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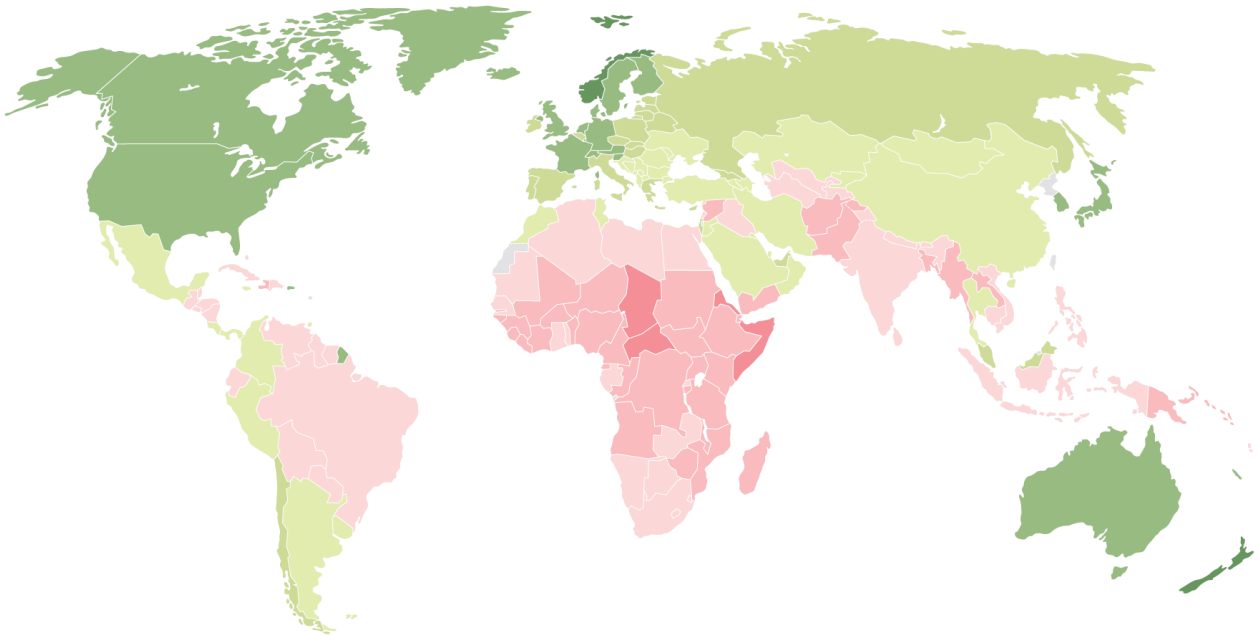
SDC Climate change foresight analysis

Global and regional risks and hotspots

Update 2021

Zürich, April 2021

Myriam Steinemann, Madeleine Guyer, Jürg Füssler



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Editorial Information

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Executive Summary

The CC foresight provides the SDC directorate and SDC units with information about short- and medium-term climate-related risks that might influence the programme and strategic work of SDC. It analyses these risks with regard to water, food, health and regional stability with a focus on short- and medium-term projections of 1–3 years. This report updates the first CC foresight, which was published in early 2020, and takes into account the COVID-19 pandemic, updated risk assessments and new data from 2020 and early 2021.

In 2020, non-climatic factors dominated the risk landscape. The COVID-19 pandemic has caused great disruption, affecting life-supporting sectors all over the world. The magnitude and unequal nature of the current crisis have resulted in an enormous setback to recent development gains, with large impacts on vulnerability. The 2021 CC foresight has largely confirmed the assessment of the 2020 analysis, with the COVID-19 pandemic amplifying and accentuating the prevailing risk situation and vulnerabilities especially in the areas health, food and regional stability. Several climate-related hazards have collided with the outbreak of COVID-19. A La Niña at the beginning of 2021 brought droughts or stronger hurricanes to various regions. A locust outbreak in Eastern Africa in early 2020, hurricanes in Central America in November 2020 and the second highest floods in Bangladesh since the late 1990s contributed to the increase in compound risks that put affected populations at heightened risk.

Current risks and hotspots strongly influence the risk situation in 1–3 years as exposure and vulnerabilities – the key determinants of risk – do not change much from year to year. Strong current extremes and compound risks also have an implication on the short-term risk as they may negatively influence vulnerability in upcoming years and the ability to cope with future shocks. Overall, hotspots with high climate-related risks are identified in large parts of sub-Saharan Africa (in particular the Horn of Africa and parts of the Sahel region), Syria, Yemen, the Hindu Kush, Bangladesh, Myanmar and Haiti. Those areas show interlinkages between various climate-related and non-climatic stressors, and a high vulnerability in all life-supporting sectors. Specifically, high climate-related risks are found in arid and semi-arid areas; in low-lying coastal areas and cities; in high mountains; and in downstream areas where changes in cryosphere strongly affect water resources. Furthermore, regions affected by recent compound or sequential events are especially at risk, such as East Africa, which was hit by a heavy locust outbreak followed by floods in 2020, and Central America, where major hurricanes caused deadly floods and landslides. Furthermore, countries with persisting conflicts and high fragility often have high climate-related risks such as Yemen, Syria, parts of the Sahel (Lake Chad Basin, Central Mali) and Afghanistan. Last but not least**,** in almost all regions with high

climate-related risks, non-climatic drivers have a stronger effect on current risks than climate variability and change.

1. Background and aim of the climate change foresight analysis

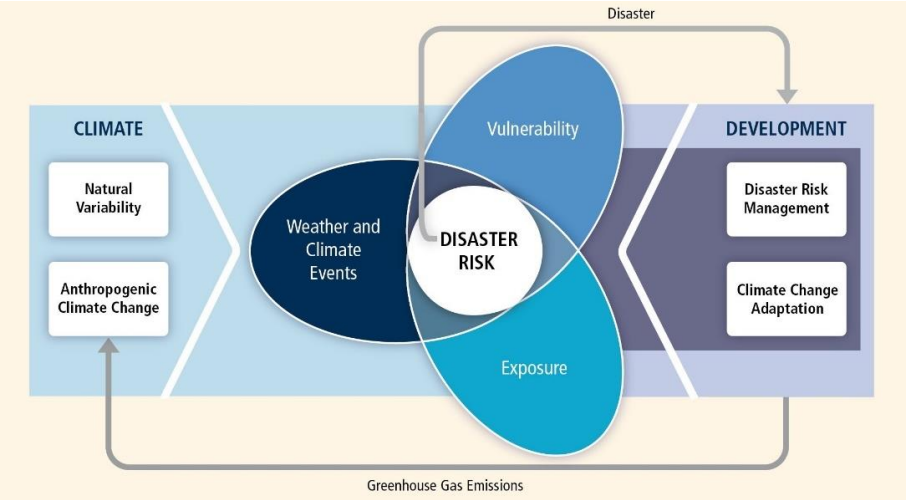
The Global Programmes Climate Change & Environment and Food Security together with representatives of humanitarian aid, south cooperation and east cooperation embarked on a strategic reflection on how SDC should increase its efforts to contribute to climate resilience in its working areas and to make its interventions fit for coping with climate change risks. One of the results of the reflection was the articulation of the need of a climate change foresight (CC foresight) analysis.

The CC foresight provides the SDC directorate and SDC units with information about short- and medium-term climate-related risks that might influence the programme and strategic work of SDC, and analyses these risks with regard to water, food, health and regional stability with a focus on short- and medium-term projections of 1–3 years. The first CC foresight was published in early 2020. This report is an updated version as of early 2021, and takes into account developments from 2020.

2. Current global risks and hotspots

Climate-related risks and hotspots are a result of a combination of climate change and variability, exposure and vulnerabilities of people and ecosystems and their ability to address those risks (readiness, adaptive capacity, etc.). The risk definition used for the CC foresight is based on the IPCC Risk framework (Figure 1):

Figure 1: IPCC Risk framework

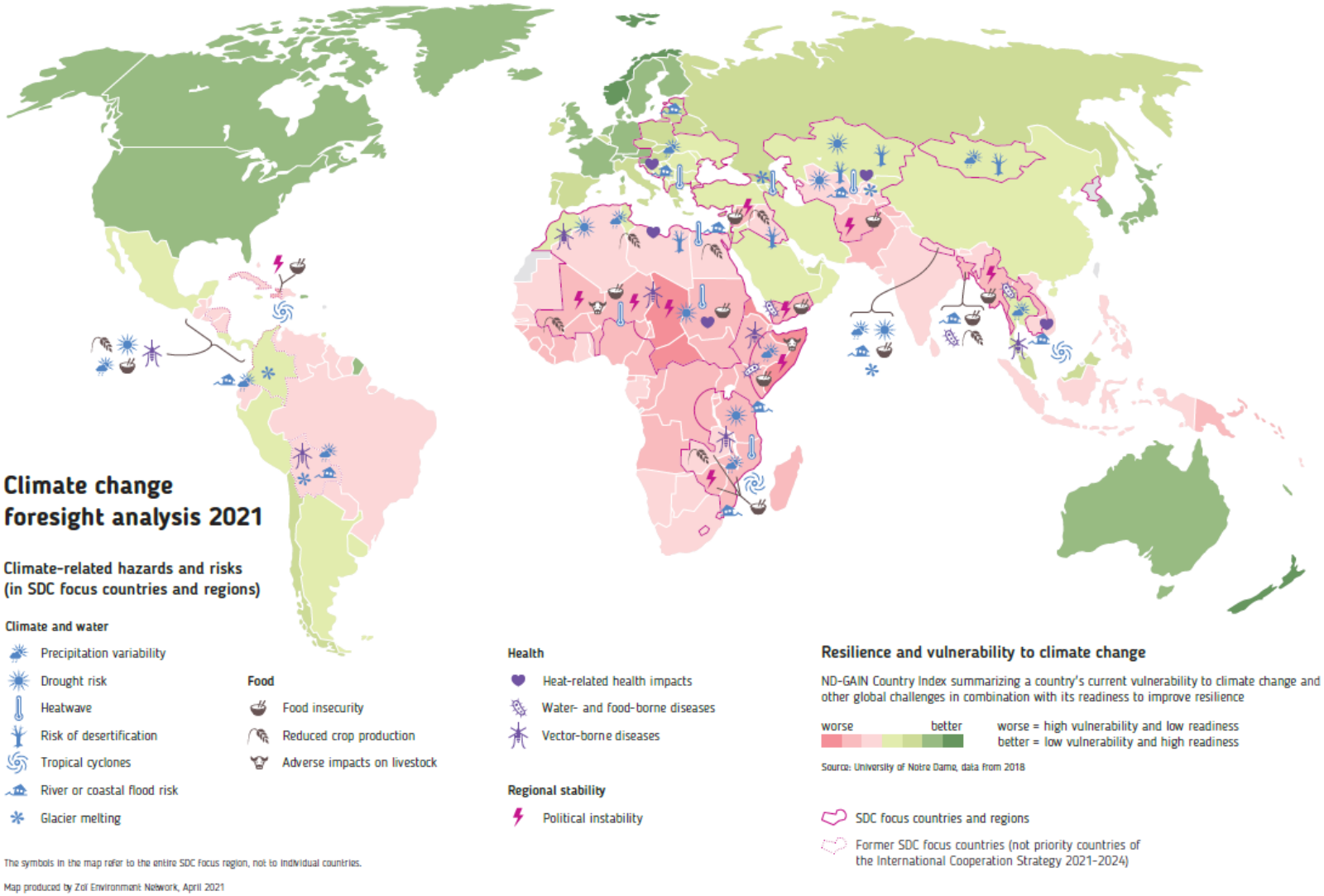


Source: IPCC 2012, SREX

Figure 2 gives an overview of the current climate-related risk situation in the world, based on the ND-GAIN Index. The ND-GAIN Index measures vulnerability including exposure in life-supporting sectors – food, water, health, ecosystem services, human habitat and infrastructure – on the one hand, and economic, governance and social readiness on the other hand.[1] The September 2020 annual ND-GAIN update includes a new food dependency indicator (as part of the food score), which includes more information regarding a country's external dependence on a broader range of imported foods beyond cereals. Furthermore, the new urban concentration indicator is more comprehensive in its scope and more frequently updated. The map in Figure 2 indicates the most relevant hazards and related impacts in SDC focus countries and regions identified in this analysis.

[1] There are several other compound indices estimating climate-related risks and/or vulnerabilities, e.g. the Climate Risk Index by Germanwatch (refer to Annex 3). ND-GAIN was chosen for this analysis due to its comprehensive approach covering all relevant life-supporting sectors.

Figure 2: Climate change foresight analysis 2021



In 2020, non-climatic factors dominated the risk landscape. The COVID-19 pandemic has caused a great disruption, affecting life-supporting sectors all over the world. The magnitude and unequal nature of the current crisis have resulted in an enormous setback to recent development gains, with impacts on vulnerability in general, and on unemployment, poverty and inequality (UNCTAD 2021).

Several climate hazards have collided with the outbreak of COVID-19 or otherwise jeopardized sensitive public health work. Such events as the locust outbreak in Eastern Africa in early 2020, hurricanes in Central America in November 2020 and the second highest floods in Bangladesh since the late 1990s contributed to the increase in compound risks that put affected populations at heightened risk and compromised recovery (Phillips et al. 2020).

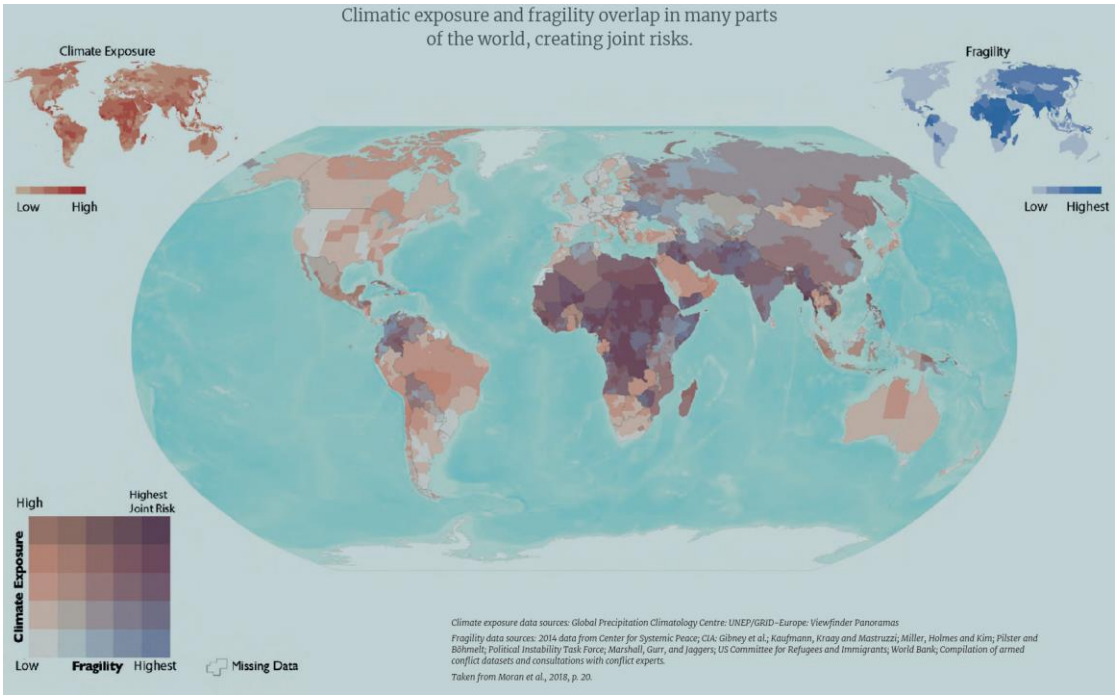
Hotspots with high climate-related risks are identified in large parts of sub-Saharan Africa (in particular the Horn of Africa and parts of the Sahel region), Syria, Yemen, the Hindu Kush, Bangladesh, Myanmar and Haiti. Those areas show interlinkages between various climate-related and non-climatic stressors, and a high vulnerability in all life-supporting sectors. The analysis of areas with currently high climate-related risks observes the following.

- **Arid and semi-arid areas** are extremely vulnerable to climatic trends. Where agriculture (crops or livestock) is the predominant livelihood activity, food systems entirely dependent on rainfall, and to a lesser extent irrigation-based systems, in water scarce areas are at risk. Such conditions can be found in large parts of the world, in particular in the Sahel region, in large parts of East and Southern Africa, the Middle East and North Africa, Central Asia and Central America.
- **Low-lying coastal areas and cities** are prone to coastal hazards and sea level rise. Given the high population densities in many coastal areas and growing urban populations, exposure and hence the risks are particularly high and increasing. This is the case for Bangladesh, coastal areas of Myanmar, parts of East and Southern Africa (Mombasa, Dar-es-Salaam, Maputo), the Nile delta in Egypt and Haiti.
- **High mountain areas and downstream areas** where the role of the cryosphere is important for water resources are strongly affected by glacier melt. As melt rates increase, run-off will also increase until a certain point – peak water – when the glacial mass is reduced to such a degree that run-off will start to decline. Peak water has likely already been reached in the Caucasus and parts of the Andes and is a future concern in Central Asia (the Syr Darya and Amu Darya rivers are mostly fed by snow melt and glacier melt) and the Hindu Kush.
- **In regions affected by compound or sequential events** – such as severe drought followed by extreme rainfall or the sequential occurrence of several hurricanes – risks are particularly high. Compound or sequential events cause extreme impacts in natural and human systems. In 2020, locust outbreaks followed by floods were reported in several countries in East Africa

(Ethiopia, Somalia and Kenya), with some regions still suffering from the impacts of previous droughts. As a result of unusually warm sea surfaces and La Niña conditions in the equatorial Pacific, the 2020 hurricane season brought more storms in the North Atlantic than ever before (MunichRe 2021). In November 2020, Central America was hit by *Eta* and *Iota*, two major hurricanes that caused deadly floods and landslides. In late 2020, four heavy storms in a row hit Vietnam, Laos and Cambodia (ERCC platform).

- **Countries with persisting conflicts and high fragility** often have high climate-related risks, given the complex interaction between climate and various drivers of conflicts and instability (water scarcity or food insecurity). As depicted in Figure 3, climate exposure and fragility overlap in many parts of the world, increasing joint risks. High political instability may further affect people's ability to cope with possible future climate shocks. Conflicts persist in Yemen, Syria and parts of the Sahel (Lake Chad Basin, Central Mali) and Afghanistan. The recent military coup in Myanmar may worsen fragility in the country.

Figure 3: Climate exposure and fragility



Source: Adelphi/PIK 2020.

- **Long-term unsustainable resource management practices**, overuse of scarce land and water resources, environmental degradation and increasing demand due to population growth are putting pressure on natural systems and are strongly influencing current climate-related

risks. In almost all regions with high climate-related risks, non-climatic drivers have a stronger effect on current risks than climate variability and change. Examples include the drying out of the Aral Sea, large-scale deforestation in the Amazon region or the depletion of aquifers in the Middle East and North Africa (MENA) region.

