital rights and standards in international frameworks, such as the Sustainable Development Goals, is an important step in this direction. This should create the basis for digital structures in which more people can participate and benefit from them in the long term. To this end, states and international institutions must be equipped accordingly and the digitalization process must be accompanied by civil society.

Precise collection and provision of global data is essential for disaster management and adaptation to climate change in order to break down the vulnerability of countries and establish targeted strategies. In addition, topic-specific digital competencies should be established to improve the use of ICT in disaster management and develop appropriate apps in line with the 'do no harm' principle. This does not mean that, driven by the pace of the technology industry, all previously proven analog measures in disaster management must be replaced immediately. A precise examination is required as to the areas in which ICT can be used sensibly and to the benefit of those affected. The following is a list of the most important requirements that need to be met in order to make better use of the potential of digitalization for disaster management and to make it more sustainable, local, and socially just.

Requirement 1: Digital technologies and competencies must be equally accessible to all people.

+ Digital skills must be promoted by actively integrating them into primary and secondary education and strengthening their use based on the conscious handling of (one's own) data.

+ Access to ICT is unequally distributed in the world. This so-called 'digital divide' separates along gender, age, skills, and social origin and between the Global South and the Global North. The digital divide must be decisively countered, for example, by developing digital solutions locally and basing them on different languages.

+ Humanitarian organizations must consider the impact of the digital divide when planning projects and ensure that their projects do not unintentionally promote inequality and exclusion. To this end, project planning must also include strengthening the digital skills of those affected. In addition, greater attention should be paid to access to ICT in needs assessments and its provision, for example, of data volumes, should be better integrated in the context of humanitarian programs.

Requirement 2: Digital structures must be in place and secure.

+ The expansion of ICT infrastructure must be promoted and access to it provided for the population. To this end, broadband network must be expanded, for example.

+ Digital infrastructure must be protected against internal risks – this includes, among other things, safeguards for system crashes or failures, data loss, and damage caused by extreme natural events – and be backed up by functioning emergency plans for rapid troubleshooting, repairs, and possible replacement strategies.

+ Far more financial resources must be made available to optimize and digitalize relief efforts. One possibility is the introduction of a digital tax for the use of digital services in large companies to finance civil society digitalization projects.

+ Incentives must be created in humanitarian action and development cooperation to make the field more attractive for experts in data analysis. Interfaces between technical developers and humanitarian experts must be established and communication must be ensured so that the technical possibilities and cultural and social circumstances can be reconciled.

Requirement 3: Data and digital techniques must be accessible and transparent.

+ Data should, where possible, be collected and processed at all levels and in all areas. This can also prevent bias in data collections and projects based on them. In addition, the availability of indicators previously lacking for risk analysis on relevant topics such as social networks, infrastructure, and disaster preparedness must be continuously expanded.

+ Access to data on the global situation for risk analysis, anticipatory humanitarian action, and sustainable adaptation strategies should be straightforward, transparent, and cost-free. Corporate profiteering in the provision of data, including for humanitarian purposes, must be discouraged.

+ Digital systems and apps that can be easily and flexibly adapted for the respective areas of application and combined and integrated according to needs must be available. They should also be able to serve as a basis for shared information systems and common knowledge management, simplifying planning and coordination processes.

Requirement 4: Data must be protected and regulated.

+ Data protection must always be guaranteed, especially for those affected by disasters. For example, the collection of biometric and personal data is only justified with a direct and transparently communicated benefit – for example, to provide social security to individuals. For this, an understanding on uniform and binding data protection standards is needed between humanitarian organizations as well as in consultation with large tech companies.

+ Any misuse of data and information collected in the context of disasters, including by institutions or states, must be prevented by law. This includes the prevention of corrupt data sharing in exchange for payment and increased efforts against fake news and misinformation, especially in the context of disasters.

Appendix

WorldRiskIndex 2021 Overview

Classification	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
very low	0.00 – 1.84	0.00 – 0.17	0.00 – 9.90	0.00 – 7.17	0.00 – 3.47	0.00 – 25.28
low	1.85 – 3.20	0.18 – 0.56	9.91 – 15.87	7.18 – 11.85	3.48 – 10.01	25.29 – 37.47
medium	3.21 – 5.87	0.57 – 1.76	15.88 – 24.43	11.86 – 19.31	10.02 – 12.64	37.48 – 48.04
high	5.88 – 12.88	1.77 – 7.78	24.44 – 33.01	19.32 – 34.16	12.65 – 39.05	48.05 – 59.00
very high	12.89 – 100.00	7.79 – 100.00	33.02 – 100.00	34.17 – 100.00	39.06 – 100.00	59.01 – 100.00

As of this year, the WorldRiskIndex and its elements will use fixed thresholds for the classification of countries to enable medium- and long-term trends analyses. These threshold values for the WorldRiskIndex and each dimension were calculated as the median of the quintiles from the results of the last 20 years.

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
1.	Philippines	46.82	39.99	54.81	51.35	57.81	55.48
2.	India	42.31	35.99	49.75	39.50	55.38	56.29
3.	Indonesia	41.46	39.89	43.10	33.48	50.67	47.19
4.	Colombia	38.37	31.54	46.69	47.84	48.23	44.11
5.	Mexico	37.55	50.08	28.16	37.26	12.09	49.55
6.	Myanmar	35.49	22.43	56.14	53.39	58.85	56.30
7.	Mozambique	34.37	18.10	65.28	64.57	64.54	66.76
8.	China	28.70	64.59	12.75	15.78	12.11	10.84
9.	Bangladesh	27.90	16.57	46.97	36.81	59.18	47.58
10.	Pakistan	26.75	13.11	54.58	41.42	60.96	64.41
11.	Russian Federation	26.54	28.35	24.85	11.22	39.19	34.91
12.	Viet Nam	25.85	26.73	25.00	26.54	12.98	45.38
13.	Peru	25.41	16.65	38.79	26.38	48.09	46.00
14.	Somalia	25.07	8.55	73.49	65.01	79.09	77.20
15.	Yemen	24.26	9.12	64.52	60.66	68.05	65.06
16.	Papua New Guinea	24.10	18.84	30.82	30.86	14.12	67.21
17.	Madagascar	23.48	18.38	29.99	25.36	15.49	68.69
18.	United States of America	22.73	39.59	13.05	11.60	6.15	31.16
19.	Bolivarian Republic of Venezuela	22.45	19.52	25.82	22.87	12.30	61.16
20.	Ecuador	22.42	14.57	34.51	20.20	46.01	44.21
21.	Nicaragua	22.35	18.71	26.71	28.28	14.02	48.06
22.	Australia	21.36	31.21	14.62	8.48	13.66	26.96
23.	Thailand	20.91	14.32	30.53	15.87	48.68	36.83
24.	Egypt	20.65	10.74	39.71	27.10	47.91	48.24
25.	Canada	18.99	25.89	13.93	10.38	7.72	33.74
26.	Iran (Islamic Republic of)	18.48	12.49	27.34	20.73	56.65	17.41
27.	Panama	18.38	15.89	21.27	20.64	10.68	43.63
28.	Japan	17.03	43.67	6.64	7.65	5.15	7.44
29.	United Republic of Tanzania	16.38	5.49	48.85	34.12	55.69	61.35
30.	Turkey	16.23	8.90	29.58	15.73	45.85	35.89
31.	Honduras	16.00	8.82	29.02	29.30	14.43	57.81
32.	Argentina	15.61	11.54	21.12	17.92	10.84	48.49
33.	Solomon Islands	14.62	9.62	22.23	17.95	11.25	54.43
34.	El Salvador	14.37	7.30	28.27	39.20	12.30	46.85
35.	Malaysia	14.36	8.64	23.86	19.10	19.81	35.88
36.	Libyan Arab Jamahiriya	14.31	4.94	41.47	24.51	54.53	53.35
37.	Costa Rica	14.20	9.89	20.39	22.57	10.82	34.72
38.	Kenya	13.92	3.27	59.27	59.30	58.50	60.03
39.	Chile	13.84	12.86	14.89	10.05	8.29	39.61