3. Future global risks and hotspots

Assessing short- and medium-term climate-related risks is challenging, as no specific weather or climate predictions can be made with a time horizon of 1–3 years (see Annex 2 for methodological details). Nevertheless, some estimates about short- and medium-term risks can be made by analysing current risks and developments.

Compound risks of COVID-19, climate change and human development are affecting the short-term risk landscape

COVID-19 will continue to increase vulnerability, poverty and the ability to cope with climate shocks in 2021 and the years to follow. Forecasts of the economic impacts of COVID-19 and its aftermath suggest long-term impoverishing effects, adding to the likelihood that the 2030 poverty reduction targets will not be reached (World Bank 2020).

Climate risks will further intersect with the health and economic crises related to the COVID-19 outbreak, with strong impacts on human development in general in the short term. The funding gap for climate and disaster resilience is expected to widen due to the massive mobilisation of resources in response to COVID-19. On the other hand, green recovery initiatives and funds that are being established in the aftermath of COVID offer developing countries opportunities to recover from COVID-19 by building back cleaner, greener and better.[2] Cleaner air and water, effective waste management, and enhanced biodiversity protection not only reduce the vulnerability of communities to pandemics and improve resilience, but have the potential to boost economic activity, generate income, create jobs, and reduce inequalities (OECD 2021).

Short- and medium-term risks are dominated by the current risk landscape

Climate risks are a result of the combination of climate hazards, exposure and vulnerability (Figure 1). While the climate signal – the occurrence of climate hazards or events in the next 1–3 years – is uncertain, exposure and vulnerabilities as key determinants of risk either do not

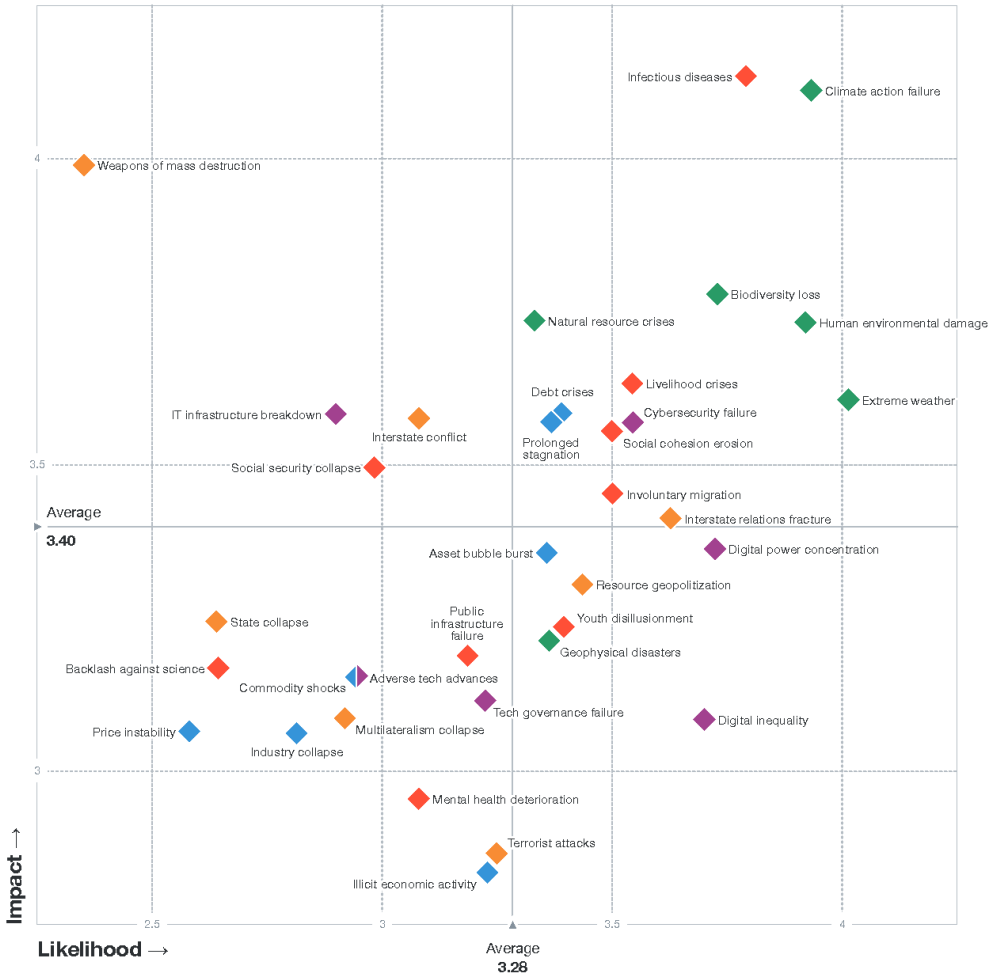
[2] e.g. the Climate Investment Fund (CIF) COVID-19 Technical Assistance Response Initiative for Green and Climate Resilient Recovery or mobilisation of private capital to green developing economies via the Green Climate Fund

greatly change from year to year or the changes are more predictable. Furthermore, non-climatic drivers have a stronger effect on current and short-term future risks than climate variability and change. Hence, we can assume that in general, the current risks and hotspots strongly influence the risk situation in 1–3 years.

Perception of risks is an indicator for potential upcoming risks

The perception of risks has a forward-looking perspective, as how people perceive risk at a given time presumably influences their decisions about the future – whether to invest or participate in prospective activities. In the perception of risks for 2020, the likelihood of infectious disease was still considered rather low, but for 2021 it overtook climate action failure as the risk with the highest potential impact. Otherwise, environmental and climate-related risks continue to dominate the results of the latest World Economic Forum Global Risks Perception Survey 2021 (Figure 4).

Figure 4: Global Risk Landscape 2021



Source: WEF 2021.

The latest survey shows that infectious diseases, climate action failure, biodiversity loss, natural resource crises, human environmental damage and livelihood crises are the risks ranked highest in terms of expected impacts. Extreme weather is perceived as being the risk with the highest likelihood to occur.

Severe impacts of current extremes are affecting risk in the short term

While past or current climate extremes or variability do not necessarily influence the situation in 1–3 years, there is evidence that past or current extreme events with severe impacts have implications for short-term risks. Extreme climate events push a system to near or beyond the ends of its normally observed range. Extremes can be very costly in terms of loss of life,

ecosystem destruction and economic damage (IPCC 2019 SROCC), and have long-term effects as they increase vulnerability in upcoming years and decrease the ability to cope with future shocks.

In 2020, parts of East and Southern Africa experienced droughts and droughts followed by flooding as well as locust outbreaks followed by flooding. These extreme weather events decimated livestock and destroyed farmland, negatively affecting people's livelihoods for several years. The two major hurricanes that hit Central America in November 2020 may also have long-term negative effects.

Gradual changes continuously increase risk

For changes related to slow onset events such as sea level rise and glacier retreat, we can interpolate the same or faster pace in the future, and implications for 1–3 years out are very likely. Hence, gradually increasing risks are likely in low-lying coastal areas and in high mountain and downstream areas where water resources depend on the cryosphere (see chapter 2).

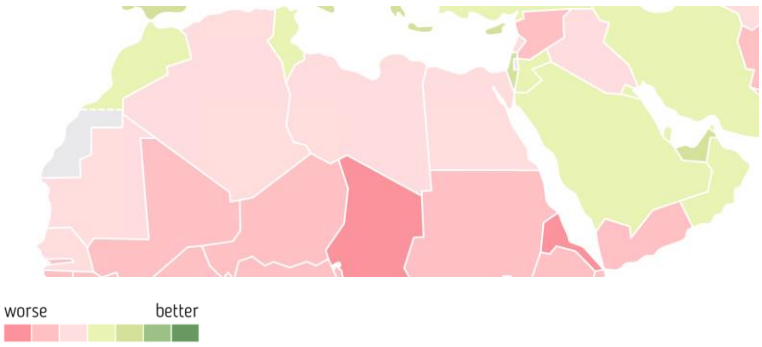
El Niño and La Niña are important drivers of climate variability

El Niño is the most important driver of climate variability and can trigger extreme weather events and disasters in various parts of the globe.[3] Many of the vector-borne and waterborne diseases in several regions are sensitive to changes in weather patterns brought about by the El Niño phenomenon. La Niña events develop approximately every two to seven years, last from six month to two years, and can have severe impacts on agriculture and food security. In October 2020, the World Meteorological Organization declared the development of a La Niña episode, and forecasted a 65% chance that it would last into the spring of 2021 with a medium to strong intensity (FAO 2020). The effects of the La Niña on agriculture and food security will potentially be felt throughout 2021. In addition, La Niña can contribute to an increase in Atlantic hurricane activity by weakening the wind shear over the Caribbean Sea and tropical Atlantic Basin, thus enabling storms to develop and intensify (NOAA 2020).

[3] The El Niño Southern Oscillation (ENSO) is a natural variation of the circulation pattern in and over the Pacific Ocean, with strong impacts on the meteorological conditions on a global level. El Niño events cause intense rainfall over Ecuador and Peru and wet conditions in Central America and the Caribbean and at the same time unusually dry conditions in Australia and Indonesia and droughts in East and Southern Africa.

4. Regional risks and hotspots

4.1. Middle East and North Africa



Source: ND Gain 2020

The overall climate related risks are mostly medium to medium high in the Middle East and North Africa and high in Syria and Yemen where civil war and conflicts dominate the overall risk situation. Potential hotspots where the risks are already high and where the situation has worsened in the past few years are Yemen, Syria, Libya and Lebanon (ND-GAIN 2020).

Climate Change

Precipitation changes, droughts and heatwaves are increasingly affecting the region. Coastal hazards and sea level rise are a concern for low-lying coastal cities and densely populated coastal areas of the Mediterranean. Observed trends are likely to increase.

Climate: Past and ongoing development	Climate: Trends
Precipitation decrease: Over the last few decades the northern regions of North Africa have experienced a strong decrease in the amount of precipitation received in winter and early spring (IPCC 2014). Decreasing trends are also observed in some parts of the Middle East. As in the two previous years, mostly average precipitation amounts were registered in the MENA region in 2020, hence no precipitation deficits have been observed (WASP index 2021).	A reduction in rainfall over many of the MENA countries (especially in the North African Mediterranean) is very likely by the end of the 21st century (IPCC 2014, Lange 2019). The projections for the maximum length of dry spells suggest trends towards drier conditions specifically for the Mediterranean (RICCAR 2018). No projections can be made for a 1–3-year period.
Droughts: Long-term trends in drought indicate higher frequency and intensity of drought in North Africa and the Middle East (IPCC SRCCL 2019). The drought risk resulting from the interactions between probability of a drought event, the number of people in drought-prone areas and vulnerability is medium high or high in most of the region, especially in densely populated coastal areas such as in Egypt, Palestine and Lebanon (ERCC 2019). Between 2010 and 2019, drought severity has been much higher	The likelihood of droughts is expected to increase with decreases in precipitation, but no projections can be made for a 1–3-year period. With ongoing population growth in drought-prone areas, however, the drought risk is likely to increase in the short term.

Climate: Past and ongoing development	Climate: Trends
compared to 1950 to 2009 in all North African countries (ERCC 2021).	
Summer warming and heatwaves: In recent decades, North African trends in mean near-surface temperatures indicate an overall warming that is significantly beyond the range of changes due to natural variability. An increase in the frequency of heatwaves has also been observed in North Africa (IPCC 2014). Temperature records have been repeatedly broken in the MENA region in recent years.	Temperatures in North Africa and the Middle East are projected to increase between 1.5 °C and 1.6 °C by mid-century and changes in the number of very hot days (> 40 °C) show significant projected warming throughout the region (RICCAR 2018). There is high confidence that heatwaves will increase in frequency, intensity and duration into the 21st century in the Middle East and Africa (IPCC SRCCL 2019). Short-term projections of heatwaves are not possible.
Dust storms: The frequency and intensity of dust storms have increased over the last few decades due to land use and land cover changes and climate-related factors in the broader Middle East and the Arabian Peninsula (IPCC SRCCL 2019).	No projections can be made on dust storms but the factors influencing the occurrence of such storms (land use, land cover changes) are expected to remain important.
Coastal hazards: Flooding, storm surges and sea level rise in the Mediterranean are putting low-lying coastal areas at risk, in particular the Nile delta, which is home to 41% of Egypt's population (IPCC 2019 SROCC). Given the high population density and the concentration of cities in coastal areas, sea level rise increases the risks to habitability of those cities (Lange 2019).	The rate of sea level rise has accelerated, and continues to increase (IPCC 2019 SROCC). Given the ongoing population growth in coastal areas, the risk of coastal hazards is expected to grow continuously.
Population growth and urbanisation: Northern Africa and West Asia have experienced high population growth rates in the last decades (UNDESA 2019). With 66% of total population, the share of urban population is relatively high with high annual growth rates in the MENA region (UNDESA 2019) The highest population densities and the major cities are concentrated along the Mediterranean coast (Lange 2019).	Over the next decade, population in the MENA region will grow further by 1.6% annually (OECD–FAO 2020).

Food

Climate change in the MENA region adds to the hazards of farming in an already exceedingly dry area of the world. Rain-fed agriculture in North Africa is highly dependent on winter precipitation and would be negatively impacted if total precipitation and the frequency of wet days decline (IPCC 2014). Low yields and a narrow scope for increases in arable area in the MENA region set limits on crop production resulting in a growing dependence on imports for basic food (OECD-FAO 2018).

Food: Past and ongoing development	Food: Trends
Agricultural production: Agricultural land and water are scarce in the Middle East and North Africa, and both rain-fed and irrigated land suffer from ongoing	Climate change is very likely to have an overall negative effect on yields of major cereal crops across Africa (IPCC 2014) and on all farming systems in the MENA

Food: Past and ongoing development	Food: Trends
degradation caused by wind and water erosion and unsustainable farming practices. Land productivity and average yields of rain-fed crops are low compared to other regions (OECD–FAO 2018). Between 2016 and 2020, cereal production slightly decreased in North Africa, with reduced production prospects for 2020 in Morocco, Tunisia and Algeria, mainly due to drought conditions. In the Near East, cereal production increased slightly in 2020 compared to 2019, with significant improvements in Syria due to favourable weather conditions (FAO 12/2020).	region (OECD–FAO 2018). Rain-fed agriculture in northern Africa is highly dependent on winter precipitation and would be negatively impacted by a decline in total precipitation and in the frequency of wet days (IPCC 2014). In the short term, conditions for sowing 2021 winter crops are mixed in North Africa and the Middle East (FAO 12/2020). No projections can be made for the year.
Non-climatic drivers: Human activities in combination with climatic variations have resulted in increased desertification in the region over the past several decades. The MENA region is among those with the highest number of people affected by desertification (IPCC SRCCL 2019). Due to the dry climate, about 40% of the cropped area requires irrigation (OECD–FAO 2018).	With climate change, desertification will increasingly affect the people in the MENA region negatively. Demand for irrigation will most likely increase with drier conditions, putting additional pressure on scarce water resources.
Food prices and food imports: Rising food demand and limited land and water resources led to rising import dependence for basic food commodities in the region. Many countries spend a large share of their export earnings on food imports (OECD–FAO 2018). In the North African countries, cereal import requirements for 2020–21 are 12% above the five-year average, with food inflation rates remaining at modest levels. Costs of living and food prices were on the rise in Yemen, Syria and Lebanon, with food inflation rates skyrocketing in Lebanon (FAO 12/2020).	High dependency on food imports makes the region potentially vulnerable to adverse climatic conditions in other parts of the world, and may lead to rising food prices. The outlook for world agricultural commodity prices remains highly uncertain and depends on the duration and severity of the COVID pandemic. Although world agricultural commodity prices are expected to rise only slightly in 2021, food insecurity concerns are high as a result of lower incomes, supply chain disruptions and border closures due to the pandemic (World Bank 2020)
Food insecurity: Conflicts, political insecurity and economic crises continue to drive high food insecurity in Yemen, Syria, Lebanon and Libya. Yemen remained the world's gravest humanitarian and food insecurity crisis in 2020, with the impacts of COVID-19, the desert locust outbreak and floods adding to the already critical situation (FAO 2020). Over 80% of the population requires humanitarian assistance (FAO 12/2020).	Projections of acute food insecurity for 2021 are very high in Yemen, with 16.2 million people projected to be at high level of food insecurity (ERCC 2021). Political instability and economic crises are increasing the numbers of food insecure people in Syria, Libya and Lebanon (FAO 12/2020).

Water

The MENA region is one of the most water-constrained areas of the world. Water scarcity and overuse of water resources is a concern for the whole region. Climate change will have an overall modest effect on future water scarcity relative to other drivers such as population growth, urbanisation and agricultural growth (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Water resources are subjected to high hydro-climatic variability over space and time (IPCC 2014), such as precipitation deficits and droughts reported in the last few years. The MENA region is one of the most water constrained areas of the world (OECD–FAO 2018). As a result of increasingly frequent and intense droughts in North Africa, surface water may not meet farmers' irrigation needs. Increasing reliance on groundwater would intensify already high pressure on groundwater and aquifers (Verner et al. 2018).	No specific projections can be made for a 1–3-year period, but climate change will amplify existing stress on water availability in Africa. Several studies point to a future decrease in water abundance due to a range of drivers and stresses, including climate change in northern Africa (IPCC 2014). In the long term (2050), climate change is estimated to account for 22% of future water shortages in the region (Droogers et al. 2012).
Water and conflict: Water challenges can compound existing and emerging instabilities and can contribute to unrest and conflict. Failure to address water challenges in the Middle East and North Africa can have significant negative spillover effects both within and outside the region (World Bank 2017). In North Africa, the decreasing availability of water and tensions over the allocation of water have combined with rising inequalities, social protests and diminishing livelihoods to increase climate-related security risks (CASCADES 2021).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor. Climate change impacts that intensify competition for increasingly scarce freshwater resources, especially in the context of population growth, are areas of concern (IPCC 2014).
Non-climatic drivers: Water scarcity in the region is driven by population growth, urbanisation, agricultural growth, land use change, over-extraction of water from rivers and lakes and increased reliance on irrigation to meet food demand (IPCC 2014). Water is used at unsustainable rates, with agriculture being the predominant user. Two-thirds of the countries use groundwater at rates exceeding renewable internal freshwater resources and leading to depletion of aquifers. Water is heavily subsidised – about 2% of GDP is spent on subsidies in the MENA region (OECD–FAO 2018)	Increased demand and unsustainable water use are expected to remain drivers of water scarcity in the coming years. Climate change is projected to account for 22% of the increase in future water shortages in North Africa, while socioeconomic factors are projected to account for 78% (IPCC 2014).
Water risks: Current overall water risks – both physical and regulatory (risk related to uncertainty in regulatory change, as well as conflicts with the public regarding water issues) – are high to extremely high in the Middle East and North Africa (WRI Aqueduct 3.0 2019). Twelve out of the 17 most water-stressed countries in the world are in the MENA region (WRI 2019).	No specific projections can be made for a 1–3-year period, but water stress and water demand are expected to increase in almost all parts of the region (WRI Aqueduct 3.0 2019). Economic losses from climate-related water scarcity are estimated to be around 6-14% of GDP by 2050 (World Bank 2017). The mid-century vulnerability of the water sector (combination of exposure, sensitivity, adaptive capacity) is particularly high in Yemen as a result of high population density, low adaptive capacity and low water availability (RICCAR 2018).

Health

People in the MENA region face a variety of health risks, many of which are exacerbated by the hot and arid conditions and relative water scarcity that generally characterise the region. The region is experiencing a resurgence of several vector-borne diseases that had previously been in decline (World Bank 2014). Impacts of extreme heat are an area of concern given the already very high summer temperatures.

Health: Past and ongoing development	Health: Trends
Heatwaves: High ambient temperatures and heatwaves have numerous health impacts including increased mortality. As in 2019, recent heatwaves in the MENA region (e.g. in May 2020 in Morocco and Libya) led to severe health impacts especially for urban populations.	Given the estimated increase in frequency, intensity and duration of heatwaves negative health impacts are expected to increase in the future. With already high and increasing levels of urbanisation, the number of people exposed to extreme heat stress (due to urban heat island effect) is expected to further increase.
Vector-borne diseases: Leishmaniasis and schistosomiasis, two neglected tropical diseases, are endemic in the MENA region and are considered major public health problems (RICCAR 2017). Outbreaks of Leishmaniasis are reportedly becoming more frequent in Tunisia, Algeria and Morocco, where the range of the disease has expanded (World Bank 2014).	Rising temperatures and changes in rainfall could impact the geographical extent and duration of disease transmission of Leishmaniasis and schistosomiasis (RICCAR 2017) No projections can be made for a 1-3-year period.
Foodborne and waterborne diseases: Cholera remains a major public health risk in the region, which has faced regular large outbreaks in recent years as in Yemen, where a major outbreak is still ongoing since 2017 (ECDC 2021). The incidence of diarrhoeal disease among children is high in parts of the MENA region where warm weather, inadequate access to drinking water, poor sanitation, and poverty collide (World Bank 2014).	Cholera outbreaks correlate with high temperatures and can follow extreme weather events that disrupt water supplies (World Bank 2014). Such disruptions might be of particular concern in Yemen where the situation is already critical. The risk of diarrhoeal diseases is expected to increase in the MENA region as a result of climate change (World Bank 2014).
Health impacts of dust storms: Growing negative impacts on human health such as damage to the respiratory and cardiovascular systems due to dust storms have been observed in the broader Middle East and the Arabian Peninsula (IPCC SRCCL 2019).	There is relatively little research on human health impacts of dust storms in the Middle East and North Africa (IPCC SRCCL 2019).
COVID-19: The pandemic is challenging MENA medical systems, some of which are particularly weak and overcrowded such as in Syria, the Palestinian Authority, Yemen, Libya and Lebanon (OECD 2020)	With the pandemic still raging in 2021, the pressure on the health system and health situation in the region will remain very high.

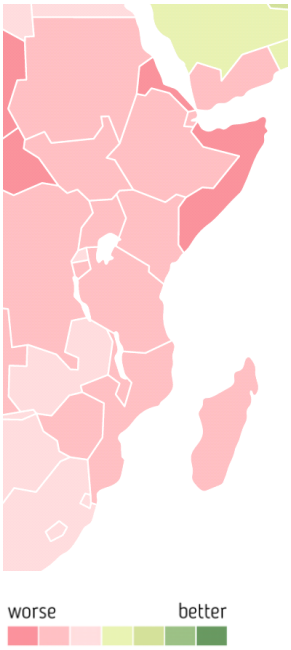
Regional stability

Climate has complex interactions with various drivers of conflict and instability, such as water scarcity or food insecurity, but its exact relevance is unclear. Climate change and climate variability have the potential to exacerbate or multiply existing threats to human security including

food, health and economic insecurity (IPCC 2014). The unprecedented 2020 economic downturn and current instabilities and conflicts in Yemen, Syria, Libya and Lebanon affect people's ability to cope with future climate shocks.

Regional stability: Past and ongoing development	Regional stability: Trends
Political instability: Yemen, Syria and Libya continue to rank among the most politically unstable and fragile countries in the world (very high alert/alert category of the Fragile States Index). The other countries fall in the category of warning or elevated warning (Fragile States Index 2020). The outbreak of the coronavirus has impacted political developments within MENA economies, and the countries' capacity to restore and support their social contracts is being increasingly questioned (OECD 2020).	High political instability may further affect people's ability to cope with possible future climate shocks in parts of the MENA region, which is already highly vulnerable and exposed to adverse climate conditions. The COVID-19 pandemic further exacerbates regional competition and political instability as well as fragility in some cases (OECD 2020).
Conflict: Major political, economic and societal transitions, frequently accompanied by armed struggles, are ongoing, and are turning the MENA region into a political, military and humanitarian hotspot (Lange 2019). Climate variability has the potential to exacerbate the threats to human security (IPCC 2014). As in previous years, conflicts and insecurity are the main drivers of acute food insecurity in Yemen, Syria and Palestine (FSIN 2020).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). As conflicts become more protracted, the resilience and coping capacities of the people caught up in them is eroded (FSIN 2020).
Migration: A key risk for the region is increased migration leading to human suffering, human rights violations, political instability and conflict (IPCC 2014). Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). Syria, Yemen and Libya counted more than 2.5 million additional internally displaced people (IDP) in 2019, the most in the region displaced by conflict and violence. Disasters triggered about 53,000 new displacements in these countries (IDMC 2020).	Given the various social, political, economic, environmental and cultural factors influencing the decision to migrate, assessments of future trends in environmentally induced migration are complex. In the short term, ongoing conflict and violence are expected to remain the main drivers of internal displacement in the region.
Economic development: GDP is estimated to shrink by 5.6% in Northern Africa and even more in the Middle East (-7.4% in Syria, -7.9% in Palestine and -31.2% in Lebanon) (UNCTAD 2021). Estimates for 2020 suggest that the economic impacts of COVID-19 and its aftermath may push about 3 million additional people into extreme poverty in the MENA region (World Bank 2020). The situation is of particular concern in Lebanon, crippled by the impact of multiple shocks which have caused an unprecedented poverty increase: 55% of the country's population are now trapped in poverty (OECD 2020).	Northern Africa is projected to achieve a relatively robust recovery, with regional GDP expanding by 6.0% in 2021 and 4.4% in 2022. In the Middle East, prospects for recovery are modest (UNCTAD 2021). The economic slowdown caused by the pandemic will cause additional millions of people to fall into poverty in the future. The pandemic might dramatically increase inequalities, and school closures risk weighing on the future development of MENA societies (OECD 2020). The long-term impacts of the pandemic on employment, productivity and output will be equally severe.

4.2. East and Southern Africa



Source: ND Gain 2020

Overall climate-related risk – including vulnerability and readiness to enhance adaptive capacity – is high to very high in the region. Overlapping climate-related and non-climatic stressors are turning the region into one of the most vulnerable and least prepared in the world (ND-GAIN 2020).

The Horn of Africa region, where weather extremes are exacerbating an already critical risk situation, faces particularly high risks. The situation has grown even worse in recent years, especially in Somalia and Eritrea.

Climate Change

Climate-related risks are high in the region as a result of numerous hazards, the severity of multiple stressors and the existing adaptation deficit (IPCC 2014). Further temperature increases, droughts and extreme precipitation changes are likely in some parts of the region and may negatively affect human and natural systems.

Climate: Past and ongoing development	Climate: Trends
Temperature increases and heatwaves: The equatorial and southern parts of East Africa and Southern Africa have experienced a significant increase in temperature since the early 1980s. In Southern Africa, the probability of austral summer heatwaves increased over the last two decades of the 20th century compared to the 1961–80 period (IPCC 2014).	Future projections of temperature show warming trends across East Africa and even more in Southern Africa. Mean land surface warming in Southern Africa is likely to exceed the global mean land surface temperature increase in all seasons (IPCC 2014). The frequency, intensity and duration of heatwaves are projected to increase in many regions.
Extreme precipitation and floods: East Africa has experienced more frequent droughts and heavy rainfalls during the last 30–60 years (IPCC 2014). In 2020, widespread floods were reported in Ethiopia, Sudan and South Sudan (FAO 12/2020). For Sudan, this flooding came in the wake of droughts followed by floods in previous years.	Rainfall over East Africa is expected to increase and decrease depending on the location and the season, but in the southern part of the continent rainfall is expected to decrease. No projections can be made for a 1–3-year period, but the impacts of La Niña are expected to affect part of the region throughout 2021. The Greater Horn of Africa is expected to face rather dry conditions, whereas Southern Africa, in particular

Climate: Past and ongoing development	Climate: Trends
	Mozambique and Zimbabwe, are at risk of facing particularly wet conditions, increased flooding and heightened cyclone activity (FAO 2020-2021 La Niña Advisory). Risks may increase as a result of compound events, such as drought followed by extreme rainfall resulting in flooding. The impacts of such compound events are not yet well understood (IPCC SRCCL 2019).
Severe droughts: A continued warming in the Indo-Pacific Warm Pool contributed to more frequent East African droughts over the past 30 years (IPCC 2014). Between 2010 and 2019, drought severity has been much higher compared to 1950 to 2009 in Eritrea, Djibouti, Sudan and Uganda (ERCC 2021). Between 2018 and 2020, severe and recurrent droughts have been observed in parts of Southern Africa, the Greater Horn of Africa (Kenya, southern Somalia, Uganda, southern Ethiopia) and Sudan (Global Drought Observatory 2020, 2019).	Both increases and decreases of rainfall are projected in East Africa depending on location and season, while Southern Africa is projected to become drier with increased drought risks (IPCC 2014). Severe drought events in the past may affect people's ability to cope with future shocks as countries and regions are still recovering from past events.
Coastal hazards: Flooding, storm surges and sea level rise are concerns for low-lying coastal cities in East and Southern Africa (e.g. Mombasa, Dar-es-Salaam, Maputo) (IPCC 2014).	With sea level rise and rapid urbanisation in coastal cities, the number of people at risk is expected to increase in the short and longer terms.
Cyclones: After being severely affected by two major tropical cyclones (*Idai* and *Kenneth*) in 2019, Mozambique was hit again by a tropical cyclone in January 2021 (*Eloise*), shattering its progress in recovering from the previous storms. There are large uncertainties whether frequency and intensity of tropical cyclones from the south-west Indian Ocean have changed (IPCC 2014).	Consensus projections of future tropical cyclone behaviour indicate increases in their maximum intensities and increases in tropical cyclone-related rainfall (Walsh et al. 2019). In the short term, past cyclones will negatively affect people's ability to cope with future shocks as countries are still recovering from past events.
Climate related risks: The region faces a combination of high climate hazards and multiple non-climatic factors and stressors such as the existing high vulnerability of the population (in particular pastoralists and city dwellers), the high dependency on rain-fed agriculture, poor health systems, rapid urbanisation and large informal settlements in hazard-prone areas. Climate conditions in rural agricultural areas have an influence on further urbanisation.	No significant changes of current climatic stressors are expected in a 1–3-year period. With population growth and urbanisation taking place mainly in coastal zones, exposure of the population to coastal flooding and sea level rise is expected to constantly increase. The population in the region is expected to grow by more than 2% per year in the next 10 years (UN 2019).

Food

Given the high reliance on livestock and rain-fed crop production and the high intra- and inter-seasonal climate variability, food production systems in East and Southern Africa are very vulnerable. A massive locust outbreak, widespread floods and the impacts of the COVID-19 pandemic were the main drivers of food insecurity in 2020.

Food: Past and ongoing development	Food: Trends
Agricultural production: Both cereal production and livestock systems are heavily dependent on rainfall and are vulnerable to droughts, changing precipitation patterns and rising temperatures. Starting in early 2020, a massive desert locust upsurge broke out across greater East Africa, affecting crops and pastures in Somalia, Kenya and Ethiopia, but large scale control operations have contained the losses. Despite this outbreak and crop losses due to floods, the abundant seasonal rainfall in 2020 had an overall positive impact on cereal production in Southern Africa (Malawi, Lesotho, Mozambique, Zimbabwe) and parts of East Africa (Sudan, Tanzania, Kenya, Uganda) (FAO 12/2020). In pastoral areas, the conditions have been mixed in 2020, with some areas (Somalia, Ethiopia) being affected by dryness (as in the previous year) and by locust-induced pasture losses, resulting in deterioration. As in 2019, widespread floods resulted in livestock deaths in parts of Ethiopia, Sudan, South Sudan and Somalia (FAO 12/2020).	In general, climate change is very likely to have an overall negative effect on yields of major cereal crops across Africa, with the exception of East Africa, where maize production could benefit from warming at high elevations. Rising temperatures and precipitation changes are linked to adverse effects on livestock (increased heat and water stress, impacts on feed quality and quantity) and to shifts in the range of pests and diseases, with adverse impacts on pastoral livelihoods and rural poverty. These are key risks for the region (IPCC 2014). In the short term, consequences of the 2020 locust outbreak will be felt in East Africa as farmland and the lifelines of millions have been destroyed. Widespread seasonal rains by the end of 2020 boosted yields but also allowed locust infestations to increase further in 2021 (FAO 2020). In Southern Africa, the weather outlook points to promising yields for 2021 cereal crops (FAO 12/2020).
Non-climatic drivers: Entrenched poverty, environmental degradation of pastures and cropland, rapid urbanisation, a high population growth rate and increasingly globalised food chains are posing challenges to food security in the region.	All non-climatic drivers are expected to remain relevant in a 1–3-year perspective. Negative impacts of the current COVID-19 pandemic will most likely exacerbate existing risks.
Food prices and imports: Prices of relevant cereals (maize, sorghum) continued to rise steeply in the Sudan and South Sudan and levelled off or declined in other parts of East Africa. In Southern Africa, food prices remained stable or climbed moderately (FAO 12/2020).	With restrictive measures to contain the COVID-19 pandemic still in place in 2021, reduced trade of food commodities, reduced market availability and higher food prices will most likely prevail in the region throughout 2021 (FAO 12/2020).
Food insecurity: The food security situation is affected by the combined impact of the COVID-19 pandemic, widespread floods and desert locusts in East Africa, with 28 million people in need of humanitarian assistance, mainly in Ethiopia, Sudan and South Sudan. In Southern Africa, COVID-19 has increased food insecurity despite large harvests and stable food prices (FAO 12/2020).	Food insecurity is expected to remain at alarming levels in East Africa, given that the impacts of the pandemic on livelihoods and related factors such as high food prices will remain noticeable throughout 2021. The desert locust upsurge continues to threaten food security in the Horn of Africa (FAO 2020). In Southern Africa, the number of food insecure people is estimated at about 13 million people for 2020–21, nearly 10% higher than the previous year, with COVID-19 being the key factor driving current conditions (FAO 12/2020).

Water

Compounded stress on water resources is very high in the region, especially in the dry areas in the Horn of Africa and parts of Southern Africa. Climate change will amplify the existing stress

on water availability due to population growth, urbanisation, agricultural growth and land use change in East and Southern Africa (IPCC 2014). There is a significant sub-regional variability of climate impacts, particularly in water-stressed regions that are projected to become drier, such as parts of Southern Africa (mainly south-western parts).

Water: Past and ongoing development	Water: Trends
Water availability: Water resources are subjected to high hydro-climatic variability over space and time (IPCC 2014). Precipitation deficits, droughts and extreme precipitation changes have been reported in the last few years.	No specific projections can be made for a 1–3-year period, but the stress on water availability is likely to increase in already dry regions where precipitation is likely to decrease over time, namely in Southern Africa. Climate change is expected to have an overall modest effect, however, on future water scarcity relative to other drivers such as population growth, urbanisation, agricultural growth and land use change (IPCC 2014).
Water scarcity: The scarcity of water may fuel existing tribal conflicts in Ethiopia, Kenya, Uganda and Sudan (Factbook ECC platform 2021). Several multinational disputes over transboundary water bodies, e.g. the conflict over access to and rights over the Nile water resources among its eleven riparian countries, and the transboundary water disagreements between South Africa and Namibia, remain unresolved (Factbook ECC platform 2021).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). Hydro-climatic change may affect the occurrence of conflicts, although water scarcity alone does not produce conflicts, but rather the water scarcity-abundance dynamic (Selby and Hoffmann 2014).
Non-climatic drivers: The main non-climatic drivers of water scarcity in the region are population growth, urbanisation, agricultural growth, land use change and over-extraction of water from rivers and lakes (IPCC 2014).	Water demand is expected to further increase due to population growth, urbanisation, agricultural growth, and land use change. This increased demand is expected to have a strong influence on future water scarcity (IPCC 2014).
Water risks: Current overall water risks – both physical and regulatory (risk related to uncertainty in regulatory change, as well as conflicts with the public regarding water issues) – are high to extremely high in the region, with extremely high risks in large parts of Sudan, South Sudan, Eritrea, Djibouti, Somalia, Zimbabwe and Botswana (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but water demand is expected to increase in almost all parts of the region with already high to extremely high water risks (WRI Aqueduct 3.0 2019).

Health

Climate variability and change affect the incidence and geographic range of sub-Saharan Africa's high health burdens. According to projections, sub-Saharan Africa is expected to have the greatest climate-induced health burden worldwide (IPCC 2014). Malnutrition, diarrhoeal diseases and vector-borne diseases are areas of concern in East and Southern Africa. With climate change, highland areas in East Africa will experience increased malaria epidemics.

Health: Past and ongoing development	Health: Trends
Malnutrition: Africa is the region where climate shocks and stressors have had the biggest impact on acute food insecurity, malnutrition and undernutrition. The levels of malnutrition remained high across East Africa, with an estimated 9.5 million children suffering from acute malnutrition in 2019, most of them in Ethiopia and Sudan. In Southern Africa, chronic malnutrition rates were particularly high in Tanzania and Mozambique (FSIN 2020). In 2020, the impact of COVID-19 has exacerbated the already considerable burden of malnutrition in East and Southern Africa (WHO Africa 2020)	Improvements in reducing the rates of undernutrition may be negatively affected, and potentially reversed, by climate change impacts (UNEP 2018). Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). Models suggest about 30,000 additional deaths due to climate change in East and Southern Africa by 2030 (WHO 2014). With COVID-19 being the key factor driving current food insecurity in large parts of the region, the burden of malnutrition will most likely increase.
Foodborne and waterborne diseases: Cholera is primarily associated with poor sanitation, poor governance and poverty, but climate factors such as increased rainfall and flooding during and after El Niño events have contributed to cholera outbreaks in East Africa, e.g. in Mozambique (Ajayi and Smith 2019). As in 2019, cholera outbreaks have been reported in Ethiopia, Kenya and Somalia in 2020 (ECDC 2020).	Additional cholera cases are projected to occur in East Africa during and after El Niño events (Amegah et al. 2016). The relationship between temperature and diarrhoeal diseases is expected to vary. Climate change is projected to cause an estimated 11,000 additional children's deaths due to diarrhoeal diseases by 2030 in East Africa (WHO 2014).
Vector-borne diseases: Climate factors have a substantial effect on malaria transmission, especially in countries where GDP per capita is low (WHO 2014). The malaria incidence rate in parts of the region, in particular in Rwanda, Mozambique, South Sudan, Uganda, Malawi and Zambia, is high but declining. The malaria mortality rate declined in the region between 2015 and 2019, with the exception of South Sudan, where the mortality rate increased (WHO 2020). The COVID-10 pandemic and restrictions related to the response have caused major disruptions in essential malaria services. Models for sub-Saharan Africa quantifying the potential impact of service disruptions due to the COVID-19 pandemic projected up to a doubling of the number of malaria deaths in 2020 compared to 2018 (WHO 2020).	Climate change is expected to affect the geographic range and incidence of malaria. Highland areas in East Africa will experience increased malaria epidemics at elevations above 2,000 m, where temperatures are currently too low to support malaria transmission (IPCC 2014). The population at risk of malaria will increase in East Africa until 2030 due to population growth and climate change (WHO 2014). Projections suggest a low number of additional malaria deaths due to climate change in East and Southern Africa, with most cases expected in central sub-Saharan Africa (WHO 2014). No short-term projections can be made, as incidence of malaria is difficult to predict.
Other vector-borne diseases: Rift Valley fever and dengue fever can be influenced by local climate. Past Rift Valley fever epidemics in the Horn of Africa are associated with altered rainfall patterns (IPCC 2014). In contrast to 2019, no dengue fever outbreaks were reported in the region in 2020 (ECDC 2020).	Outbreaks of Rift Valley fever are linked to El Niño events, with strong effects expected in East Africa (Anyamba et al. 2019). In general, the risk of dengue fever is expected to increase in Southern Africa (Ryan et al. 2019). Large increases in suitable conditions for the disease are predicted in Southern Africa (Messina et al. 2019).
Heatwaves: Temperature effects on mortality have already been detected in Southern Africa.	With a projected increase in frequency, intensity and duration of heatwaves, especially in Southern Africa, negative effects on human health are likely to increase.