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
40.	Dominican Republic	13.23	7.05	24.81	22.81	13.17	50.81
41.	New Zealand	13.05	17.99	9.47	7.03	3.66	32.96
42.	Syrian Arab Republic	12.16	2.53	58.46	49.28	65.02	62.36
43.	Brazil	12.15	6.37	23.19	20.90	12.07	49.44
44.	Dem. People's Republic of Korea	11.82	7.22	19.35	16.16	13.66	32.82
45.	Guatemala	11.18	4.29	29.15	30.62	14.57	55.50
46.	Cameroon	11.17	2.08	60.00	59.69	57.55	62.89
47.	Angola	11.02	2.37	51.21	33.12	59.30	68.36
48.	Djibouti	10.66	4.25	26.72	22.57	14.23	59.40
49.	Vanuatu	10.64	5.80	19.53	18.93	11.90	33.05
50.	Republic of Korea	10.51	9.96	11.09	10.30	8.18	16.20
51.	Morocco	10.29	7.63	13.87	18.48	12.70	11.36
52.	Sudan	10.12	1.65	62.05	59.38	61.58	65.34
53.	Haiti	9.99	2.78	35.89	41.48	15.98	69.73
54.	Tunisia	9.87	2.88	33.84	18.34	44.73	47.24
55.	Spain	9.68	7.77	12.07	9.32	7.56	24.96
56.	Democratic Republic of the Congo	9.65	1.37	68.00	68.10	66.23	69.71
57.	Saudi Arabia	9.64	5.25	17.71	7.32	19.94	38.06
58.	Algeria	9.58	2.62	35.05	18.93	50.33	45.19
59.	South Africa	9.42	3.13	28.35	36.75	11.68	53.09
60.	Italy	9.37	8.69	10.11	7.59	5.01	27.17
61.	Mauritania	9.34	2.91	29.97	29.66	15.45	58.72
62.	Nigeria	9.12	1.32	63.06	55.64	64.71	69.65
63.	Iraq	8.65	1.72	43.52	28.88	57.64	49.51
64.	Greece	8.55	8.25	8.87	8.98	7.99	9.71
65.	Cambodia	8.42	2.47	28.68	30.73	14.34	53.52
66.	Cuba	7.97	2.93	21.69	16.92	12.73	47.38
66.	Timor-Leste	7.97	4.57	13.89	14.34	7.26	25.75
68.	Eritrea	7.70	2.30	25.77	19.06	14.94	60.10
69.	Belize	7.65	2.50	23.41	27.58	12.24	38.01
70.	Oman	7.27	6.68	7.92	10.66	4.70	9.91
71.	Guinea	6.84	1.47	31.85	30.94	14.35	72.77
72.	France	6.67	2.70	16.50	5.44	26.83	30.75
73.	Guyana	6.64	2.63	16.76	16.21	11.19	25.97
74.	Fiji	6.54	2.79	15.33	17.05	11.74	18.01
75.	United Arab Emirates	6.52	3.77	11.27	9.75	4.15	35.33
76.	Namibia	5.93	1.32	26.62	29.11	11.96	54.19
76.	Sri Lanka	5.93	1.60	21.99	19.97	12.17	43.77
78.	United Kingdom	5.78	2.58	12.97	8.86	7.24	34.05
79.	Senegal	5.42	1.05	27.94	29.72	12.91	56.87
80.	Portugal	5.08	3.07	8.39	7.85	7.08	10.64
81.	Sierra Leone	5.00	1.09	22.89	13.65	13.18	66.65
82.	Albania	4.98	2.29	10.81	6.68	11.44	16.52
83.	Uruguay	4.92	1.54	15.71	10.88	8.84	40.33
84.	Suriname	4.87	1.78	13.34	14.62	2.97	54.69
85.	Croatia	4.86	1.57	15.05	11.75	9.67	30.01
86.	Republic of Congo	4.85	0.57	41.25	20.34	58.49	59.00
87.	Ethiopia	4.80	0.36	63.88	64.57	58.43	69.10
88.	Gabon	4.72	1.50	14.85	19.63	3.33	50.12
89.	Israel	4.65	0.88	24.52	15.26	34.33	28.14
89.	Jamaica	4.65	1.10	19.63	14.12	11.63	46.09
91.	Poland	4.63	1.73	12.39	6.56	7.42	39.07

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
92.	Gambia	4.45	0.67	29.50	31.63	12.75	63.64
93.	Federated States of Micronesia	4.36	1.12	16.97	9.50	12.24	42.00
94.	South Sudan	4.21	0.25	70.80	70.33	67.15	75.14
95.	Belgium	4.16	1.84	9.39	4.56	7.60	23.91
96.	Guinea-Bissau	4.14	0.67	25.56	20.24	13.75	60.02
97.	Liberia	4.11	0.54	31.32	34.31	13.05	68.65
98.	Afghanistan	4.05	0.25	65.65	55.60	77.36	65.79
99.	Netherlands	4.04	2.20	7.41	7.56	1.84	29.30
100.	Tonga	3.94	1.33	11.66	15.46	11.38	9.01
101.	Germany	3.92	1.99	7.74	4.98	3.14	29.62
102.	Ukraine	3.89	0.48	31.57	15.96	42.80	46.07
103.	Antigua and Barbuda	3.84	1.20	12.27	5.57	9.34	35.55
104.	Georgia	3.79	0.73	19.67	19.29	8.78	44.96
105.	Bahamas	3.75	1.51	9.30	8.49	9.60	9.86
106.	Lebanon	3.52	0.38	32.52	12.94	46.65	56.95
107.	Mauritius	3.50	0.73	16.78	11.07	9.87	43.21
108.	Jordan	3.48	0.57	21.28	10.80	19.89	44.89
109.	Equatorial Guinea	3.36	0.86	13.13	10.19	3.67	60.47
110.	Central African Republic	3.34	0.16	69.84	72.37	63.08	74.63
111.	Malawi	3.30	0.35	31.20	34.13	14.24	62.51
111.	Montenegro	3.30	0.83	13.11	8.13	7.87	35.23
113.	Dominica	3.27	0.79	13.51	6.80	10.95	33.08
114.	Romania	3.19	0.71	14.31	7.46	8.78	44.77
115.	Norway	3.16	1.06	9.43	7.54	4.65	23.92
116.	Samoa	3.15	0.81	12.24	15.38	2.53	47.14
117.	Ireland	3.10	1.45	6.61	5.85	6.54	7.56
118.	Plurinational State of Bolivia	3.07	0.35	26.90	27.38	13.47	52.75
119.	Ghana	3.05	0.34	27.33	28.56	12.66	56.48
120.	Burundi	3.03	0.16	57.47	47.92	59.28	66.83
121.	Zambia	2.94	0.28	30.83	33.64	13.64	63.88
122.	Trinidad and Tobago	2.93	0.49	17.47	11.94	11.08	40.32
123.	Chad	2.92	0.12	70.90	68.38	70.01	74.44
124.	Lao People's Democratic Republic	2.91	0.38	22.22	13.74	14.02	56.92
125.	Uganda	2.81	0.23	34.27	49.03	13.60	60.37
126.	Cyprus	2.78	1.02	7.60	5.69	2.36	32.70
127.	Armenia	2.72	0.23	32.22	19.14	41.94	41.68
128.	Rwanda	2.70	0.16	45.47	34.11	46.02	59.90
129.	Saint Lucia	2.69	0.46	15.68	8.17	10.52	44.86
130.	Kiribati	2.64	0.69	10.13	7.46	2.83	49.29
131.	Nepal	2.62	0.25	27.54	27.17	13.52	56.89
132.	Comoros	2.56	0.33	19.83	10.08	14.66	52.80
132.	Kuwait	2.56	1.05	6.24	4.29	2.46	23.06
134.	Seychelles	2.54	1.03	6.27	4.01	2.51	24.49
135.	Bosnia and Herzegovina	2.51	0.34	18.60	14.19	10.32	43.96
136.	Zimbabwe	2.44	0.20	29.78	24.64	15.27	70.16
137.	Tajikistan	2.38	0.23	24.61	25.84	11.77	48.99
138.	Saint Vincent and the Grenadines	2.30	0.43	12.27	11.42	10.28	15.74
139.	Marshall Islands	2.29	0.50	10.51	9.14	2.86	44.35
140.	Mali	2.25	0.08	63.19	58.52	69.50	62.05
141.	Lithuania	2.24	0.64	7.83	6.50	2.12	34.83
142.	Azerbaijan	2.20	0.23	21.06	15.26	12.49	49.04
142.	Kyrgyzstan	2.20	0.22	22.00	19.09	10.76	51.87