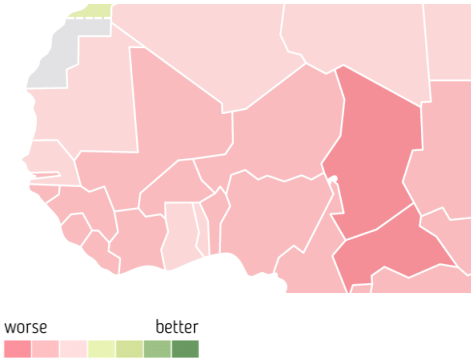
Regional stability

Climate's interactions with various drivers of conflict and instability, such as water scarcity-abundance-dynamic, high commodity prices or food insecurity, is complex but its exact relevance is unclear. Climate change and variability have the potential to exacerbate or multiply existing threats to human security including food, health and economic insecurity, all of which are particular concerns for East and Southern Africa (IPCC 2014). Current instabilities and conflicts affect people's ability to cope with future climate shocks, especially in the Horn of Africa.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: East African countries continue to rank among the most politically unstable and fragile countries worldwide, with particularly high risks in Somalia, South Sudan and Sudan (very high alert/alert category of the Fragile States Index 2020). In Southern Africa, instability and fragility ranges from the very high alert category (Zimbabwe and Mozambique) to relatively low (Botswana), with Mozambique experiencing an increase in instability compared to previous years.	High political instability will possibly affect people's ability to cope with possible future climate shocks especially in regions already highly vulnerable and exposed to adverse climate conditions such as the Horn of Africa. Perceptions of political instability suggest a high likelihood of political instability in the majority of the countries in the region (South Sudan, Somalia, Sudan, Burundi, Ethiopia and Kenya) (World Bank 2020).
Conflict: The conflict situations in several countries in the region are strongly affecting human security, with climate variability having the potential to exacerbate those threats (IPCC 2014). The joint impacts of conflict and floods on poverty are particularly high in Sudan and South Sudan (World Bank 2020). Conflict, insecurity and related displacements constituted the primary drivers of acute food insecurity in South Sudan and among refugee people in Uganda, and important drivers of food insecurity in Kenya, Ethiopia, Somalia and Mozambique (FSIN 2020).	No projections on future conflicts can be made, but the root causes of most of the conflict situations are expected to remain over the next few years.
Migration: The increase in migration leading to human suffering, human rights violations, political instability and conflict is a key risk for the region (IPCC 2014). Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). In 2019, Ethiopia, Somalia and South Sudan experienced ongoing conflicts and floods leading to 2.8 million internally displaced people, 1.2 million of whom were associated with disasters. In Mozambique, powerful storms triggered hundreds of thousands of new displacements (IDMC 2020). COVID-19 adds an additional layer of vulnerability to displaced persons in environmentally fragile areas, as they are often living in densely populated settlements where communicable diseases can spread quickly (UNHCR/PIK 2020).	Given the various social, political, economic, environmental and cultural factors influencing the decision to migrate, assessments of future trends in environmentally induced migration are complex. In East Africa, models project 1.9–2.7 million internal climate migrants for 2020 and 6.9–10.1 million for 2050, with out-migration hotspots being coastal regions of Kenya and Tanzania, western Uganda, and parts of the northern highlands of Ethiopia (IBRD and World Bank 2018). Some models project net migration of 750,000 people out of the East African coastal zone between 2020 and 2050 with sea level rise and episodic flooding being the key drivers (IPCC 2019 SROCC). In the short term, ongoing conflict and violence are expected to be the main drivers of internal displacement in the region.

Regional stability: Past and ongoing development	Regional stability: Trends
Poverty: COVID-19 and its associated economic crisis, compounded by the effects of armed conflict and climate change, are reversing hard-won gains in poverty reduction and shared prosperity worldwide. Estimates for 2020 suggest that in sub-Saharan Africa, between 26 million and 40 million additional people will be pushed into extreme poverty (World Bank 2020).	Forecasts projecting the economic impacts of COVID-19 and its aftermath suggest long-term impoverishing effects, confirming that 2030 poverty reduction targets will most likely not be reached (World Bank 2020). East Africa and Southern Africa are projected to achieve a modest recovery, with regional GDP expanding by 2.9–3.0% in 2021 and 2.6–4.1% in 2022 (UNCTAD 2021).

4.3. West Africa



Source: ND Gain 2020

Increasing temperatures and shifting rainfall patterns are affecting livelihoods, food security and economic and governance stability of West Africa. Overall climate-related risk – including vulnerability and readiness to enhance adaptive capacity – is high to very high in the region with particularly high risks in Chad, Niger and Mali (ND-GAIN 2020).

Climate Change

Trends in precipitation and extreme precipitation – the main climate-related drivers in the region – have been uneven in the last decades. Future changes in precipitation remain uncertain. The risk of severe impacts of both droughts and intense precipitation events are high in the Sahel region.

Climate: Past and ongoing development	Climate: Trends
Temperature increases and heatwaves: Mean annual temperatures have increased over the past century over most of the African continent, with the highest increases in the Sahara and Sahel (IPCC 2014). The region has also experienced hotter and longer heatwaves since 2000 than in previous decades.	Temperatures over Africa will rise faster than the global land average, particularly in the more arid regions such as the Sahel (IPCC 2014). No projections can be made for a 1–3-year period.
Rainfall and flood: The Sahel experienced an overall reduction in rainfall over the 20th century, with a recovery toward the last 20 years of the century (IPCC 2014). Wetting and greening conditions have been observed in this region over the last three decades (IPCC SRCCL 2019) with a tendency towards more intense but fewer precipitation events with increased risk of flooding. Exceptionally heavy rains and record floods across West Africa affected millions of people in August and September 2020, mostly in Burkina Faso, Chad, Niger and Mali (UNHCR 2020).	Projected changes in precipitation are uncertain in West Africa, projections show inter-model variation both in the amplitude and direction of change (IPCC 2014). Regional modelling studies show a substantial increase of central Sahel rainfall by the end of the century due to an expansion of the West African Monsoon (IPCC SRCCL 2019). No projections can be made for a 1–3-year period, but recently affected countries are perceived as particularly vulnerable to future shocks.
Drought: The risk of drought is high in some parts of the region, namely in the Sahel (IPCC SRCCL 2019). Between 2010 and 2019, drought frequency increased in the Sahel region compared to 1950–2009, whereas the drought severity remained unchanged	No projections on future droughts can be made. Projected trends in drought frequency and intensity are uncertain (IPCC 2014).

Climate: Past and ongoing development	Climate: Trends
(ERCC 2021). In contrast to 2018, no severe drought was reported in the Sahel pastoralist region.	

Food

Agriculture is the predominant livelihood in the Sahel, where climate variability and extremes already have significant impact. Crop production and livestock systems are almost entirely reliant on the region's low and highly variable rainfall, making them extremely vulnerable to climate trends.

Food: Past and ongoing development	Food: Trends
Agricultural production: Crops and/or livestock are the principal livelihoods for more than 70% of the population in Niger, Burkina Faso, Mali and Chad, and for more than 50% in Senegal and Mauritania (USAID 2018). Both cereal production and livestock systems are heavily dependent on rainfall and are vulnerable to droughts, changing precipitation patterns, and rising temperatures. Since 2016, cereal production slightly increased in West Africa. In 2020, relatively favourable weather conditions prevailed throughout the season in the Sahel region, although there were localized exceptions caused by drought or floods. Persistent conflicts continued to impact agricultural activities in north-east Burkina Faso, the Lac region in Chad, north-central Mali, western and eastern parts in Niger and north-east Nigeria (FAO 12/2020). As in 2019, the abundant rainfall replenished livestock water points and benefited growing conditions of pastures in most pastoral and agro-pastoral areas. The availability and accessibility of pasture and water improved animal body conditions and enhanced their market value (FAO 12/2020).	Given a projected high climate variability, the Sahel is assessed as an area of high agricultural risk in the future (GGAFS 2019). A warming of 2 °C to 4 °C may lead to losses and damage to various crops that are important in West Africa, namely maize, sorghum, wheat, millet, groundnut and cassava (Sultan and Gaetani 2016). Adverse effects on livestock linked to rising temperatures and precipitation changes (increased heat and water stress, impacts on feed quality and quantity) and shifts in the range of pests and diseases, with adverse impacts on pastoral livelihoods and rural poverty are key risks for the region (IPCC 2014). In the short term, regional crop assessments estimate above-average 2020–21 cereal production in West Africa and the Sahel. Watering conditions are favourable for livestock production outside of conflict-affected areas (FEWS NET 2021).
Non-climatic drivers: Cropland areas in the Sahel region of West Africa have doubled since 1975, with the settlement area increasing by about 150% (IPCC SRCCL 2019). Multiple stressors such as rangeland degradation, fragmentation of grazing areas and in-migration of non-pastoralists into grazing areas are putting pressure on livestock systems and are interacting with climate change (IPCC 2014). Ongoing conflicts continue to affect farming activities in some parts of Nigeria, Mali, Niger and Burkina Faso (FAO 12/2020).	All non-climatic drivers are expected to remain relevant in a 1–3-year perspective. The populations of Burkina Faso, Chad, Mali, Mauritania and Niger could double in the next 20 years, resulting in an increase of 80–160 million inhabitants by 2040 (UNDESA 2019).

Food: Past and ongoing development	Food: Trends
The Sahel region is experiencing a phase of population growth unprecedented in any other part of the world.	
Food prices: In 2020, prices for coarse grain remained generally above their 2019 levels due to the effects of COVID-19-related lockdown measures, persisting insecurity in conflict-affected areas in Chad, Burkina Faso, Niger and Mali, high inflation rates and weak currencies (FAO 12/2020).	Food prices are likely to remain high in conflict-affected areas. COVID-19-related movement restrictions may further disrupt marketing activities across the region (FEWS NET 2021).
Food insecurity: The number of food insecure people between October and December 2020 is estimated at 16.7 million in West Africa, 77% above the figure in the corresponding period in 2019 and the highest number on record. Despite the expected good 2020 harvests, civil insecurity, the COVID-19 health emergency, weather extremes and pest attacks resulted in pockets of severe food insecurity in several countries, in particular in conflict zones in Burkina Faso, Mali, Niger, the Lake Chad Basin and north-east Nigeria (FAO 12/2020).	In the bordering areas of Burkina Faso, Niger and Mali, the deteriorating security situation is disrupting household access to livelihoods and markets. The situation of acute food insecurity is expected to persist in 2021 (FEWS NET 2021).

Water

Water resources are subjected to high hydro-climatic variability over space and time. Current water risks are extremely high in the region. Compounded stress on water resources facing significant strain from overexploitation and degradation at present and increased demand in the future is a key risk for the entire region (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Water resources are subjected to high hydro-climatic variability over space and time (IPCC 2014), such as precipitation deficits, droughts and extreme precipitation changes. In 2020, water availability was higher than average thanks to relatively favourable weather conditions with higher than average precipitation throughout the region (WASP Index 2021).	Estimating the influence of climate change on water resources in West Africa is limited by the significant climate model uncertainties with regard to the region's future precipitation (IPCC 2014). In general, climate change is expected to have an overall modest effect on future water scarcity relative to other drivers such as population growth, urbanisation, agricultural growth, and land use change (IPCC 2014). Shallow aquifers in the Sahel, however, which respond more quickly to seasonal and yearly changes in rainfall, may experience a decline in groundwater recharge to the extent that prolonged drought and other precipitation anomalies become more frequent with climate change (IPCC 2014). Freshwater resources are expected to experience reduced water quantities in Burkina Faso and Niger by 2025.

Water: Past and ongoing development	Water: Trends
Non-climatic drivers: The main drivers of water scarcity are population growth, urbanisation, agricultural growth, land use change and over-extraction of water from rivers and lakes (IPCC 2014).	Water demand is expected to further increase due to population growth, urbanisation, agricultural growth and land use change. This is expected to have a strong influence on future water scarcity (IPCC 2014).
Water risks: Current overall water risks – both physical and regulatory (risk related to uncertainty in regulatory change, as well as conflicts with the public regarding water issues) – are extremely high in the entire Sahel region (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but water demand is expected to further increase in the whole region, aggravating the already critical situation (WRI Aqueduct 3.0 2019).

Health

Climate variability and change affect the incidence and geographic range of sub-Saharan Africa's high health burdens. Increased risk of food insecurity, infectious disease and health impacts of heat and dust are pressing climate-related challenges to human health in West Africa.

Health: Past and ongoing development	Health: Trends
Malnutrition: Africa is the region where climate shocks and stressors had the biggest impact on acute food insecurity, malnutrition and undernutrition. This is particularly the case for the Sahel region, where reliance of the food system on variable rainfall is very high. Even before the outbreak of the COVID-19 pandemic, the nutrition situation remained alarming throughout many areas in West Africa as insecurity exacerbated pre-existing drivers of malnutrition (FSIN 2020). In 2020, the impact of COVID-19 exacerbated the already considerable burden of malnutrition in the region (WHO Africa 2020)	Improvements in reducing the rates of undernutrition may be negatively affected and potentially reversed by climate change impacts (UNEP 2018). Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). Models suggest about 23,000 additional deaths due to climate change in West Africa by 2030 (WHO 2014). With COVID-19 and insecurity remaining key factors driving current food insecurity in large parts of the region, the burden of malnutrition will most likely increase.
Foodborne and waterborne diseases: Past outbreaks of cholera in Ghana, Senegal and other coastal West African countries were associated with heavy rainfall, with a possible association with the El Niño-Southern Oscillation (IPCC 2014).	Projected increases in precipitation in parts of West Africa where cholera is already endemic will possibly lead to more frequent cholera outbreaks in the future (IPCC 2014).
Vector-borne diseases: The malaria incidence rate is very high in the whole region, both in the coastal region and in the Sahel (in particular in Niger, Burkina Faso, Mali), but the malaria mortality rate declined in the whole region between 2000 and 2019 (WHO 2020). The COVID-19 pandemic and restrictions related to the response have caused major disruptions in essential malaria services. Models quantifying the potential impact of service disruptions due to the COVID-19 pandemic for sub-Saharan Africa projected up to a	Projections of the impact of climate change on malaria in West Africa are unclear, as warming climate does not directly translate into greater malaria transmission. Some studies observed a pattern of reduced burdens with a rise in temperatures in West Africa (UNEP 2018).

Health: Past and ongoing development	Health: Trends
doubling of the number of malaria deaths in 2020 compared to 2018 (WHO 2020).	
Other vector-borne diseases: Worldwide, dengue causes the greatest human disease burden of any mosquito-borne virus. As in 2019, the Sahel currently reports dengue only sporadically (ECDC 2020).	Africa is likely the continent to see the biggest change in dengue risk due to climate change. Large increases in suitable conditions for the disease are predicted in the Sahel, largely due to more favourable temperatures and increased rainfall (Messina et al. 2019).
Heat and dust: The Sahel region has the highest incidence and fatality rates in the world for bacterial meningitis. High temperatures and high concentrations of dust are significant risk factors (Jusot et al. 2016).	With rising temperatures, in particular in the Sahel region, the risk of meningitis is projected to significantly increase. Furthermore, negative effects of heatwaves on human health are likely to increase. No projections can be made for a 1–3-year period.

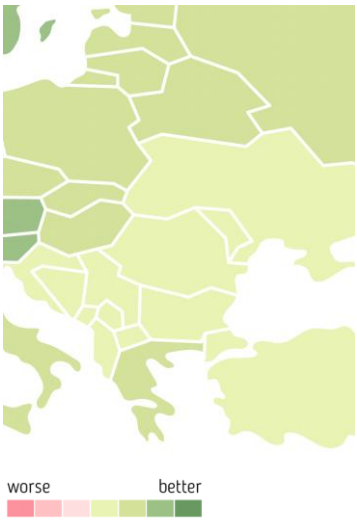
Regional stability

Climate's interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, is complex. Climate change and climate variability have the potential to exacerbate or multiply existing threats to human security including food, health, and economic insecurity, all concerns for West Africa (IPCC 2014). Current instabilities and conflicts may affect people's ability to cope with future climate shocks in parts of the Sahel region.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: West African countries continue to rank among the most politically unstable and fragile countries worldwide, with particularly high risks in Chad (high alert category of the Fragile States Index 2020), Mali and Niger (both in the alert category)	High political instability may further affect people's ability to cope with possible future climate shocks in the whole Sahel region, which is already highly vulnerable and exposed to adverse climate conditions. Perceptions of political instability suggest a high likelihood of political instability in all Sahel countries and some countries on the Gulf of Guinea (Nigeria, Côte d'Ivoire) (World Bank 2020).
Conflict: Persistent conflict and violence in several countries of the Sahel are strongly affecting human security and food security (FAO Sahel Regional Overview July 2019). Insecurity associated with conflict was the primary driver of acute food insecurity for 10.3 million people in six countries across the region (Burkina Faso, Cameroon, Chad, Mali, the Niger and northern Nigeria) (FSIN 2020). There is, however, low confidence in climate change and desertification leading to violent conflicts. Droughts and desertification in the Sahel played a relatively minor role in the conflicts in the Sahel in the 1980s (IPCC SRCCL 2019).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one factor, but rarely the most decisive (IPCC 2014). Hydro-climatic change may affect the occurrence of conflicts, although it is not water scarcity alone that produces conflicts, but more the water scarcity-abundance dynamic (Selby and Hoffmann 2014).
Migration: Increased migration leading to human suffering, human rights violations, political instability	Given the various social, political, economic, environmental and cultural factors influencing the decision to

Regional stability: Past and ongoing development	Regional stability: Trends
and conflict is a key risk for the region (IPCC 2014) Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). In 2019, the Sahel region suffered a sharp increase in violence and mass displacements. More than a million new internal displacements (compared to 280,000 in 2018) were recorded in Burkina Faso, Mali, Niger and Chad, 158,000 of whom were associated with disasters (IDMC 2020). During 2020, border closures, quarantine and curfew measures have disrupted cross-border and national transhumance and limited access to grazing land in the pastoral areas of the Sahel (RPCA 2020).	migrate, assessments of future trends in environmentally induced migration are complex. For West Africa, models project 17.9–54.4 million internal climate migrants for 2050 – the highest levels and percentages of climate migrants worldwide (IBRD and World Bank 2018). In the short term, ongoing conflict and violence are expected to be the main drivers of internal displacement in the region.
Poverty: COVID-19 and its associated economic crisis, compounded by the effects of armed conflict and climate change, are reversing hard-won gains in poverty reduction. An estimated 26-40 million additional people in sub-Saharan Africa were expected to be pushed into extreme poverty in 2020 (World Bank 2020). West Africa's GDP for 2020 is expected to have shrunk by 2.7%, the first contraction in decades (UNCTAD 2021).	Forecasts projecting the economic impacts of COVID-19 and its aftermath suggest long-term impoverishing effects, confirming that 2030 poverty reduction targets will most likely not be reached (World Bank 2020). Additionally, up to 40 million people in sub-Saharan Africa are expected to be pushed into extreme poverty by 2030 due to climate change (Jafino et al. 2020). In the short term, West Africa is projected to achieve only a modest recovery, with regional GDP expanding by 2.5% in 2021 and 3.7% in 2022 (UNCTAD 2021).