Rank	Country	WorldRiskIndex	Exposure	Vulnerability	Susceptibility	Lack of Coping Capacities	Lack of Adaptive Capacities
144.	Kazakhstan	2.18	0.25	18.97	15.53	9.94	44.22
145.	Niger	2.17	0.07	67.29	66.01	66.81	69.09
146.	Bulgaria	2.15	0.30	15.34	10.57	8.17	41.78
147.	Latvia	2.14	0.79	5.79	7.32	2.35	11.27
148.	Cote d'Ivoire	2.08	0.13	33.33	53.25	13.06	53.24
148.	Mongolia	2.08	0.21	20.57	18.37	11.27	42.03
150.	Saint Kitts and Nevis	2.07	0.53	8.11	6.71	9.04	8.80
151.	Barbados	2.06	0.48	8.88	6.32	2.48	44.63
151.	Burkina Faso	2.06	0.07	60.53	60.45	60.76	60.38
151.	Sweden	2.06	1.05	4.06	3.95	1.08	15.72
154.	Grenada	1.85	0.31	11.08	13.65	2.62	38.05
155.	Serbia	1.84	0.17	20.00	22.06	10.00	36.26
156.	Estonia	1.82	0.43	7.69	6.78	2.14	31.29
156.	Eswatini	1.82	0.14	23.59	17.11	13.54	56.63
158.	Paraguay	1.74	0.14	21.63	15.86	13.06	48.87
158.	Uzbekistan	1.74	0.18	16.86	14.34	11.21	29.83
160.	Iceland	1.65	0.55	4.97	6.92	0.92	19.23
161.	Benin	1.61	0.09	28.66	30.63	12.41	61.96
162.	Tuvalu	1.46	0.15	14.16	10.19	10.54	26.43
163.	Botswana	1.44	0.09	23.15	26.37	10.34	45.52
163.	Slovenia	1.44	0.31	6.68	5.70	2.06	25.39
165.	Brunei Darussalam	1.34	0.33	5.47	6.42	2.33	10.95
166.	Lesotho	1.32	0.07	25.04	17.83	13.97	63.05
166.	Togo	1.32	0.07	24.73	18.17	13.73	60.64
168.	Finland	1.30	0.49	3.45	4.53	0.58	15.63
168.	Republic of Moldova	1.30	0.10	17.00	10.68	10.19	45.12
170.	Turkmenistan	1.29	0.17	9.76	10.99	3.08	27.46
171.	Cape Verde	1.27	0.07	23.11	25.35	11.08	43.96
172.	North Macedonia	1.26	0.10	15.99	9.53	10.45	41.07
173.	Palau	1.25	0.36	4.34	4.89	2.51	6.67
174.	Qatar	1.17	0.15	9.09	2.49	8.34	36.19
175.	Austria	1.14	0.17	7.66	4.80	3.19	29.33
176.	Bhutan	1.09	0.10	11.91	14.27	2.62	45.15
177.	Denmark	1.03	0.18	5.85	4.72	1.70	24.91
177.	Switzerland	1.03	0.16	6.65	4.99	2.42	24.36
179.	Maldives	1.02	0.11	9.42	5.63	10.27	14.44
180.	Czech Republic	1.00	0.10	10.08	7.38	4.03	34.45
180.	Nauru	1.00	0.11	9.17	7.90	2.89	33.73
180.	Slovakia	1.00	0.10	10.10	7.06	4.19	34.86
183.	Hungary	0.97	0.11	8.59	6.76	9.52	9.85
184.	Bahrain	0.95	0.14	6.50	5.14	2.68	19.91
185.	Malta	0.94	0.15	5.89	5.00	2.15	18.99
186.	Belarus	0.83	0.05	13.83	8.08	9.03	36.27
187.	Singapore	0.81	0.15	4.37	4.29	0.88	22.10
188.	Liechtenstein	0.79	0.09	7.00	6.47	1.76	30.12
189.	Luxembourg	0.52	0.06	4.43	5.49	5.69	2.79
190.	Sao Tome and Principe	0.48	0.02	11.69	9.70	3.06	53.83
191.	San Marino	0.38	0.03	4.75	2.54	1.89	22.29
192.	Andorra	0.26	0.02	3.37	2.54	1.81	8.29
192.	Monaco	0.26	0.02	3.37	2.35	1.77	9.21

WorldRiskIndex 2022, Countries in Alphabetical Order

Country	WRI	Rank
Afghanistan	4,05	98.
Albania	4,98	82.
Algeria	9,58	58.
Andorra	0,26	192.
Angola	11,02	47.
Antigua and Barbuda	3,84	103.
Argentina	15,61	32.
Armenia	2,72	127.
Australia	21,36	22.
Austria	1,14	175.
Azerbaijan	2,20	142.
Bahamas	3,75	105.
Bahrain	0,95	184.
Bangladesh	27,90	9.
Barbados	2,06	151.
Belarus	0,83	186.
Belgium	4,16	95.
Belize	7,65	69.
Benin	1,61	161.
Bhutan	1,09	176.
Bolivarian Republic of Venezuela	22,45	19.
Bosnia and Herzegovina	2,51	135.
Botswana	1,44	163.
Brazil	12,15	43.
Brunei Darussalam	1,34	165.
Bulgaria	2,15	146.
Burkina Faso	2,06	151.
Burundi	3,03	120.
Cambodia	8,42	65.
Cameroon	11,17	46.
Canada	18,99	25.
Cape Verde	1,27	171.
Central African Republic	3,34	110.
Chad	2,92	123.
Chile	13,84	39.
China	28,70	8.
Colombia	38,37	4.
Comoros	2,56	132.
Costa Rica	14,20	37.
Cote d'Ivoire	2,08	148.
Croatia	4,86	85.
Cuba	7,97	66.
Cyprus	2,78	126.
Czech Republic	1,00	180.
Dem. People's Republic of Korea	11,82	44.
Democratic Republic of Congo	9,65	56.
Denmark	1,03	177.
Djibouti	10,66	48.
Dominica	3,27	113.
Dominican Republic	13,23	40.
Ecuador	22,42	20.
Egypt	20,65	24.
El Salvador	14,37	34.
Equatorial Guinea	3,36	109.
Eritrea	7,70	68.
Estonia	1,82	156.
Eswatini	1,82	156.
Ethiopia	4,80	87.
Federated States of Micronesia	4,36	93.
Fiji	6,54	74.
Finland	1,30	168.
France	6,67	72.
Gabon	4,72	88.
Gambia	4,45	92.
Georgia	3,79	104.
Germany	3,92	101.
Ghana	3,05	119.
Greece	8,55	64.
Grenada	1,85	154.
Guatemala	11,18	45.
Guinea	6,84	71.
Guinea-Bissau	4,14	96.
Guyana	6,64	73.
Haiti	9,99	53.
Honduras	16,00	31.
Hungary	0,97	183.
Iceland	1,65	160.
India	42,31	2.
Indonesia	41,46	3.
Iran (Islamic Republic of)	18,48	26.
Iraq	8,65	63.
Ireland	3,10	117.
Israel	4,65	89.
Italy	9,37	60.
Jamaica	4,65	89.
Japan	17,03	28.
Jordan	3,48	108.
Kazakhstan	2,18	144.
Kenya	13,92	38.
Kiribati	2,64	130.
Kuwait	2,56	132.
Kyrgyzstan	2,20	142.
Lao People's Democratic Republic	2,91	124.
Latvia	2,14	147.
Lebanon	3,52	106.
Lesotho	1,32	166.
Liberia	4,11	97.
Libyan Arab Jamahiriya	14,31	36.

Country		WRI	Rank
Liechtenstein		0,79	188.
Lithuania		2,24	141.
Luxembourg		0,52	189.
Madagascar		23,48	17.
Malawi		3,30	111.
Malaysia		14,36	35.
Maldives		1,02	179.
Mali		2,25	140.
Malta		0,94	185.
Marshall Islands		2,29	139.
Mauritania		9,34	61.
Mauritius		3,50	107.
Mexico		37,55	5.
Monaco		0,26	192.
Mongolia		2,08	148.
Montenegro		3,30	111.
Morocco		10,29	51.
Mozambique		34,37	7.
Myanmar		35,49	6.
Namibia		5,93	76.
Nauru		1,00	180.
Nepal		2,62	131.
Netherlands		4,04	99.
New Zealand		13,05	41.
Nicaragua		22,35	21.
Niger		2,17	145.
Nigeria		9,12	62.
North Macedonia		1,26	172.
Norway		3,16	115.
Oman		7,27	70.
Pakistan		26,75	10.
Palau		1,25	173.
Panama		18,38	27.
Papua New Guinea		24,10	16.
Paraguay		1,74	158.
Peru		25,41	13.
Philippines		46,82	1.
Plurinational State of Bolivia		3,07	118.
Poland		4,63	91.
Portugal		5,08	80.
Qatar		1,17	174.
Republic of Congo		4,85	86.
Republic of Korea		10,51	50.
Republic of Moldova		1,30	168.
Romania		3,19	114.
Russian Federation		26,54	11.
Rwanda		2,70	128.
Saint Kitts and Nevis		2,07	150.
Saint Lucia		2,69	129.

Country		WRI	Rank
Saint Vincent and the Grenadines		2,30	138.
Samoa		3,15	116.
San Marino		0,38	191.
Sao Tome and Principe		0,48	190.
Saudi Arabia		9,64	57.
Senegal		5,42	79.
Serbia		1,84	155.
Seychelles		2,54	134.
Sierra Leone		5,00	81.
Singapore		0,81	187.
Slovakia		1,00	180.
Slovenia		1,44	163.
Solomon Islands		14,62	33.
Somalia		25,07	14.
South Africa		9,42	59.
South Sudan		4,21	94.
Spain		9,68	55.
Sri Lanka		5,93	76.
Sudan		10,12	52.
Suriname		4,87	84.
Sweden		2,06	151.
Switzerland		1,03	177.
Syrian Arab Republic		12,16	42.
Tajikistan		2,38	137.
Thailand		20,91	23.
Timor-Leste		7,97	66.
Togo		1,32	166.
Tonga		3,94	100.
Trinidad and Tobago		2,93	122.
Tunisia		9,87	54.
Turkey		16,23	30.
Turkmenistan		1,29	170.
Tuvalu		1,46	162.
Uganda		2,81	125.
Ukraine		3,89	102.
United Arab Emirates		6,52	75.
United Kingdom		5,78	78.
United Republic of Tanzania		16,38	29.
United States of America		22,73	18.
Uruguay		4,92	83.
Uzbekistan		1,74	158.
Vanuatu		10,64	49.
Viet Nam		25,85	12.
Yemen		24,26	15.
Zambia		2,94	121.
Zimbabwe		2,44	136.

Only countries that are member states of the United Nations are considered.

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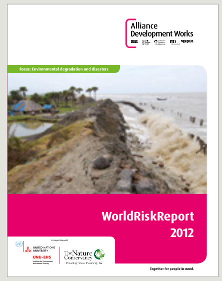

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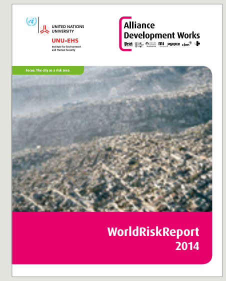

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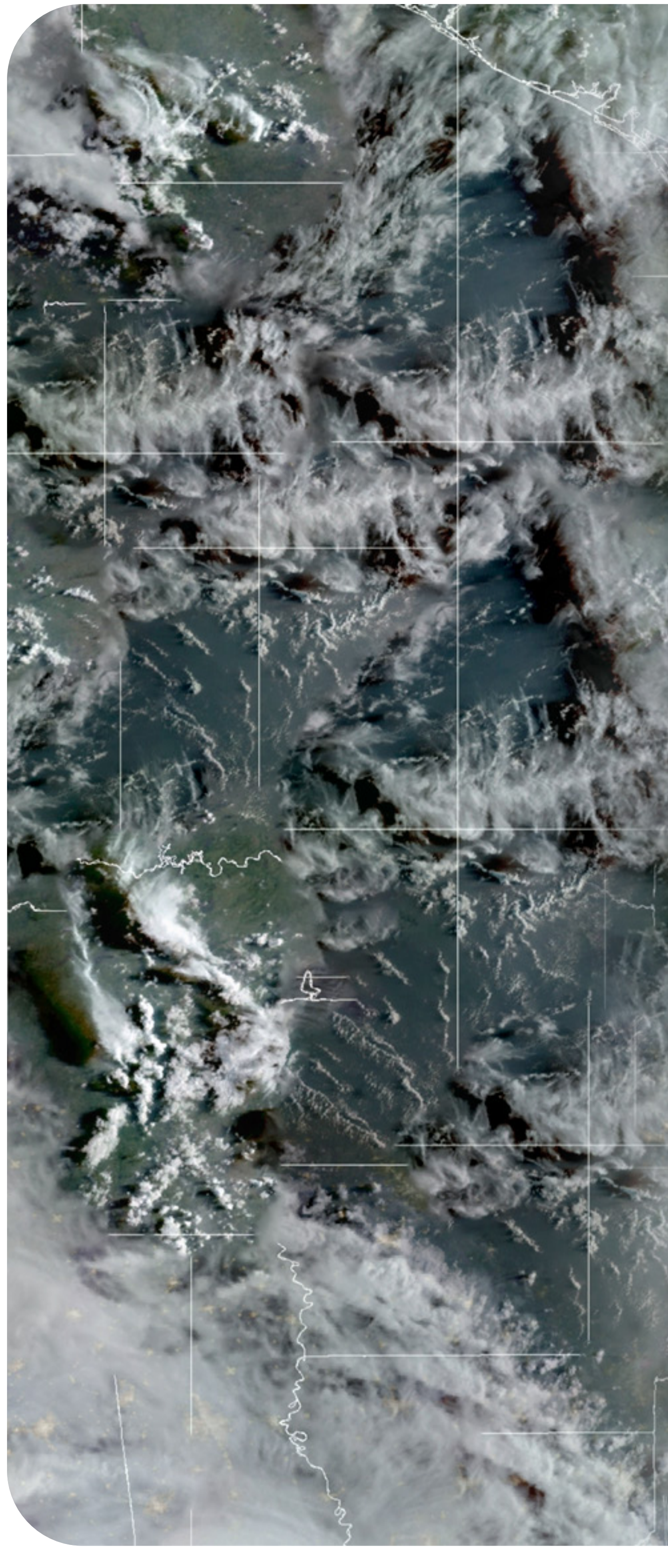

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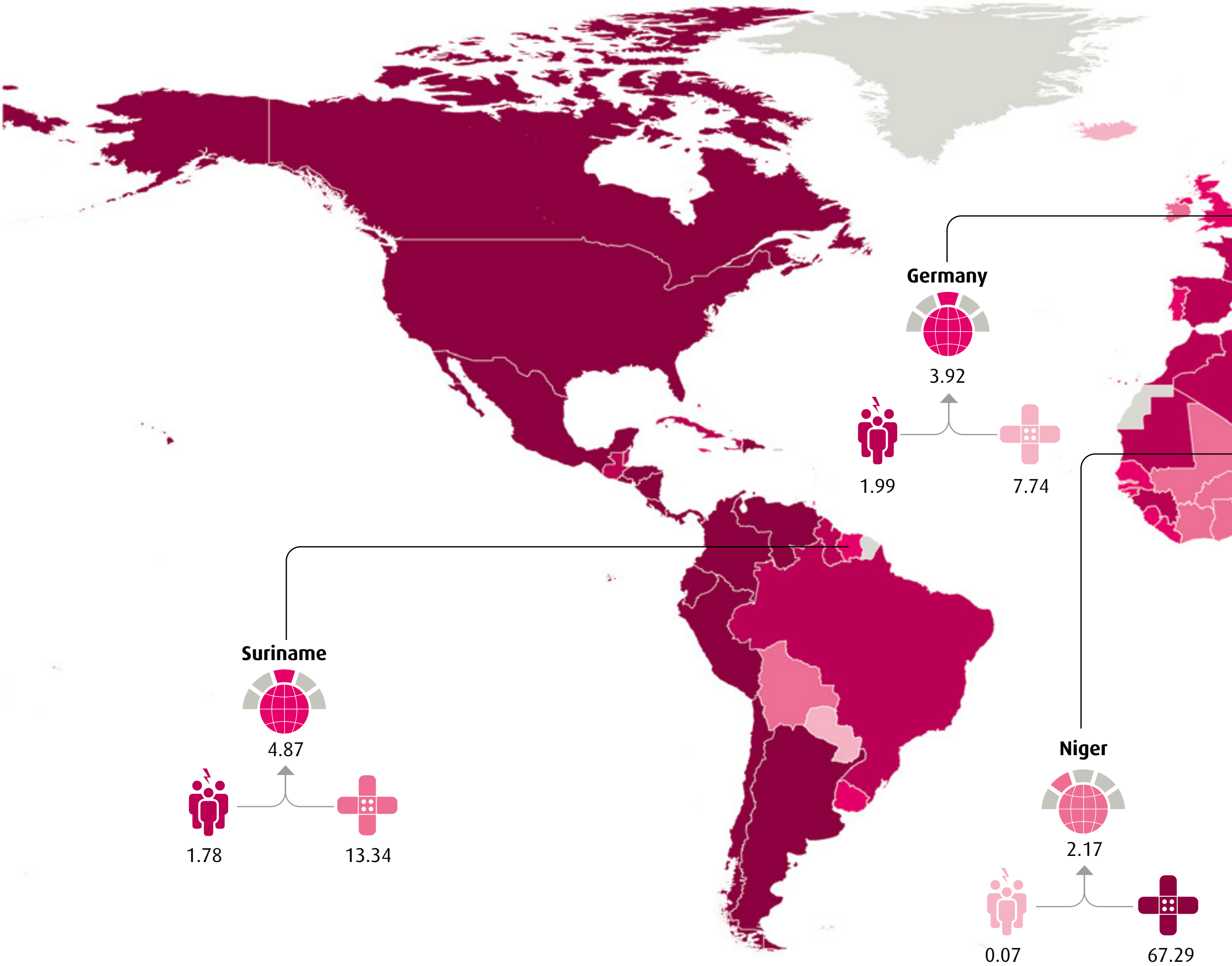