4.4. Western Balkans and new EU member states



Source: ND Gain 2020

Overall climate-related risk – including vulnerability and readiness to enhance adaptive capacity – is relatively low in the Western Balkans and the new EU member states. All countries in the region face rather low vulnerability to climate change and show fairly high readiness to adapt (ND-GAIN 2020).

Climate Change

High climate variability, the occurrence of extreme events, droughts and heatwaves are affecting the region, especially the Western Balkans. Precipitation changes are affecting the Baltic Sea region. The frequency and intensity of weather extremes are likely to increase. As countries in the region continue to grow, so too does their exposure to risk from climate change and natural disasters.

Climate: Past and ongoing development	Climate: Trends
Precipitation: On the one hand, the Western Balkans are getting drier. On the other hand, there have been increases in either the frequency or intensity of heavy precipitation in Europe with some seasonal and/or regional variation (IPCC 2014). The Western Balkan region has also observed an increased flood risk (RCC 2018). The frequency and severity of floods has increased over the past few years, especially in the Drin River Basin in Albania, Kosovo, Montenegro and North Macedonia (GIZ 2019). As in previous years, the region has been hit by heavy floods with Serbia and Bosnia especially affected in 2020 (Balkaninsight).	The Western Balkans expect variable changes in annual precipitation starting mid-century with increases in northern Serbia and intensifying decreases towards the south, including coastal areas. By the end of the century, drying conditions will prevail (RCC 2018). Further, there are risks of increased damage from river and coastal floods in the Western Balkans (e.g. along the Drin River Basin) and the Baltic Sea region (IPCC 2014, Räisänen 2017). In the Baltic Sea region, warming will be accompanied by a general increase in winter precipitation, but in summer, precipitation may either increase or decrease. Southern areas are more likely to become drier than northern areas (Räisänen 2017). Projections for the coming 1–3 years are not possible.
Droughts: Some parts of Serbia, Romania and Ukraine were facing severe drought in November 2019 (Global Drought Observatory 2019). In 2020 eastern	No projections can be made for a 1–3-year period, but current severe drought events may affect people's ability to cope with future shocks.

Climate: Past and ongoing development	Climate: Trends
Romania, eastern Bulgaria, and southern Ukraine were hit by severe drought (EU 2020).	
Heatwaves: An increased frequency and duration of heatwaves and drought have been reported in the Western Balkan region (RCC 2018). Extreme weather events currently have significant impacts in Europe in multiple economic sectors as well as adverse social and health effects (IPCC 2014). Previous heatwaves have shown severe impacts on agriculture, forestry, energy production and use, transport, tourism, labour productivity, health and the built environment (IPCC 2014).	Average temperatures are expected to increase over the Western Balkans (RCC 2018), and summer high temperatures over central and southern Europe are projected to warm substantially (IPCC 2014). In the Baltic Sea region, warming is likely to exceed the global average, particularly in winter and in the northern areas (Räisänen 2017). The intensity, duration and frequency of summer heatwaves are expected to be substantially greater over Europe (IPCC 2014).
Economic impacts: The Western Balkans have observed a decline in average river discharge and water supply especially during summer, increased energy consumption during summer and increased health and safety risks (RCC 2018). Climate change is disrupting transportation and energy production – two important economic sectors.	Climate change is projected to adversely affect inland water transport in summer in some rivers. Damage to rail infrastructure from high temperatures may also increase (IPCC 2014). In the Western Balkans, land transport infrastructure will be at risk from the increase in flood frequency and intensity, extreme temperatures, soil erosion and landslides (RCC 2018). Specific projections for the next 1–3 years are not possible.
Non-climatic drivers: Urban development is projected to increase over Europe but especially rapidly in Eastern Europe, with the magnitude of these increases depending on population growth, economic growth and land use planning policy (IPCC 2014).	Increasing urban development is posing additional threats to natural systems and will exacerbate the impacts of climate change in the next 1–3 years.

Food

Southern Europe shows trends toward more intense and longer meteorological droughts. Crop suitability is likely to change throughout Europe. In 2020, again, the production of total cereals in the European Union was estimated to be below the five-year average due to a rain deficit.

Food: Past and ongoing development	Food: Trends
Agricultural production: Contrary to the developments in 2019, the production of wheat and total cereals in the European Union was estimated to be below the five year average in 2020 (FAO 2020). In Ukraine, the 2020 yield expectations was reduced due to a substantial rain deficit (EU 2020). Agricultural production is particularly important in Albania. It contributes about 23% of gross domestic product (FAO 2018).	Climate change is likely to decrease yields in southern Europe and may adversely affect dairy production because of heat stress in lactating cows (IPCC 2014). For the Western Balkans, yield mass and quality are projected to decrease progressively by the end of the century (RCC 2018). No specific projections can be made for a 1–3-year period.

Food: Past and ongoing development	Food: Trends
Food prices and imports: The Western Balkan countries rely heavily on food imports. Overall, domestic food inflation remained calm in 2017 and 2018 (FAO 2018). The COVID-19 pandemic has not caused major problems in trade among countries of the Western Balkans (UNECE 6/2020).	High food import dependency makes the region potentially vulnerable to adverse climatic conditions in other parts of the world, and therefore to increasing food prices, but no projections can be made for a 1-3 year period.
Food insecurity: The prevalence of severe food insecurity is a concern in Albania. Household income and livelihoods largely affect economic access to food, but high market prices of basic food items also limit economic access, particularly among lower income groups who spend a large share of their income on food (FAO 2018). The COVID-19 pandemic has especially affected the Roma communities in the Western Balkans, resulting in increased risk of famine (balkaninsight.com).	No specific projections can be made for a 1–3-year period, but COVID-19 is projected to exacerbate inequalities in food security in Albania as well as for Roma communities in the Western Balkans.

Water

Water availability is unevenly distributed between northern and southern Europe. A widening gap in water resources is already apparent and likely to increase with climate change, with impacts on future water availability and increased risks of water restrictions in the southern, central and Atlantic sub-regions (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Water availability is unevenly distributed between northern and southern Europe. Dryness has increased mainly in southern Europe (IPCC 2014). The Western Balkans have faced negative impacts on water resources, especially due to decreased average river discharge and problems with drinking water quality and supply during summer (RCC 2018).	No specific projections can be made for a 1–3-year period. Because significant impacts on future water availability are projected in the long term (IPCC 2014), however, a reduction of water availability is possible for the next few years. Water quality could be negatively affected by nitrate leaching due to changing precipitation patterns – less precipitation in summer and higher rainfall during winter (IPCC 2014).
Non-climatic drivers: Water demand for irrigation and hydropower are increasing. More than 2,700 small hydroelectric plants are either planned or under construction in North Macedonia, Bosnia and Herzegovina, Serbia, Albania, Montenegro and Croatia (Global Voices 2019).	Increased water demand is projected in the near and long terms (IPCC 2014). Environmentalists are concerned about the planned increase in hydropower as it may threaten the environment and freshwater sources and exacerbate the impacts of climate change (Global Voices 2019).
Water risks: In Albania, Macedonia and in parts of Serbia, Bulgaria, Romania and Ukraine, overall water risks are high. In these countries, water stress and drought risks are especially high (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period. The region, particularly southern Europe, faces a medium to high risk of increased water restrictions in the near term (2030–2040) due to a significant reduction in water availability related to abstractions from rivers and groundwater resources, combined with increased water demand and reduced run-off (IPCC 2014).

Health

The greatest impact of climate change on health is expected through the increase in heatwaves. The region is expected to face an increase in hospital admissions for cardiovascular and respiratory diseases in connection with deteriorating air quality.

Health: Past and ongoing development	Health: Trends
Heatwaves: The region has already experienced health effects of heatwaves. Extensive evidence shows the impacts of heatwaves on health in the form of changes in mortality and morbidity. In 2010, many Eastern European cities recorded extremely high temperatures (UNEP 2018) resulting in an increase in daily mortality. Synergistic effects between high temperature and air pollution (PM_{10} and ozone) led to an increase in hospital admissions for cardiovascular and respiratory diseases (WHO 2017).	Forecasts call for an increase in frequency and intensity of heatwaves with impacts on human health, especially in the western Balkans (RCC 2018). Eastern Europe can expect an additional 1,974 deaths due to heat attributable to climate change by 2030 (WHO 2014). No specific projections can be made for a 1–3-year period.

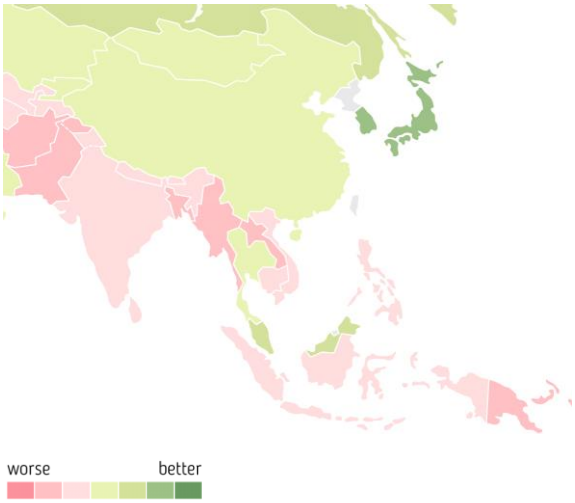
Regional stability

The regional stability in the Western Balkans and the new EU members states is mainly good providing a good base for coping with adverse climate change impacts. Politically less stable countries such as Ukraine may have lower capacities to cope with future climate shocks.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: As in the previous year, Bosnia and Herzegovina, Ukraine, Serbia and Moldova face elevated warnings (Fragile States Index 2021), and Ukraine in particular has faced a drastic downturn in political stability since 2013 (TheGlobalEconomy.com). The rest of the Western Balkans and the new EU member states are politically stable.	Political instability will possibly affect people's ability to cope with possible future climate shocks in Ukraine.

Regional stability: Past and ongoing development	Regional stability: Trends
Migration: Displacement in the Western Balkans is mainly associated with natural disasters. In 2019 33,000 people were internally displaced in Albania due to natural hazards (flooding and landslides) (IDMC 2020) almost 10 times as many as in 2017. After Hungary effectively closed its borders, more people (mainly from Syria, Iraq, Afghanistan, Pakistan and Bangladesh) have been trying to enter the EU via Bosnia and Herzegovina (Southern Route). In late 2020, about 8,000 people lived under inhumane conditions in shelters in the forest or mud (DW Made for minds). But countries along the Balkan Route like North Macedonia, Kosovo and Serbia also face inhumane refugee situations.	Floods are one of the most significant weather-related drivers of population displacements globally (IDMC 2020). With a potential increase in flood risk in the region, the numbers of internally displaced people might also increase. The highly vulnerable refugees in the region are particularly susceptible to extreme weather events. Their numbers endanger the social stability of the countries, and increase the overall risk situation. No short-term projections can be made.
Economic development: Economic conditions and governance and social readiness have improved in all countries. Over the last 20 years, living standards have increased six-fold in Bosnia and Herzegovina, and nearly three-fold in Albania and in Serbia. With economic growth and the accumulation of assets, more assets are exposed to climate change but the capacity to cope with adverse climate impacts has increased (World Bank 2018). Due to the COVID-19 pandemic, economic activity was expected to shrink by 4.8% in 2020 (World Bank 2020).	The region's good economic outlook (World Bank 2018) will accelerate the accumulation of assets exposed to climate change, but adaptation capacity will also increase. Because poor rural low-income have the least capacity to adapt, the depopulation of rural areas could accelerate. Economic growth is expected to recover gradually (3.5%) in 2021, assuming that the impact of COVID-19 will fade and by 2.3% if risks emerge (World Bank 2020).

4.5. South Asia and South East Asia



Source: ND Gain 2020

Overall climate-related risks are high in most of the region with historical trends indicating decreasing levels of vulnerability and slightly decreasing risks due to improved readiness to enhance adaptive capacity. Potential hotspots where the risks are already high and where the situation has not improved significantly in the past few years include Myanmar, Bangladesh, Pakistan, Laos and Afghanistan. Medium risks are identified in Cambodia and Vietnam (ND-GAIN 2020).

Climate Change

South East Asia is generally affected by floods and storms. Between 1998 and 2017, South East Asia (especially Myanmar, the Philippines, Bangladesh, Pakistan and Vietnam) were among the regions most affected by extreme weather events such as storms, floods and temperature extremes as well as mass movements. Given the high exposure of people living in low-lying coastal zones and flood plains, future climate risks are likely to increase.

Climate: Past and ongoing development	Climate: Trends
Heavy precipitation events: The frequency of heavy precipitation events in South Asia and South East Asia has increased (IPCC 2014). In 2020 unusually heavy monsoon rainfall and flooding affected India and neighbouring South Asia countries as well as China. In the Asia-Pacific region, 2020 has been a record year for flooding. Specifically, parts of India, Bangladesh, Bhutan, Tibet, south-eastern parts of China, southern Myanmar, Pakistan and Afghanistan experienced a significant increase in precipitation in 2020 compared to the long-term average for 1981–2010 (WASP Index 2021). Consequently, floods have affected more people than any other type of natural hazard in the 21st century. South East Asia, (especially Bangladesh, Pakistan, India and Vietnam) is primarily affected (CRED 2015). Bangladesh was hit hard by floods in the past. At one point in 2020, one-third of Bangladesh was under water. Rohingya refugee camps in Cox's Bazar are particularly vulnerable to heavy monsoon rains	Future increases in precipitation extremes related to the monsoon are very likely in East, South and South East Asia. Flood risk and associated human and material losses are heavily concentrated in India, Bangladesh and China due to the exposure of the population (IPCC 2014). No projections can be made for a 1–3-year period, but recently affected countries like Bangladesh, Pakistan, India and Vietnam are perceived as particularly vulnerable to future shocks. Rohingya refugees in Cox's Bazar camps will continue to be highly vulnerable. Compared to the beginning of 2020, the constraints on economic activity and loss of income caused by the COVID-19 pandemic have increased vulnerability. Annual precipitation will further decrease in Mongolia and seasonal rainfall will become more erratic (UNDP 2019).

Climate: Past and ongoing development	Climate: Trends
and were substantially affected during 2019 and 2020 (reliefweb 2020). Severe monsoon floods in 2020 are further exacerbating the humanitarian situation in a country already facing other emergencies, including the ongoing COVID-19 pandemic. The annual precipitation has decreased in Mongolia over the last years and the seasonal rainfall pattern has become erratic (UNDP 2019).	
Tropical cyclones: Significant trends in tropical cyclones making landfall are not found on shorter timescales (IPCC 2014), but South East Asia was hit by multiple storms in 2020 (especially Vietnam, China, India, the Philippines) as in previous years. Vietnam was also hit by four heavy storms in October 2020. Also Laos and Cambodia were hit by many storms in late 2020 (ERCC platform) Generally, storms are cost-intensive disasters (CRED 2015).	Maximum wind velocity of tropical cyclones at the coast is projected to increase by about 6% for mainland South East Asia by the 2080s under the high emission scenario RCP8.5 (World Bank 2013). No projections can be made for a 1–3-year period, but recently affected countries such as China, India, Vietnam and the Philippines are perceived as particularly vulnerable to future shocks.
Sea level rise: As a result of groundwater withdrawal, floodplain engineering and the trapping of sediments by dams, large deltas in Asia are sinking much faster than global sea level is rising (IPCC 2014). One third of Bangladesh's population lives in coastal zones, with many people living below the absolute poverty line (World Bank 2017). Deltas are particularly vulnerable as the negative impacts of sea level rise and coastal flooding collide.	Future rates of sea level rise are expected to exceed those of recent decades and to increase coastal flooding, erosion and saltwater intrusion into surface waters and groundwater (IPCC 2014). Highly populated deltas in Asia remain increasingly vulnerable in the next 1–3 years, especially in Bangladesh where sea level rise and flooding come together and the number of people living in coastal zones is increasing (EJF).
Drought: Throughout much of Asia, drought is becoming the norm rather than the exception. In 2020, a long-lasting drought affected parts of South East Asia (Vietnam, Laos, Thailand, Myanmar, Cambodia) because of a combination of a precipitation deficit inherited from 2019 and a poor start of the monsoon in 2020 (reliefweb 2020). In contrast to 2019, in early 2020 Thailand experienced its worst drought in possibly four decades (Earth Observatory 2020).	Severe drought events in the past may affect people's ability to cope with future shocks as countries and regions are still recovering from past events. In contrast to 2019, the La Niña event at the end of 2020 may increase the drought risk especially for Pakistan and Afghanistan in early 2021 (FAO 2020 La Nina advisory). The duration and strength of the event cannot be forecasted.
Glacier retreat: The rate of melting of Himalayan glaciers has doubled since the turn of the century, with more than a quarter of all ice lost over the last four decades (Maurer et al. 2019).	Trends of increased glacier mass loss are projected to continue in most of the Hindu Kush Himalaya region, with possibly large consequences for the timing and magnitude of glacier melt run-off and glacier lake expansion. Glacier volumes are projected to decline by up to 90% through the 21st century (ICIMOD 2019)
Non-climatic drivers: Rapid urbanisation, industrialisation and economic development are key drivers of environmental degradation that are compounded by climate change (IPCC 2014).	Urbanisation is progressing at a high rate in Asia. People living in low-lying coastal zones and flood plains are probably most at risk from climate change impacts in Asia. Half of Asia's urban population lives in these areas (IPCC 2014).