WorldRiskIndex

very low	0.00	–	1.84
low	1.85	–	3.20
medium	3.21	–	5.87
high	5.88	–	12.88
very high	12.89	–	100.00
no data			

Exposure

very low	0.00	–	0.17
low	0.18	–	0.56
medium	0.57	–	1.76
high	1.77	–	7.78
very high	7.79	–	100.00
no data			

Vulnerability

very low	0.00	–	9.90
low	9.91	–	15.87
medium	15.88	–	24.43
high	24.44	–	33.01
very high	33.02	–	100.00
no data			

As of this year, the WorldRiskIndex and its elements will use fixed thresholds for the classification of countries to enable medium- and long-term trends analyses. These threshold value
WorldRiskIndex model is always based on unweighted geometric mean values.
Data sources: IFHV's own calculation based on CReSIS, EMDAT FAO, GFDRR, IHME, IDMC, JRC, IMF, ILO, UCDP, UNESCO, UNHCR, UNSIDR, WHO, Worldbank, WorldPop, WID; detailed informatio

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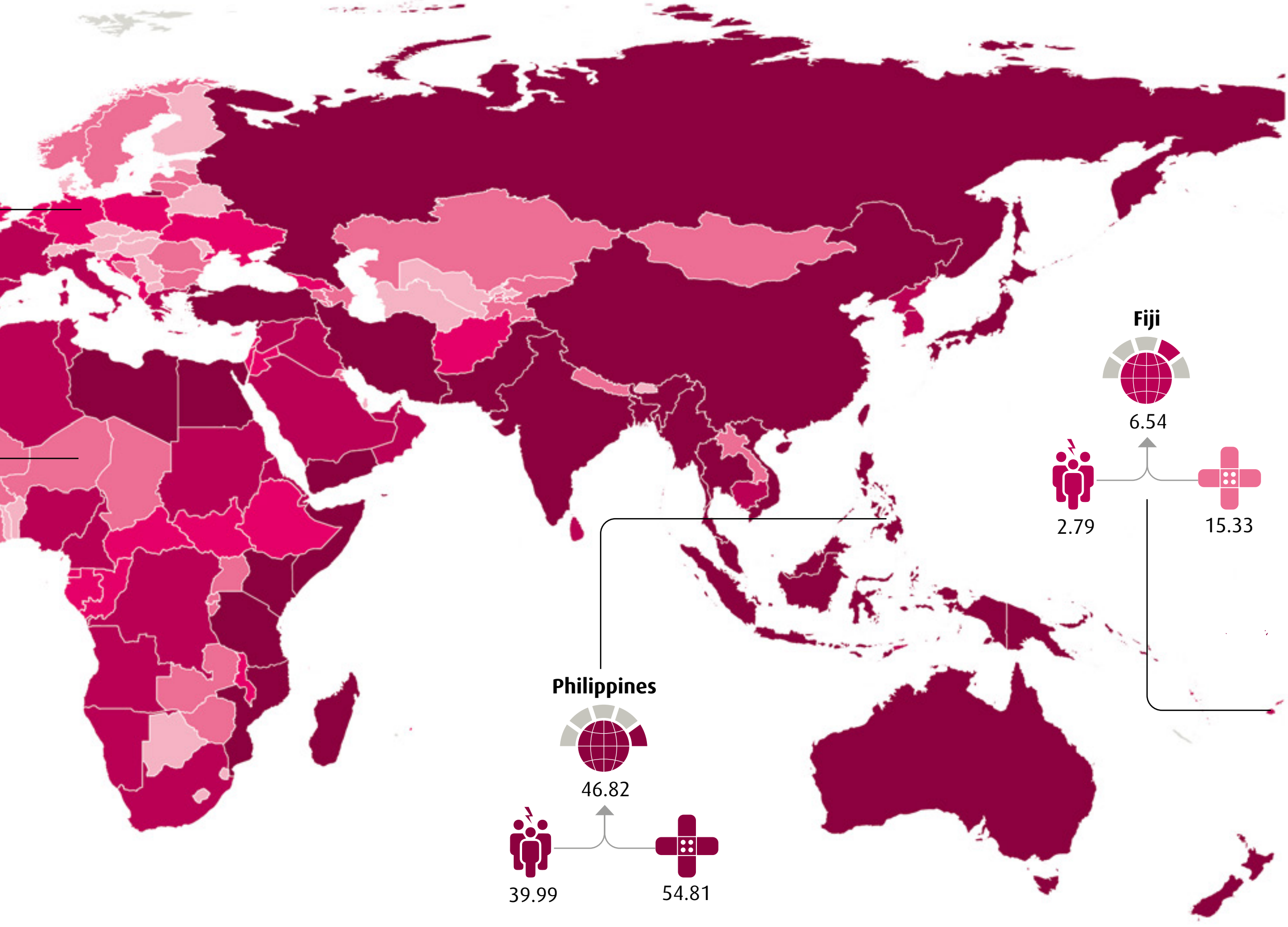


10 countries with highest risk

1.	Philippines	46.82
2.	India	42.31
3.	Indonesia	41.46
4.	Colombia	38.37
5.	Mexico	37.55
6.	Myanmar	35.49
7.	Mozambique	34.37
8.	China	28.70
9.	Bangladesh	27.90
10.	Pakistan	26.75

10 countries with highest exposure

1.	China	64.59
2.	Mexico	50.08
3.	Japan	43.67
4.	Philippines	39.99
5.	Indonesia	39.89
6.	United States of America	39.59
7.	India	35.99
8.	Colombia	31.54
9.	Australia	31.21
10.	Russian Federation	28.35

10 countries with highest vulnerability

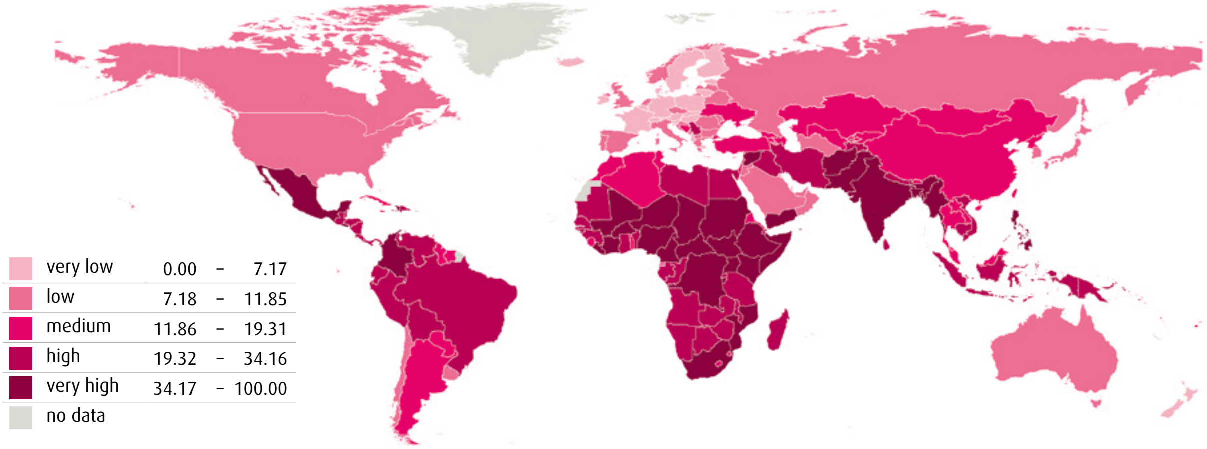
1.	Somalia	73.49
2.	Chad	70.90
3.	South Sudan	70.80
4.	Central African Republic	69.84
5.	Democratic Republic of Congo	68.00
6.	Niger	67.29
7.	Afghanistan	65.65
8.	Mozambique	65.28
9.	Yemen	64.52
10.	Ethiopia	63.88

s for the WorldRiskIndex and each dimension were calculated as the median of the quintiles form the results of the last 20 years. The aggregation of values across all levels of the

n at www.WeltRisikoBericht.de.

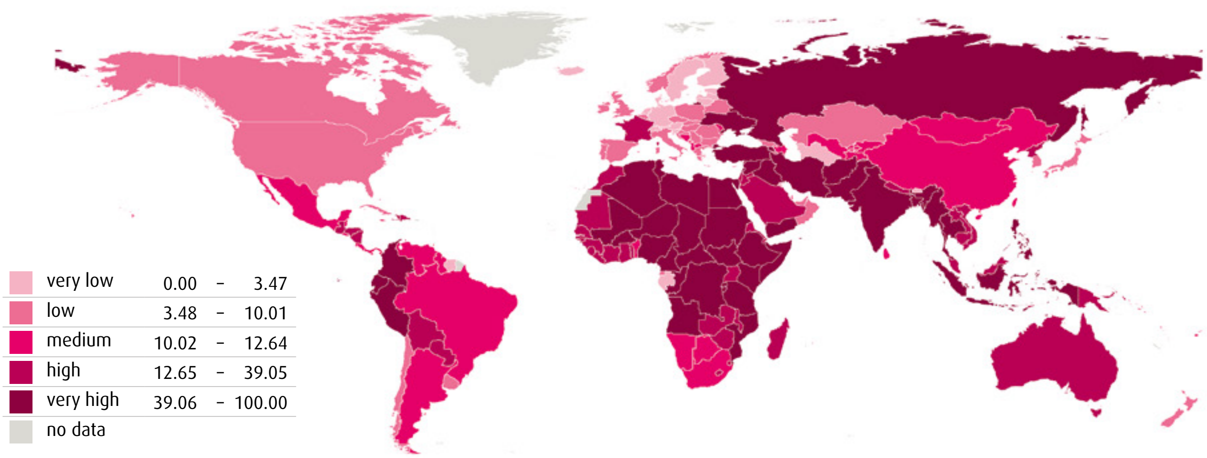
Susceptibility

Dependent on the level of socio-economic development, social disparities, deprivations and vulnerable population groups



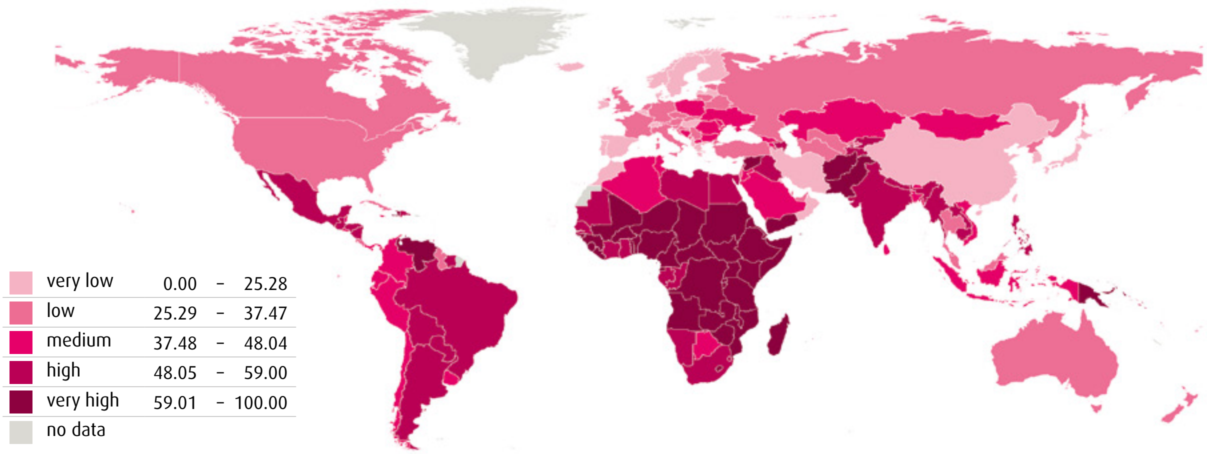
Lack Of Coping Capacities

Dependent on social shocks, political stability and the rule of law, health care capacities, infrastructure and material protection



Lack Of Adaptive Capacities

Related to developments in education and research, reduction of disparities, investments, disaster prevention and climate protection



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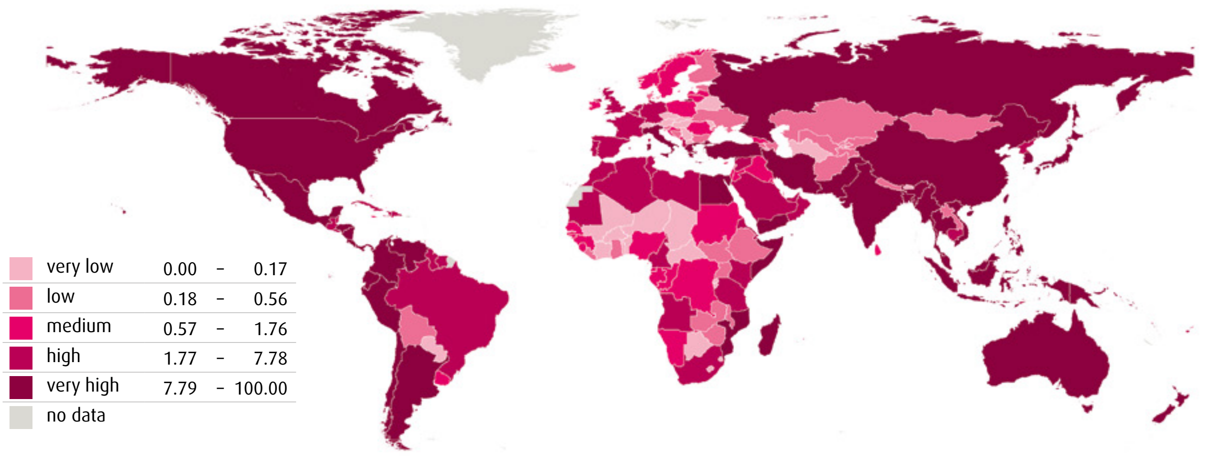
Data sources: IFHV's own calculation based on CReSIS, EMDAT, FAO, GFDRR, IHME, IDMC, JRC, IMF, ILO, UCDP, UNESCO, UNHCR, UNSIDR, WHO, Worldbank, WorldPop, WID; detailed information at w

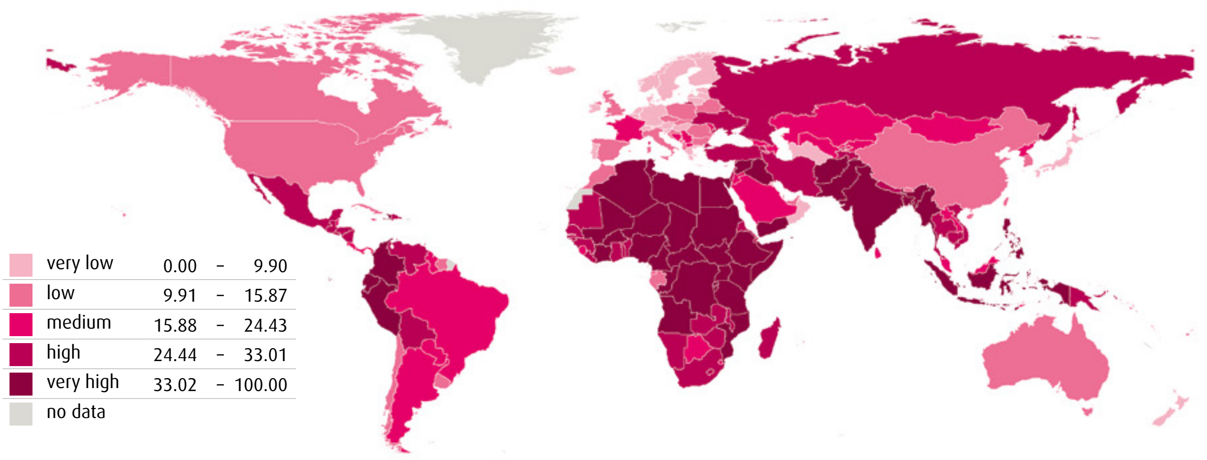
Exposure

Sphere of exposure to earthquakes, tsunamis, coastal flooding, riverine flooding, cyclone, droughts and sea level rise