Food

Projected changes to the monsoon system and rising peak temperatures put water and therefore crop production at severe risk. Climate change is projected to increasingly affect food security by the middle of the 21st century, with the largest number of food-insecure people located in South Asia (IPCC 2014).

Food: Past and ongoing development	Food: Trends
Agricultural production: Agriculture in the region is vulnerable to climatic variations such as droughts, changing precipitation patterns and rising temperatures (IPCC 2014). In South Asia, monsoon floods often cause high level of loss in agricultural production FAO 12/2020). In the last five years, however, overall cereal production increased in East, South East and South Asia, reflecting production upturns in all sub-regions. The aggregated 2020 cereal output was forecasted to be well above the previous five-year average (FAO 12/2020).	Climate change effects on crop production are predicted to be negative for some specific crops and regions and positive for others. Whether rice yields will decrease or increase due to increased atmospheric CO_2 is uncertain. Saltwater intrusion is projected to decrease total arable areas and thus food production in low-lying parts of Asia, such as those in Bangladesh and the Mekong River Delta (IPCC 2014). Aggregate cereal production in Asia was forecast to increase marginally in 2021 despite flooding and dry conditions in some areas (FAO 12/2020). La Niña could, however, have negative impacts on crop production in Afghanistan and Pakistan in the coming year (FAO 2020 La Nina advisory).
Non-climatic drivers: Continuing conflicts and limited economic opportunities have increased the vulnerability of subsistence farmers in Afghanistan, where millions have abandoned their rural homes and moved to cities (FAO 2019). The influx of Rohingya refugees into Bangladesh intensifies the problem of food insecurity as the community has settled in one of the poorest and most vulnerable regions in Bangladesh and is very vulnerable itself to climate change. The total population in the Cox's Bazar district is 2.7 million plus almost 1 million refugees (FSIN 2020). Land degradation is a major challenge for Mongolia, with negative implications on rural livelihoods and food security. Furthermore, the recent military coup of January 2020 in Myanmar may have negative impacts on the food security (see section on regional stability).	Food insecurity linked to conflicts in Afghanistan and Bangladesh are likely to persist. The continued war and conflict amidst the COVID-19 pandemic exacerbates the risk situation for the people of Afghanistan (Conflict and Health 2020). The COVID-19 pandemic will further exacerbate the vulnerability of refugees, especially in Cox's Bazar and increase their risk for food insecurity. Land degradation in Mongolia is likely to remain a relevant factor in the future.
Food insecurity: In 2020 – as in 2018 – people in Afghanistan, Bangladesh, Myanmar and Pakistan were food insecure (FAO 12/2020). Climate shocks were among the main drivers of food insecurity in all these countries, followed by civil conflicts, population displacement and economic slowdown. Climate change is already affecting food security in high mountain areas of Asia (IPCC 2014). Especially in Bangladesh and Myanmar, food insecurity levels have increased due to income losses and a decline in remittances as a result of the COVID-19 pandemic (FAO 12/2020).	Although crop production is forecasted to increase slightly, food insecurity in Afghanistan, Pakistan, Bangladesh and Myanmar is likely to persist especially due to the aftermath of the COVID-19 pandemic. Highly negative impacts are expected due to food insecurity because of reduced global food supplies and trade, hunger due to falling incomes and reduced availability or poorer nutrition due to interruption of school meals (Sustainable Development Report 2020). The number of food-insecure people in need of urgent assistance will persist for the refugee population and host

Food: Past and ongoing development	Food: Trends
Bhutan and Myanmar faced serious food price increases between February 2020 and February 2021 (FAO Data Lab 2021).	community in Cox's Bazar, Bangladesh. The COVID-19 pandemic exacerbates this (FSIN 2020).

Water

South Asia and South East Asia feature a wide variety of threatened inland and coastal water ecosystems such as coastal freshwater wetlands vulnerable to saltwater intrusion with rising sea levels, but in most river deltas local subsidence for non-climatic reasons will be more important. For much of interior Asia, an increase in drought stress as a result of declining rainfall and/or rising temperatures is the key concern (IPCC 2014). Snow and glacier melt will increasingly affect water availability of people who live in the Hindu Kush Himalaya region and in the densely populated catchments in South Asia.

Water: Past and ongoing development	Water: Trends
Water availability: Adequate water supply is one of the major challenges in many regions and is subject to hydro-climatic variability (IPCC 2014). The Hindu Kush Himalayan region is the water tower for many South and South East Asian countries, serving as the source for ten major river systems (Wester et al. 2018). Snow and glacier melt are highly relevant to water availability in the region (IPCC 2014). The region is also highly susceptible to flash floods caused by glacial outburst floods.	Projected impacts of climate change on water availability in Asia differ substantially across river basins and seasons. Water scarcity is expected to be a big challenge in many Asian regions because of increasing water demand from population growth and consumption per capita with higher standards of living (IPCC 2014). In high mountain areas of Asia, glacier ice is projected to decrease substantially leading to an increase in stream flow in the short term (Kraaijenbrink et al. 2017). In the Hindu Kush Himalayan region, cryospheric change will have modest impacts on total annual stream flows in large river systems but will strongly affect the timing and seasonal distribution of run-off (Bolch et al. 2019).
Water scarcity continues to fuel existing conflicts in India, on Pakistan's border with India, and in Bangladesh, Bhutan and Myanmar (Factbook ECC platform 2021).	Conflicts are based on a variety of interconnected causes of which the environment is considered to be one, but rarely the most decisive factor (IPCC 2014). Hydro-climatic changes may affect the occurrence of conflicts.

Water: Past and ongoing development	Water: Trends
Non-climatic drivers: Growing demand for water is driven by soaring populations, increasing per capita domestic use due to urbanisation and thriving economic growth and increasing use of irrigation. Coastal low-lying forest swamps and coral reef areas in South East Asia are under severe pressure from non-climate impacts (IPCC 2014).	There is high confidence that water demand in most Asian countries is increasing because of increases in population, irrigated agriculture and industry. Climate change impacts on inland waters will interact with dam construction, pollution and land use changes. Coastal freshwater wetlands may be vulnerable to saltwater intrusion with rising sea levels, but in most river deltas, local subsidence for non-climatic reasons will be more important (IPCC 2014).
Water risks: Low per capita water availability and a high relative level of water use make South Asia one of the most water-scarce regions of the world (WEF 2019). Current overall water risks – both physical and regulatory (risk related to uncertainty in regulatory change, as well as conflicts with the public regarding water issues) – are extremely high in India, Afghanistan, Pakistan and parts of Indonesia, the Philippines and Nepal. The southern parts of Thailand and Malaysia face lower water risks (WRI Aqueduct 3.0 2019).	The perception of high water risk is increasing, as executives in the region ranked water crises as the number one risk for doing business in countries in South Asia. Water crises ranked as the top risk in India, second in Pakistan and fourth in Sri Lanka (WEF 2019). No specific projections can be made for a 1-3 year period, but water demand is expected to increase in almost all parts of the region with already high to extremely high water risks (WRI Aqueduct 3.0 2019).

Health

Climate variability and change affect the incidence and geographic range of South and South East Asia's high health burdens. According to projections, especially South Asia is expected to face great climate-induced health burdens such as undernutrition, diarrhoeal diseases and malaria as well as heat-induced impacts.

Health: Past and ongoing development	Health: Trends
Malnutrition: South Asia is among those regions where climate shocks and stressors had the biggest impact on food insecurity. The COVID-19 pandemic led to severe disruptions in the economic, food and health systems. The FAO estimates that the number of people in Asia and the Pacific region who are facing acute food insecurity will nearly double to 265 million by the end of 2020 due to COVID-19 (FAO 2021).	Climate change is expected to cause a significant increase in the number of children with severe stunting (an indicator for undernutrition). South Asia is expected to face around 20,000 additional childhood deaths due to undernutrition attributable to climate change by 2030 (WHO 2014). Negative impacts of the current COVID-19 pandemic will most likely exacerbate existing risks regarding malnutrition due to higher food prices, food insecurity resulting from the reduction in global food supplies and trade, hunger due to falling incomes and reduced availability in possible future lockdown situations.

Health: Past and ongoing development	Health: Trends
Waterborne diseases: Cholera outbreaks in coastal populations in South Asia have been associated with increased water temperatures and algal blooms (IPCC 2014). Diarrhoea is currently a major cause of child mortality in Asia and the Pacific, with 13.1% of all deaths under age five in the region caused by diarrhoea. (World Bank 2014). The El Niño cycle and Indian Ocean Dipole have been associated with cholera epidemics in Bangladesh (IPCC 2014). In particular, high positive anomalies in sea surface temperatures in the tropical Pacific during the winter have been shown to exacerbate the seasonal outbreak of cholera following the monsoons from August to November (Martinez et al. 2017). During 2020, especially in Bangladesh (Cox's Bazar) an increase of acute watery diarrhoea has been reported (ECDC 10/2020). The increase could have been affected by the COVID-19 pandemic due to limited access to clean water among disadvantaged groups.	In a 4 °C warming scenario, the relative risk of diarrhoea is expected to increase 5–11% for the period 2010–39 and 13–31% for the period 2070–99 in South East Asia relative to 1961–90. Diarrhoea cases are projected to significantly decrease in the absence of climate change (World Bank 2014). South Asia will be especially affected by diarrhoeal diseases. Diarrhoeal diseases are projected to cause almost 15,000 additional deaths attributable to climate change by 2030 (WHO 2014). Especially the most vulnerable population are facing an increased risk of waterborne diseases due to current unstable or possibly deteriorating COVID-19 situations.
Vector-borne diseases: Dengue outbreaks in South Asia and South East Asia are correlated with temperature and rainfall with varying time lags. Besides Central and Latin America, South and South East Asia are most affected by dengue outbreaks. After a spike year of dengue cases in 2019, the number of cases decreased in most countries in South East Asia in 2020 (ECDC 12/2020). Outbreaks of vaccine-preventable Japanese encephalitis have been linked to rainfall in studies from the Himalayas. Malaria prevalence is often influenced by non-climate variability factors, but studies from India and Nepal have found correlations with rainfall (IPCC 2014). The last malaria report shows declines in estimated cases worldwide in 2019 (compared to 2000), while South East Asia accounted for about 3% of the burden of malaria cases globally. Malaria cases fell by 73% from 2000 to 2019 in the region (WHO 2020). The COVID-19 pandemic has affected the availability of insecticide-treated mosquito nets, insecticides or personal protective equipment (due to lockdown measures, disruptions in supply chains). Also malaria tracking systems, which are key for interventions, were disrupted during the COVID-19 pandemic (WHO 2020).	Dengue fever may increase due to floods (World Bank 2013). The impact of climate change on malaria risk will differ across areas, and the impact of socioeconomic development will be larger than that of climate change (IPCC 2014). South Asia ranks second to Central Africa in the number of additional malaria deaths attributable to climate change by 2030 (WHO 2014). No short-term predictions can be made, but the aftermath of the COVID-19 pandemic could further jeopardize the fight against vector-borne diseases due to disruptions in supply chains of medical equipment and pesticides.
Heat: Associations between high temperatures and mortality have been shown for populations in India and Thailand and in several cities in East Asia. Several studies have analysed the health effects of air pollution in combination with increased temperatures. Intense heatwaves have been shown to affect	A large net increase in temperature-related excess mortality is projected for South East Asia at the end of the century under high emission scenarios (UNEP 2018). Furthermore, with an ageing population the number of people at risk will increase, especially those with cardiovascular and respiratory disorders.

Health: Past and ongoing development	Health: Trends
the health of outdoor workers in South Asia (IPCC 2014). Extreme heatwaves were observed in South East Asia during several months of the 2015–16 El Nino event, which researchers attributed fully to anthropogenic warming. This extreme warmth during the south-western monsoon exacerbated forest fires caused by clearing land and increased air pollution throughout the region (UNEP 2018). Even without an El Nino, 2020 matched that heat record. In fact, temperatures were at an all-time high despite the beginning of a La Nina period that started at the end of the summer 2020 (phy.org 2021).	Continuing urbanisation will increase the urban heat island effect. No specific projections can be made for a 1–3 year period.

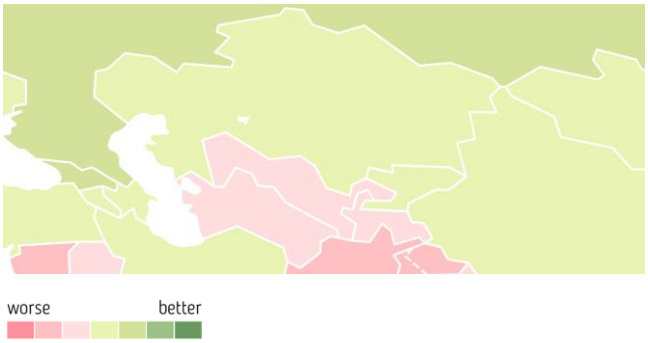
Regional stability

Climate change has complex interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, but its exact relevance is unclear. The region is growing very fast economically, poverty is not significantly improving and urbanisation is rapidly increasing and adds to the complexity of the nexus of climate change and regional stability.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Malaysia is the only country in South Asia or South East Asia that had political stability in 2020 (Fragile States Index 2020). An alarming level of instability was observed in 2019 in Afghanistan, Pakistan and Myanmar. In contrast to 2019, the situation in Myanmar has intensified with the military coup of January 2021.	High political instability will possibly affect people's ability to cope with possible future climate shocks especially in regions already highly vulnerable and exposed to adverse climate conditions and fragile political conditions such as Pakistan, Afghanistan and Myanmar. In particular, Pakistan may become a regional hotspot due to heat and water stress and irrigation issues affecting food security and regional stability (Interview with Alliance4water 2019). Tensions between India and Pakistan may be negatively influenced by climate change (Factbook ECC Platform 2021). Furthermore, Myanmar will most likely again become a regional hotspot due to the military coup of January 2021. The aftermath of the COVID-19 pandemic will exacerbate the overall risk situation in all these highly vulnerable countries.
Migration: Internal migration occurred in parts of India and Bangladesh due to climate-induced events in recent years (IBRD and World Bank 2018). Mostly weather-related disasters displaced 19 million people in 2019 in South and East Asia and the Pacific with India accounting for more than 5 million (2 million more than in 2018), Bangladesh and the Philippines more than 4 million and Myanmar more than 270,000 internally displaced people. Little data is available on	In South Asia, the number of climate migrants is projected to increase from 1.7–6.1 million people in 2020 to 16.9–35.7 million by 2050 across scenario averages (IBRD and World Bank 2018). Newer studies estimate around 63 million people up to 2050 (Singh 2020). Short-term projections are not possible, but the pressure from the impact of COVID-19 on economic livelihoods may exacerbate the risk of internal migration.

Regional stability: Past and ongoing development	Regional stability: Trends
internal displacement in Mongolia, but the country has been increasingly affected by the impacts of the dzud, severe weather conditions that lead to mass livestock loss and disrupt the livelihoods of thousands of nomadic communities (IDMC 2020).	
Poverty: The region in general is growing fast. The growth rates in average annual GDP per capita in East Asia and South Asia are above the long-term average growth rate of developing countries (UN 2019). Asia has achieved remarkable economic progress in recent decades, but the COVID-19 pandemic is likely to reverse a considerable part of the gains. South Asia is the region hardest hit, with 49 million (or almost 57 million under a more pessimistic scenario) additional people pushed into extreme poverty in 2020 (World Bank 2020).	Even under optimistic assumptions that after 2021 growth returns to its historical rates, the pandemic's impoverishing effects will be vast, and achieving SDG goal 1 "eradicate extreme poverty" by 2030 will be unlikely (World Bank 2020). Hence, steady economic growth will not be enough in the next 1–3 years to lift the highly vulnerable region out of the poverty trap, particularly in the aftermath of the COVID-19 pandemic.

4.6. Central Asia and South Caucasus



Source: ND Gain 2020

Central Asia and South Caucasus countries range mainly in the middle in terms of ND-GAIN scores (combination of vulnerability and readiness). They are mainly characterised by a relatively low level of vulnerability to climate change, but a low to middle level of readiness to make use of investments for adaptation (economic, social and governance readiness). Potential regional hotspots are Tajikistan, Uzbekistan and Turkmenistan (ND-GAIN 2020).

Climate Change

Temperature increases in Central Asia and South Caucasus are significant and droughts have been observed in recent years. One of the main challenges is the negative impacts on water availability due to glacier retreat caused by increasing temperatures. Furthermore, increasing aridity and land degradation threaten the region.

Climate: Past and ongoing development	Climate: Trends
Precipitation: In northern Asia, observations indicate some increase in heavy precipitation events, but in Central Asia, no spatially coherent trends were found (IPCC 2014). Precipitation anomalies show general drying trends in the west of the region around the Caspian Sea and Caucasus (ERA-Interim). Floods and mudflows occur frequently across the region (USAID 2018). In early 2020, heavy rains brought significant damage to agriculture and private property in the southern parts of Uzbekistan and Turkmenistan (CAREC 2020). During late 2020 and early 2021 a La Niña event was present in Central Asia, where experience shows that such events lead to droughts between January and May. This time, however, some climate models predict an earlier onset of this dry period for the area (WMO 2020).	There are inconsistent signals in models for projected changes in precipitation (IPCC 2014). Precipitation projections show that Central Asia's south-west areas are becoming drier and north-east regions becoming wetter. The dry-getting-drier-and-wet-getting-wetter under climate change is hence a good first order approximation for Central Asia (CAREC 2020). Changes in precipitation, such as snowfall being replaced by rainfall because of warming, are also expected to result in a decrease in river flow during the agriculturally important spring and summer months. Instead, river flow will likely increase in winter, resulting in winter floods and low river flow in the summer (USAID 2018). Scenarios for South Caucasus are also inconsistent. Armenia and Georgia are projected to become drier, whereas Azerbaijan faces mixed trends. Extreme precipitation is projected to decrease in Armenia and increase in Georgia (UNEP 2015). Forecasts of 1–3 years are not possible.