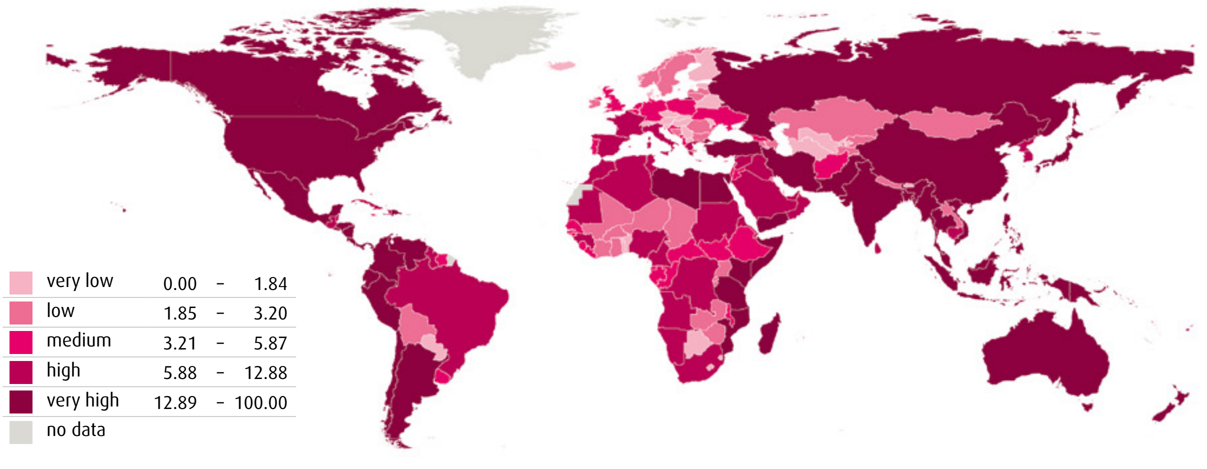
Vulnerability

Sphere of societal vulnerability consisting of susceptibility, lack of coping capacities and lack of adaptive capacities



WorldRiskIndex

Geometric mean of exposure and vulnerability



e WorldRiskIndex and each dimension were calculated as the median of the quintiles form the results of the last 20 years. The aggregation of values across all levels of the WorldRiskIndex model

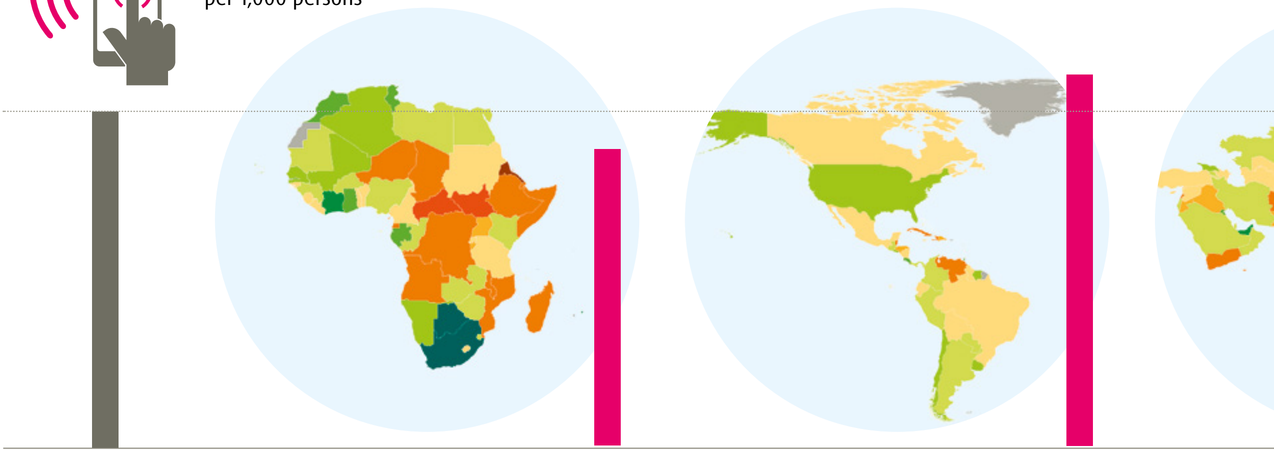
ww.WeltRisikoBericht.de.

Bündnis Entwicklung Hilft

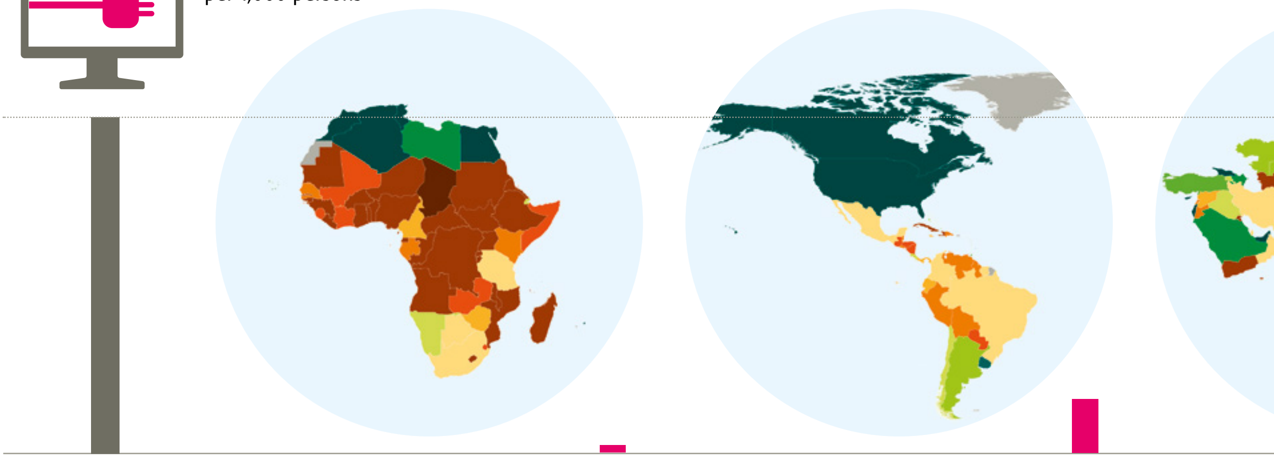
Gemeinsam für Menschen in Not.

Global Access to Inform
Communication Techno

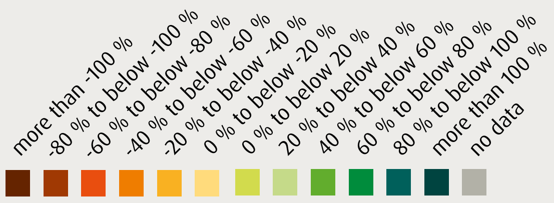
Mobile phone subscriptions
per 1,000 persons



Broadband subscriptions
per 1,000 persons



Negative to positive deviation from the continental mean value in percent



The chart shows ICT access worldwide based on the continental averages of the indicators ‘mobile phone subscriptions per 1,000 people’ and ‘broadband subscriptions per 1,000 people.’ The coloring in the map sections indicates the deviation (+/-) of the countries from the respective mean value in groups of percentage points. For example, Venezuela is in the group of countries that are 40-60 percent below the Americas mean (1,099.8) for mobile phone subscriptions, while China is more than 100 percent above the Asian mean (111.8) for broadband subscriptions.