Climate: Past and ongoing development	Climate: Trends
Temperature increases and heat: Between 2017 and 2019, Central Asia was hit by anomalously hot summers (the diplomat 2019). In 2020, Uzbekistan was especially hit by periods of exceptional heat of up to 44 °C (novastan.org) which added to the health stress due to the COVID-19 pandemic. The number of hot days is increasing (IPCC 2014). Across the region, temperature increases are strongest at low elevations, becoming less pronounced with increasing elevation (USAID 2018).	Hot days and heat extremes are likely to increase in the future in Central Asia and the Caucasus (IPCC 2014), but a 1–3-year forecast is not possible.
Droughts: Spatially varying trends have been observed in dryness and drought for the region (IPCC 2014) leading to the destruction of harvests and resulting in drastic collapses of rural household income.	The region is likely to experience increased incidence of drought and lengthened dry spells. Higher temperatures will increase evapotranspiration, leading to drier conditions, even if precipitation does not change (USAID 2018). No projections can be made for a 1–3-year period.
Glacier retreat: Clear evidence from observations shows that glaciers are retreating throughout Central Asia and the Caucasus (Muccione and Fiddes 2018). As a short-term consequence, increased water flow causes flooding. In 2015, floods took place throughout Tajikistan, damaging crops and destroying houses (the diplomat 2019).	The shrinking of glaciers in Central Asia and the Caucasus is expected to increase and to influence downstream river run-off (IPCC 2014). In the short term, this can cause increasing water flow and flooding. Glacier retreat is progressing at a high pace, and is intensifying already critical conditions in the regions. The negative impacts for downstream regions are likely to be high, but no projections can be made for a 1–3 year period.
Non-climatic drivers: Hydroelectric dams and huge infrastructure projects under the Belt and Road Initiative are being planned in the region. In Central Asia, competing demands for water for hydropower and irrigation between upstream and downstream countries has raised tensions (IPCC 2019 SROCC). Large dams affect downstream agriculture, mainly because they potentially disrupt water flows (EU Parliament 2018).	Huge infrastructure projects may exacerbate the negative impacts of climate change. Tajikistan's Roghun Dam will become the world's tallest dam, and will provide 80% of the country's electricity capacity (EU Parliament 2018).

Food

The main food challenges in Central Asia – where irrigated agriculture is widespread – are related to the adequacy of the water supply. Some parts of the region could profit from longer growing seasons, warmer winters and increased winter precipitation. Other parts of Central Asia are expected to become warmer and increasingly arid, exacerbating human-induced desertification (IPCC 2014).

Food: Past and ongoing development	Food: Trends
Agricultural production: Adequate water supply is a major challenge in Central Asia, where irrigated agriculture is widespread. In Uzbekistan, for example,	In the north and east of Kazakhstan, crop production will benefit from climate change, and in western Turkmenistan and Uzbekistan, crop production will be

Food: Past and ongoing development	Food: Trends
90% of the available water resources of the Amu Darya basin is used for crop irrigation (IPCC 2014). The total cereal production in 2020 was slightly below the five-year average in Central Asia, but increased a little compared to 2019 (FAO 12/2020).	negatively affected by climate change. Frequent droughts could negatively affect cotton production, increase already high water demands for irrigation and exacerbate the existing water crisis and human-induced desertification (IPCC 2014). No projections can be made for a 1-3 year period.
Non-climatic drivers: Land degradation is a major challenge in Central Asia, with negative implications for rural livelihoods and food security. Land degradation is caused by land use and cover changes and deforestation. The region has one of the Earth's driest climates and has been subject to increased human pressures in recent decades, exacerbating the already harsh conditions and increasing desertification and reducing crop production. Turkmenistan (desertification) and Uzbekistan (salinised areas) are especially affected (OSCE 2016). Countries in the Caucasus are also affected by desertification (UNEP 2015). Climate change exacerbates the negative impacts of land degradation and desertification.	Land degradation and desertification will most likely continue at a high pace in the coming 1–3 years. Furthermore, desertification amplifies global warming through the release of CO_2 linked with the decrease in vegetation cover (IPCC 2019 SRCCL). A warming by more than 1.5 °C showed an acceleration of desertification trends under a high emission scenario in the middle and northern parts of Central Asia (IPCC 2019 SRCCL). Besides Central Asia, especially Armenia will see intensified desertification due to future warmer temperatures and reduced water availability (UNEP 2015).
Food prices and imports: Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan are heavily dependent on the import of cereals, mainly wheat. The significant level of these imports makes these countries highly vulnerable to international food markets, a vulnerability that can severely affect the food security of their populations. (FAO 2018). In some countries in the region (Tajikistan, Kyrgyzstan, Kazakhstan, Georgia, Moldova and Ukraine), more than 40% of household budgets is spent on food (53% in Tajikistan). Vulnerable groups of the population spend even more on food; for example, pensioners spent 62% of their budgets on food in 2019 (FAO 7/2020). As a result of COVID-19, the retail prices of most staple foods in Tajikistan, Kyrgyzstan and Georgia increased during 2020, implying a significant increase in the cost of diets (FAO 7/2020). The imposition of export bans and quotas, especially on wheat and wheat products from the Russian Federation and Kazakhstan have resulted in localized surges of prices of these products in countries within the region, most evidently in Kyrgyzstan and Tajikistan (ADB 2020).	The region's high dependency on food imports makes it potentially vulnerable to adverse climatic conditions in other parts of the world, and therefore to potentially increasing food prices. As of 2019, world agricultural commodity prices were projected to stabilise in 2020. After an increase in agricultural commodity prices due to the COVID-19 pandemic in 2020, however, the World Bank Food Price Index is expected to gain an additional 1.5% in 2021 (World Bank Commodity Markets Outlook 2020). Achievements made prior to the pandemic regarding land reforms, agricultural diversification and harmonisation of trade policies will most likely be eroded in the long term as the pandemic is likely to persist through 2021 (ADB 2020).
Food insecurity: The prevalence of undernourishment between 2016 and 2018 is of concern in Georgia (7.9%), Kyrgyzstan (7.1%), Uzbekistan (6.3%) and Turkmenistan (5.4%). The overall availability of food is not a severe problem, but high market prices limit economic access particularly among lower-income groups (FAO 2019). Significant increases in staple	Evidence points to a stagnation of the decreasing trend in food insecurity in recent years in some regions, particularly in Central Asia (FAO 2019). Projected drought risks in populated areas of Central Asia may have serious repercussions on food security in the medium to long term (Carrão et al. 2016). Furthermore, lockdown situations with restrictions in food transport, economic

Food: Past and ongoing development	Food: Trends
food prices as a result of COVID-19 have lowered the affordability of normal diets, resulting in significant impacts on food security and nutrition (FAO 7/2020).	losses and increasing food prices may add additional risks to food security in the coming year.

Water

Central Asia and South Caucasus face increasing challenges of sufficient water availability in light of the heavy dependence of the agricultural sector on precipitation, disrupted river run-off and groundwater supplies combined with increasing demand related to high population growth (IPCC 2014).

Water: Past and ongoing development	Water: Trends
Water availability: Adequate water supply is a major challenge particularly in Central Asia (IPCC 2014). High mountain areas are water towers that play a critical role in supplying lowland regions with water in Central Asia and the Caucasus. Water availability is mainly driven by hydro-climatic variability, glacier retreat due to temperature increases and human activities. Due to retreating glaciers, peak water has likely already been reached in the Caucasus and will be reached by mid-century in Central Asia (Huss and Hock 2018).	Given the already very high level of water stress in many parts of Central Asia, projected temperature increases, and precipitation decreases in the western part of Kazakhstan, Uzbekistan and Turkmenistan could exacerbate the problems of water shortages and distribution (IPCC 2014). Projections indicate a continued increase in winter run-off in many snow and/or glacier-fed rivers over the 21st century in high mountain areas of Asia (IPCC 2019 SROCC). Water shortages due to glacier melting may occur in the Caucasus region in the coming 1–3 years.
Shrinking of the big lakes: Water levels in the Aral Sea have decreased dramatically since the 1960s in a complex combination of global, regional and local processes, human-induced changes and climate change (Global Surface Water App 2021). The shrinking of big lakes such as the Aral Sea, is one of the major challenges for Central Asia and highly driven by institutional failures.	Huge technical and financial problems and differing objectives of stakeholders as well as differing views of the problems hinder any prospects for improvements in the near future. Climate change will exacerbate the negative impacts.
Water conflicts: Relations between Central Asian states have been shaped by long-running water disputes related to the overuse and mismanagement of the scarce water resources in the region (Factbook ECC platform 2021). Competing water interests within the transnational Syr Darya and Amu Darya basins are a longstanding condition (IPCC 2019 SROCC). In Central Asia, scarcity could be a contributing factor in water conflicts (Zhupankhan et al. 2018).	The ongoing water-related disputes in Kyrgyzstan, Uzbekistan and Tajikistan are multi-dimensional, and a quick resolution seems unlikely (Factbook ECC platform 2021). Within the transnational Syr Darya and Amu Darya basins, reductions in flow later in this century will exacerbate competition for water among multiple users, and may hamper future coordination. Other evidence from Central Asia suggests that relative water scarcity may not be the only factor to exacerbate conflict in this region (IPCC 2019 SROCC).
Non-climatic drivers: Growing demand for water is driven by soaring populations, by the increasing per capita domestic use due to urbanisation and thriving economic growth, and by the increasing use of	There is high confidence that water demand in most Asian countries is increasing because of increases in population, irrigated agriculture and industry (IPCC 2014) and because of hydropower development. Water

Water: Past and ongoing development	Water: Trends
irrigation (IPCC 2014) as well as by the increasing demand for hydropower (EU Parliament 2018).	demand is expected to increase in the coming 1–3 years.
Water risks: Current overall water risks – both physical and regulatory (risk related to uncertainty in regulatory change, as well as conflicts with the public regarding water issues) – are high to extremely high or high in most parts of Central Asia and medium high or high in South Caucasus (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but the risk of water shortages in arid areas of Central Asia already exists, and is projected to increase (IPCC 2014), colliding with the high water dependency of irrigated agriculture. Water demand in Turkmenistan and Uzbekistan is projected to increase significantly (WRI Aqueduct 3.0 2019).

Health

Health impacts for Central Asia are low compared to the other regions, but poverty and hunger present major challenges that are projected to increase. Furthermore, heatwaves will become more frequent affecting mainly urban dwellers over 65.

Health: Past and ongoing development	Health: Trends
Malnutrition: Poverty and hunger present major challenges across Central Asia, particularly in Tajikistan and parts of the Kyrgyz Republic. As a result, impacts to the agriculture sector from increased drought, flooding and desertification could increase crop failures, decrease food security and significantly impact human health and nutrition. A slowdown in food imports and higher food prices due to lockdown situations in Central Asia further exacerbate the risk.	Undernutrition attributable to climate change is projected to cause 473 additional deaths in Central Asia by 2030 (WHO 2014). No specific projection can be made for a 1–3-year period, but the aftermath of the COVID-19 pandemic can exacerbate the risk of undernutrition.
Temperature increases and heat: An increase in the number of hot days is being observed in Central Asia (IPCC 2014).	The number of hot days and heat extremes will likely increase in Central Asia and the Caucasus (IPCC 2014). By 2030 Central Asia is projected to face 740 additional heat deaths attributable to climate change, mainly among people over 65 (WHO 2014). A 1–3-year forecast is not possible.

Regional stability

Climate has complex interactions with various drivers of conflict and instability, such as water scarcity or food insecurity, but its exact relevance is unclear. Climate change and climate variability have the potential to exacerbate or multiply existing threats to human security. The main challenges for the region are conflicts due to water availability and problems associated with domestic and international migration.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Countries in Central Asia and South Caucasus mostly rank in the middle for political	Water scarcity is perceived as a risk contributing to water conflicts (Zhupankhan et al. 2018) but it may not be

Regional stability: Past and ongoing development	Regional stability: Trends
stability and fragility (Fragile States Index 2020). Warnings are in place for Georgia, Azerbaijan, Uzbekistan, Turkmenistan, Tajikistan and Kyrgyzstan. Most of the population is rural and depends on agriculture, so droughts and floods are heavily affecting local incomes. Furthermore, water has always been a contentious issue in Central Asia, particularly between Dushanbe and Tashkent (the diplomat 2019).	the only factor exacerbating conflicts in the region (IPCC 2019 SROCC). Uzbekistan's economy relies heavily on water that flows out of Tajikistan, and a decrease in general water availability in Tajikistan will hit Uzbekistan hard and aggravate the tensions between the countries. Similar disputes may occur between Kyrgyzstan and Kazakhstan (the diplomat 2019). Most of the conflict situations are expected to continue over the next few years with the population increasingly vulnerable due to the aftermath of the COVID-19 pandemic.
Migration: As in 2019, Tajikistan and Kyrgyzstan accounted for an important share of the region's new internal displacements associated with disasters. In June 2020, 4,800 people were evacuated in Tajikistan as a result of heavy rains, mudflows and widespread flooding. An estimated 2,100 people were expected to be displaced by the end of 2020 (IDMC 2020).	Floods are one of the most significant weather-related drivers of population displacements globally (IDMC 2019). Given the inconsistent signals for projected changes in rainfall, no projections can be made on a potential increase of internal displacements due to climate change, but pressure from the impacts of COVID-19 on livelihoods may exacerbate the risk of internal migration.
Poverty: Central Asia has drastically reduced poverty over the last 30 years, but Central Asia's middle class is almost entirely concentrated in and around a handful of big cities, and the unemployment rate is the highest among youth and women. Furthermore, the cost of living in Central Asia's large cities is higher than the national average. In some cases, legal restrictions make domestic moves difficult (World Bank 2019). In 2020, Central Asian economies shrunk by 1.7% due to the COVID-19 pandemic, with regional variations. Kazakhstan and Kyrgyzstan faced economic contractions by the end of 2020, and other countries faced very low growth rates. The pandemic also increased poverty in all countries of Central Asia in 2020 (World Bank 10/2020).	Generally, the medium-term growth outlook for most countries in Central Asia are forecasted to rebound in 2021, with regional variations in extent. The long-term impact on poverty and inequality will depend on the severity and duration of the ongoing COVID-19 pandemic. Especially in Kyrgyzstan, the poverty rate is projected to remain high in 2021–22, since households will continue to face the impact of coronavirus (World Bank 2020 Macro Poverty Outlook).

4.7. Latin America and the Caribbean

Source: ND Gain 2020

Overall climate-related risks are medium in most of the region and medium high in Central America and the Caribbean and some parts of the Andes. This risk assessment combines vulnerability and readiness to enhance adaptive capacity.

Past trends in overall climate-related risk indicate slightly decreasing risks due to improved readiness to enhance adaptive capacity and decreasing levels of vulnerability. Potential hotspots where the risks are high or the situation has worsened in the past few years are Central America, Haiti, Venezuela and Bolivia (ND-GAIN 2020).

Climate Change

High climate variability, extreme events and droughts are affecting parts of Latin America and the Caribbean, resulting in impacts such as major flooding, declining crop yields, glacier retreat and unevenly distributed water availability in parts of the region. The frequency and intensity of weather extremes are likely to increase.

Climate: Past and ongoing development	Climate: Trends
Precipitation: Rainfall extremes and in particular the occurrence of flash floods and landslides have increased in intensity and frequency in Central America and South America, especially in south-eastern South America (IPCC 2014). In 2020, some countries in Central America (in particular Nicaragua, Honduras, Guatemala) and the Caribbean have experienced strong floods as a result of the interplay of La Niña conditions and the hurricane season (FAO 2020).	Risk of flooding and landslides in urban and rural areas due to extreme precipitation is expected to increase until 2030 (IPCC 2014), but no projections can be made for a 1–3-year period. The impacts of La Niña may affect part of the region in the first half of 2021. Central America and the north of South America are expected to face rather wet conditions, with the risk of excessive rainfalls in Central America (FAO 2020-2021 La Niña Advisory).
Hurricanes and cyclones: A steady increase in extreme events, especially hurricanes, has been registered in Central America and the Caribbean over the	Past shocks such as the hurricanes in Central America in 2020 may have undermined adaptive capacity and may increase the vulnerability in upcoming years. This

Climate: Past and ongoing development	Climate: Trends
last 20 years. After an intense Atlantic hurricane season 2019, the 2020 season was extremely active, with La Niña being a major factor enhancing hurricane activity. Two major hurricanes (*Eta, Iota*) hit Central America, in particular Nicaragua, Honduras and Guatemala, causing severe landslides and flooding (ERCC 2021). Increases in tropical cyclones and rainfall in combination with relative sea level rise exacerbate coastal hazards. In the Latin America and Caribbean regions 6–8% of the population live in areas that are at high or very high risk of being affected by coastal hazards (IPCC SROCC 2019).	history may affect people's ability to cope with future shocks as countries and regions are still recovering from past events.
Droughts: Extreme droughts were reported in Amazonia in the last decade (IPCC 2014), and a significant change can be observed in the Greater Amazon basin (including Ecuador, Colombia and Bolivia), where the Amazon rainforest is shifting from being a carbon sink to a carbon source due to rising deforestation. In Bolivia, drier-than-average conditions have been observed in 2020 in some areas as a result of the current La Niña event (FAO 2020-2021 La Niña Advisory). The Central American Dry Corridor is one of the most susceptible regions in the world to climate change and variability with those countries being most prone to drought. After severe droughts and erratic seasonal weather patterns in 2018 and 2019, mostly favourable rainfall conditions have been observed in 2020 in Central America (FSIN 2020, FAO 12/2020).	There is medium confidence that droughts will intensify over the 21st century in some seasons and areas due to reduced precipitation and/or increased evapotranspiration in Amazonia and North-east Brazil (IPCC 2014). With ongoing deforestation the drought risk may increase in the coming few years as much of the rain that falls in a rainforest is linked to evapotranspiration from trees. Deforestation has caused an estimated 4% of the recent observed drying, with the south-western part of the Amazon being most strongly affected (Staal et al. 2020). The impacts of La Niña may affect part of the region in 2021. Bolivia, Chile and Argentina are expected to face rather dry conditions (FAO 2020-2021 La Niña Advisory).
Glacier retreat: The trend of glaciers retreating has intensified, reaching critical conditions in the Andean countries (IPCC 2014).	Glacier retreat is progressing at a rapid pace intensifying already critical conditions in the Andes. The negative impacts for downstream regions are projected to be high. Some of the lower altitude glaciers of the tropical Andes (Colombia, Ecuador, Peru, Bolivia) could lose between 78% and 97% of their volume by the end of the century, reducing the region's available freshwater resources (UNESCO 2019).
Non-climatic drivers: Land use change, especially deforestation, is a key driver of environmental degradation in Latin America, and exacerbates the negative impacts from climate change. Deforestation attributed to increased agriculture has reached alarming levels. In 2020, deforestation of the Amazon rainforest in Brazil surged to its highest level since 2008, with a total of 11,000 km^2 being destroyed between August 2019 and July 2020 (BBC 2020).	Deforestation will most likely continue at a rapid pace in Brazil given that the administration is encouraging more agricultural activity and reducing enforcement of illegal deforestation within the Amazon. Rising rates of primary forest loss in recent years have reduced forest areas in Bolivia (-290,000 hectares), Peru (-162,000 hectares) and Colombia (-115,000 hectares) (Global Forest Watch 2020), and may continue at a similar pace in the coming years.

Food

Decreased food production and lower food quality are key risks for the region, and are expected to remain high or unchanged until 2030 (IPCC 2014). Food insecurity is of concern in parts of the region, especially in Central America, Haiti and Venezuela, with climate shocks being among the key drivers of acute food insecurity both in the aftermath of a disaster and in the long run.