Globally, significantly more people have mobile phone subscriptions than broadband subscriptions. In Africa, the continent with the lowest

Compilation based on ITU 2022, Weller 2022

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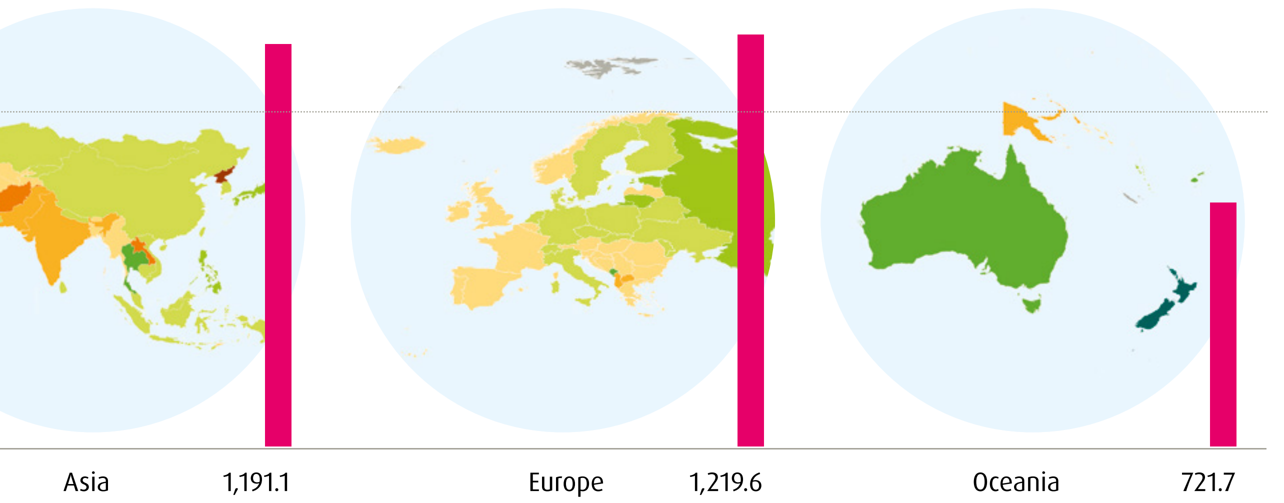

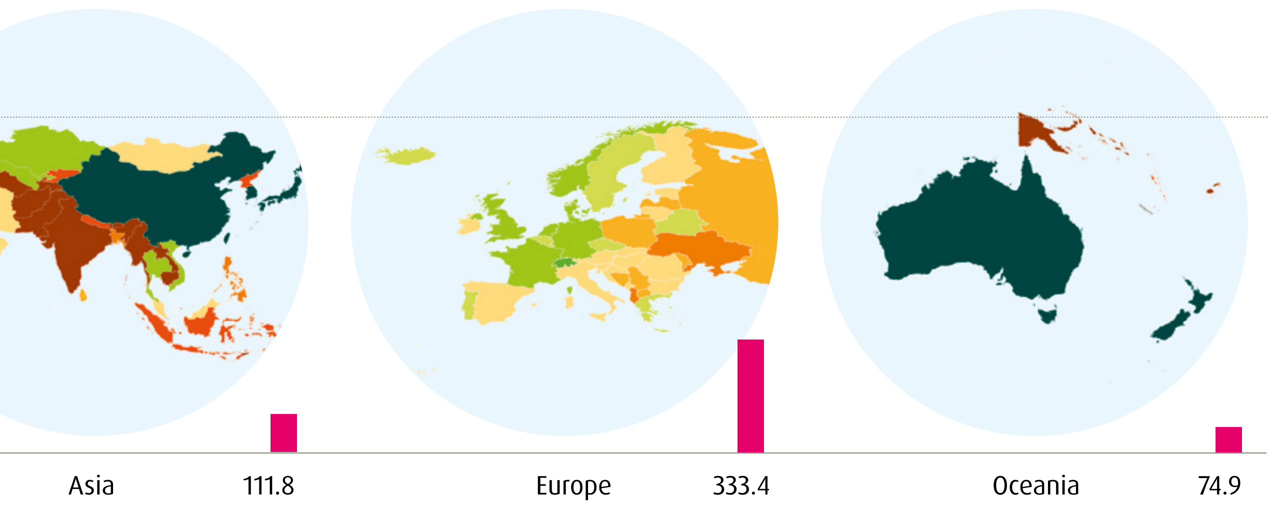

ICT connection values, the mean value for mobile phone subscriptions is 878.2, but only 21.5 for broadband subscriptions. Europe has the highest subscriptions values, with mean values of 1,219.6 for mobile phone subscriptions and 334.4 for broadband subscriptions. In addition to Europe, the Americas and Asia also have values of mobile phone subscriptions well above 1,000, suggesting that more than one subscription was concluded per person on average. Globally and continentally, mobile phone subscriptions are much more evenly distributed than broadband subscriptions. The reason for this is that mobile communications have become a basic technology as a result of enormous advances in production and technology. The interconnection with other areas, such as mobile banking, has made mobile devices a key societal resource globally. While mobile phone networks can be scaled in a short time, there are high technical obstacles for broadband connections due to the necessary infrastructure and higher investment and maintenance costs. This infrastructure is far from available in all regions and is also more susceptible to damage from extreme natural events. There is an urgent need for action on broadband coverage worldwide to improve access and make the opportunities for communication, research, and innovation, among other things, available to more people.

Bündnis Entwicklung Hilft

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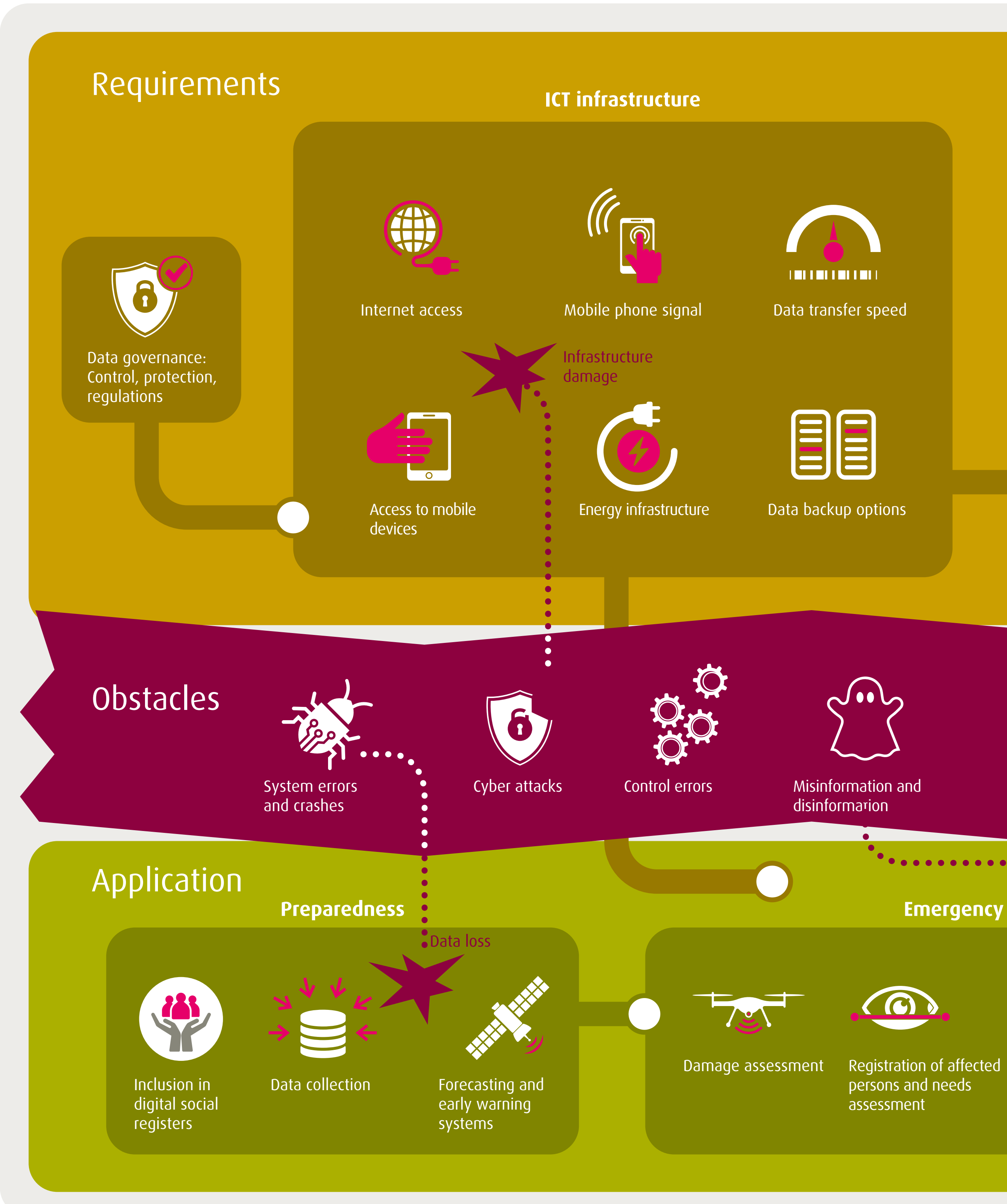
Gemeinsam für Menschen in Not.

ICT in disaster manage
Requirements, applicat



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