Food: Past and ongoing development	Food: Trends
Agricultural production: Agriculture in the region is heavily dependent on rain-fed systems for both subsistence and export crops and is vulnerable to climatic variations such as droughts, changing precipitation patterns and rising temperatures. Between 2016 and 2020, cereal production increased in South America and remained more or less stable in Central America. Two consecutive hurricanes in Central America caused considerable damage and substantial bean crop losses (FAO 12/2020). In the Andean region, glacier retreat and snow cover changes have contributed to localised declines in agricultural yields in some parts of the tropical Andes (IPCC SROCC 2019).	Implications of climate change on future food production and food security show a large range of uncertainty with possibly increasing productivity of soybeans, maize and sugarcane (IPCC 2014) especially in the southern part of South America. In Central America, parts of the Andean region and North-eastern Brazil climate change could negatively affect crop yields and food security. No specific projections can be made for a 1–3-year period, but cereal production, in particular maize, in Latin America and the Caribbean may be higher in 2021 as a result of the expansion of areas planted or sown (FAO 12/2020).
Commodity prices: Cereal imports have been increasing in Central America for more than five consecutive years due to an increased demand for wheat (FAO 12/2020). World agricultural commodity prices increased by 3% in 2020 as a result of supply chain disruptions and border closures that have restricted food flows during the COVID-19 pandemic (World Bank 2020).	Agricultural prices are expected to rise slightly in 2021 (World Bank 2020).
Non-climatic drivers: Increases in the global demand for food and biofuels promoted a sharp increase in agricultural production in South and Central America, associated mainly with the expansion of planted areas (IPCC 2014) and the ongoing expansions of crop areas (FAO 12/2020).	Expansion of planted areas is predicted to continue in the future (IPCC 2014), and may lead to a further production increase. Forecasts for planted areas of maize in South America in 2021 are well above average (FAO 12/2020).
Food insecurity: The population affected by food insecurity in Latin America has continued to increase over the past five years (FAO 2021). In Central America, about 9.3 million people were estimated to be food insecure in the second half of 2020 (4 million in Haiti, 3.7 million in Guatemala and 1.6 million in Honduras) as a result of reduced economic activities due to the COVID-19 pandemic and the two hurricanes in November 2020 (FAO 12/2020). In South America, the food security of Venezuelan refugees and migrants has further deteriorated, with	Conflicts and economic shocks as main drivers of food insecurity are likely to persist in some countries. The reduced economic activities due to the COVID-19 pandemic and associated reduction in employment, income and remittances will further exacerbate the food insecurity situations in 2021 throughout the region. Past climate-related disasters, such as the 2020 hurricanes will further aggravate conditions of vulnerable households in Guatemala and Honduras (FAO 12/2020).

Food: Past and ongoing development	Food: Trends
70% of them experiencing a decrease in their income due to COVID-19 with severe consequences in terms of access to food (FAO 12/2020).	

Water

Water availability is a key issue for some areas in Central America and in semi-arid and glacier melt-dependent areas of South America (IPCC 2014). The risk is expected to significantly increase until 2030. Unevenly distributed water availability combined with high water stress are resulting in high water risks in parts of the region such as the west coast of South America, the Andes, the Caribbean and Central America.

Water: Past and ongoing development	Water: Trends
Water availability: Central and South America have high average but unevenly distributed availability of water resources. Water availability is of concern in Central America and in semi-arid and glacier melt-dependent regions of South America. Changes in stream flow and water availability have been observed in the whole region (IPCC 2014).	No specific projections can be made for a 1–3-year period, but the risk of unevenly distributed water availability is expected to increase and changes in stream flow and water availability are projected to continue until 2030. In semi-arid regions, risk of water supply shortages will increase owing to reductions in precipitation and increases in evapotranspiration (IPCC 2014).
Glacier retreat: The retreat of Andean glaciers is affecting the seasonal distribution of stream flows. In the tropical Andes most glaciers have already passed peak water (IPCC SROCC 2019) meaning that annual run-off has already declined.	Glacier retreat and reduction of snowmelt-related run-off in the Andes pose growing challenges for water users, especially for many cities and metropolitan areas such as Lima, La Paz and El Alto, and Santiago de Chile, already facing high water stress.
Non-climatic drivers: Water demand is high for agriculture, human consumption and hydropower generation. Water availability is of great concern for large cities, which are home to more than 20% of the population in the region (IPCC 2014).	Water demand is expected to increase with rapidly growing agricultural production, accelerated urbanisation and population growth, leading to higher water risks in the future.
Water risks: Current overall water risks – both physical and regulatory (risk related to uncertainty in regulatory change, as well as conflicts with the public regarding water issues) – are low-medium to medium-high in most of the region and hence lower than in all other regions analysed. High water risks are, however, identified for the west coast of South America and parts of the Andes, the Caribbean and Central America, mainly due to high water stress and high variability of available water supply (WRI Aqueduct 3.0 2019).	No specific projections can be made for a 1–3-year period, but water demand and water stress are expected to increase in almost all parts of the region with already high water risks (WRI Aqueduct 3.0 2019).

Health

Changes in weather and climatic patterns are negatively affecting human health in Central and South America by increasing morbidity, mortality and disabilities, and through the emergence

of diseases in previously non-endemic areas (IPCC 2014). Many of the vector-borne and water-borne diseases in the region are sensitive to changes in weather patterns brought about by the El Niño phenomenon (World Bank 2014).

Health: Past and ongoing development	Health: Trends
Mosquito-borne diseases: Climate-related mosquito-borne diseases have appeared in previously non-endemic regions (e.g. malaria in the Andes, dengue in Central America and southern South America) (IPCC 2014).	Mosquitoes of the genus Aedes that can transmit dengue, Zika and chikungunya show high sensitivity to temperature (transmission peak at 29 °C) (UNEP 2018).
Dengue fever: After an substantial increase in dengue infections in 2019, the number of infections increased a further 30% in 2020, with most infections reported in Brazil, Paraguay, Mexico, Bolivia and Colombia (ECDC 2020).	The geographical range of dengue is expected to further expand due to climate change and urbanisation. With ongoing urbanisation, the number of people at risk is expected to increase, given that dengue is endemic in large areas of the region. There is, however, very little projected increase in deaths due to dengue fever attributed to climate change in the region (UNEP 2018).
Zika: The Brazil outbreak of 2016 was related to the hot and dry winter of 2015, influenced by the El Niño phenomenon, which contributed to the zika epidemic in South America. Since 2016, most countries in the Americas and the Caribbean have witnessed a decline in cases (ECDC 2019).	As temperatures move towards the predicted thermal optimum (29 °C) owing to climate change and urbanisation, Zika could expand north and into longer seasons (Tesla et al. 2018).
Malaria: The number of malaria cases in the Americas is low compared to other regions, but linkages between the El Niño phenomenon and malaria have been reported from several countries and regions (Colombia, Peru, Ecuador, Amazonia, Venezuela) (IPCC 2014). The malaria case incidence rate and the mortality rate have both decreased between 2000 and 2019. The trend has, however, slowed down since 2017 due to a major increase of malaria in Venezuela. The COVID-19 pandemic and restrictions related to the response have caused disruptions in essential malaria services worldwide (WHO 2020).	With climate change, the malaria vectorial capacity will likely increase in parts of South America. The projected increase in deaths due to malaria attributed to climate change is small to 2030 (UNEP 2018). In the short term, there is a risk that disruptions in malaria service due to COVID-19 continue in 2021 and efforts to prevent, detect and treat malaria are not sustained.

Regional stability

Climate has complex interactions with various drivers of conflict and instability, such as water scarcity, high commodity prices or food insecurity, but its exact relevance is unclear. Current instabilities, poor governance and poverty affect people's ability to cope with future climate shocks, especially in Central America, Haiti, Venezuela and Bolivia.

Regional stability: Past and ongoing development	Regional stability: Trends
Fragile states: Latin American countries continue to rank mostly in the middle on political stability and fragility indicators (Fragile States Index 2020). A high level of instability was observed 2020 in Haiti and Venezuela (alert category) with strong worsening trends in Chile, Bolivia, Venezuela, Brazil and Colombia.	Political and economic instability such as in Venezuela, Bolivia and Chile may trigger increases in food prices and further political instability and possibly affect people's ability to cope with possible future climate shocks (FSIN 2020). Perceptions of political instability suggest a high likelihood of political instability in Venezuela, Nicaragua and Colombia (World Bank 2020).
Migration: Many drivers of migration are climate sensitive, but the potential for migration is determined by the context where climate change occurs (Adger et al. 2015). In 2019, weather-related disasters and conflicts continued to impact El Salvador, Colombia and Brazil and newly affected Guatemala and Bolivia. While conflicts were the main reason for new displacements in El Salvador and Colombia, natural disasters led to new displacements in Brazil (295,000), Bolivia (77,000), Colombia (35,000) and Guatemala (21,000). New displacements were expected in 2020 as a result of the November hurricanes, as tropical cyclones usually trigger large numbers of internal displacement (IDMC 2020).	The various social, political, economic, environmental and cultural factors influencing the decision to migrate make the assessment of environmentally induced migration a complex endeavour. In Central America and Mexico, models project 0.6 million internal climate migrants for 2020 and 1.4–2.1 million for 2050, with out-migration hotspots being mostly the lowland areas along the Gulf of Mexico and the Pacific coast of Guatemala (IBRD and World Bank 2018).
Poverty: Socioeconomic development shows a high level of heterogeneity and unequal income distribution, resulting in high vulnerability to climatic conditions for poorer populations. After an already weak period of growth between 2014 and 2019 and a stagnation in poverty reduction, the COVID-19 pandemic has accentuated this complex scenario. Latin America and the Caribbean will be the most affected emerging and developing regions in the world in terms of GDP growth contraction. The impact of the COVID crisis will leave the large majority of the countries with negative growth and GDP per capita, and will bring the region back to levels similar to those of 2009 (OECD 2020). Estimates for 2020 suggest that in Latin America and the Caribbean between 3.6 million and 4.8 million additional people will be pushed into extreme poverty (World Bank 2020).	Worldwide forecasts projecting the economic impacts of COVID-19 and its aftermath suggest long-term impoverishing effects, confirming that 2030 poverty reduction targets will most likely not be reached (World Bank 2020). Prospects for recovery are modest in Latin America, with projected regional GDP expanding by 3.8% in 2021 and 2.6% in 2022 (UNCTAD 2021). This growth would be insufficient to reach pre-pandemic levels.

Annexes

Annex 1: Sources

Overview of sources for the CC foresight analysis

Source, year	Title	Content relevant for CC foresight Analysis	Links
Climate			
Global Drought Observatory (regularly updated)	Database of drought events	Updated information on global drought including drought reports for affected countries. Mostly short-term (monthly perspective), no projections.	https://edo.jrc.ec.europa.eu/gdo/
IPCC 2019 (SROCC)	IPCC Special Report on the Ocean and Cryosphere in a Changing Climate	Observed regional impacts from changes in oceans and the cryosphere. Relevant updated information for high mountain areas and coastal areas.	https://www.ipcc.ch/srocc/
IPCC 2019 (SRCCL)	Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems	Relevant updated information on risks to land-related systems from climate change. Some regional and country information available throughout the report, but no specific regional analysis.	https://www.ipcc.ch/srccl/
IPCC 2014	Fifth Assessment Report Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects.	Observed climate trends, future projections, vulnerability and impacts per sector (ecosystem, water, agriculture, health) as well as key risks for different regions (Africa, Europe, Asia, Australasia, North America, Central and South America, polar regions, small islands).	https://www.ipcc.ch/report/ar5/wg2/
IPCC 2012 (SREX)	Managing the risks of extreme events and disasters to advance climate change adaptation	Relevant information on risk and its determinants, on changes in climate extremes and their impacts. Not much regional information.	https://archive.ipcc.ch/report/srex/
MunichRe (regular update)	MunichRe NatCatSERVICE	Overview of natural loss events per year (losses, insured losses and fatalities globally and per country). Provides a good picture of past events, does not allow any projections.	https://natcatservice.munichre.com
ND-GAIN (yearly)	ND-GAIN Country Index	Country data on the ND-GAIN Index and its elements, which give a good overview of overall vulnerability and readiness.	https://gain.nd.edu/our-work/country-index/
USAID (different years)	Climate Risk profile by country or region	USAID regularly develops climate risk profiles by country, and provides an overview of historical and future climate and impacts.	accessible via www.climatelinks.org/

Source, year	Title	Content relevant for CC foresight Analysis	Links
World Bank 2013, 2014	Turn down the heat: confronting the new climate normal (5 volumes)	Information on regional impacts on key sectors. All relevant regions covered. Although not new, it gives a good overview on impacts per region.	accessible via https://openknowledge.worldbank.org/
WMO (regular update)	WMO El Niño/La Niña update	Regular update on short-term El Niño probabilities (a few months ahead). Relevant in a short-term perspective given that El Niño is the most important driver of climate variability and can trigger extreme weather events and disasters in various parts of the globe.	www.wmo.int
Food			
FAO (every 3 months)	FAO Crop prospects and food situation – Quarterly global reports	Quarterly global reports with regional reviews on cereal production incl. short-term forecast (early warning). Regular updates on countries requiring external food assistance and on low-income food deficit countries.	www.fao.org/giews/reports/crop-prospects/en/
FAO (biannual)	FAO Food Outlook - Biannual Report on Global Food Markets	Biannual update on production, trade and demand of different food products incl. short-term forecast. Not much regional information.	www.fao.org/giews/reports/food-outlook/en/
FAO (various years)	Regional overview of food security and nutrition (various regions)	Series of regional updates on food security and nutrition with climate variability and extremes being an important element.	accessible via www.fao.org
FAO	FAO 2020–2021 La Niña advisory	Update on projected impacts of the La Niña Year 2020–21.	http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/1366250
FAO	Regional food market situation and policy bulletins in response to the COVID-19 pandemic	Analysis and policy briefs of the regional food market or food security situation related to COVID-19 pandemic impacts.	http://www.fao.org/policy-support/tools-and-publications/ =
FSIN Food Security Information Network (annual)	Global report on Food Crises	Country (and regional) information on food insecurity and its main drivers incl. forecast of acute food insecurity.	www.fao.org/resilience/resources/resources-detail/en/c/1187704/
OECD–FAO (various years)	OECD–FAO Agricultural Outlook (e.g. 2019–2028)	Assessment of ten-year prospects for agricultural and fish commodity markets at national, regional and global levels. Each report has a regional focus.	www.agri-outlook.org/
Water			
WRI (yearly)	WRI Aqueduct Water Risk Atlas	Yearly update of global to local water risk and its components (physical and non-	www.wri.org/aqueduct

Source, year	Title	Content relevant for CC foresight Analysis	Links
		physical risks) including future scenarios for 2030–40.	
IRI/LDEO Climate Data Library (monthly updates)	WASP Indices	The WASP index (Weighted Anomaly Standardized Precipitation) gives a standardised measure of precipitation excess or deficits over a selected monthly or yearly accumulation period.	https://iridl.ldeo.columbia.edu/maproom/Global/Precipitation/WASP_Indices.html
Health			
ECDC (European Centre for Disease Prevention and Control)	Surveillance Atlas of infectious diseases	Surveillance of various diseases such as cholera, dengue, chikungunya, etc.	www.ecdc.europa.eu/en/home
UNEP 2018	The Adaptation Gap Report 2018	The 2018 edition has a focus on health. Background information on health impacts of heat, extreme events, climate sensitive infectious diseases and food and nutritional security. Includes some regional information, although not systematically.	www.unenvironment.org/resources/adaptation-gap-report
WHO 2014	Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s	Regional projections for selected climate related deaths. Although not new, it is still one of the most cited sources.	accessible via https://apps.who.int/iris/
WHO (yearly)	World Malaria Report	Regional information on progress and challenges due to malaria.	https://www.mmv.org/newsroom/publications
Regional stability			
IBRD and World Bank 2018	Groundswell: Preparing for Internal Climate Migration	Conceptual information on climate change–migration nexus and climate migration projections for selected regions and countries (East Asia, South Asia, Central America).	https://openknowledge.worldbank.org/handle/10986/29461
IDMC (yearly)	Global Report on Internal Displacement	Annual data on new displacements by conflicts and disasters including regional overviews and country spotlights.	www.internal-displacement.org/global-report/
UNDP 2020	Socio-economic impact of the COVID-19 pandemic	Analysis for many countries and a few regions regarding impacts on the economy, poverty and inequality, migration, education, food security and governance.	https://www.undp.org/content/undp/en/home/covid-19-pandemic-response/socio-economic-impact-of-covid-19.html

Source, year	Title	Content relevant for CC foresight Analysis	Links
The Fund for Peace (yearly)	Fragile States Index	Measuring fragility: Risk and vulnerability in 178 countries. No link to climate, is a composite indicator for regional stability.	https://fragilestatesindex.org/
World Bank 2020	Regional economic update	Regional economic updates containing information on COVID-19.	

Annex 2: Methodology for CC foresight

The challenges in assessing future climate risks

The CC foresight will conduct a short- to medium-term analysis of climate-related risks with a perspective of 1–3 years. The climate-related risks will be assessed with regard to food security, water, health and political stability. Challenges:

- In general, no specific weather or climate predictions can be made with a time horizon of 1–3 years. Extreme events are uncertain per se, and only a certain probability that they may occur may be projected into the future. Recurring events such as monsoons or the El Niño phenomenon have a certain circularity over the years, and under specific circumstances predictions can be made. A new model developed by researchers from the Potsdam Institute for Climate Impact Research and others allows the forecasting of an El Niño event about one year ahead. Slow onset events by definition occur slowly and sometimes gradually (e.g. sea level rise, glacier retreat). For such changes we can interpolate that they are ongoing at the same or even at higher pace and hence implications for a 1–3-year period are very likely.
- The 1–3-year perspective is below the time horizons of climate change assessments (2030 and beyond). High frequency and intensity of climate extremes in the present or recent past and a projected increasing frequency and intensity of such events in the future (IPCC perspective 2030) does not mean that frequency and intensity of such events will be necessarily higher in the short term. But we can assume that current extremes and related damages have an implication on the short-term risk environment as they may negatively influence vulnerability in upcoming years and the ability to cope with future shocks as people are still recovering from past events (e.g. current extreme drought influencing agricultural yields and food security in the near term or recovery from tropical cyclones lasting for years).

Assumptions and methodological implications

- The current risk situation and hotspots are strongly influencing the risk situation 1–3 years out, hence it is crucial to identify and understand the current risk situation and hotspots.
- The climate-related risks not only depend on the climate signal (intensity, frequency of climate-related hazards, changes in variability, etc.), but to a large extent on exposure and vulnerabilities of people and ecosystems (see Figure 1), on the ability to address those risks (readiness, adaptive capacity, etc.) and on other non-climatic drivers. The analysis of climate risks absolutely requires the consideration of the relevant non-climatic factors. The ND-GAIN Index (https://gain.nd.edu/our-work/country-index/), summarizing a country's vulnerability to climate change and other global challenges in combination with its readiness to improve

resilience, is in our view a good base for describing current climate-related risk on a general level and in a comprehensive manner.

- In the short-term (1–3-year) perspective, changes of such non-climatic factors (e.g. land use changes, political turmoil, population increase, etc.) are more relevant for the whole risk situation than any changes on the climate side, and are the main drivers influencing the capability to cope with climatic change events if they occur.
- To a certain extent we can analyse past or current events or trends to make a rough forecast of near-term risks. This is the case of current extremes, where we assume that they have a longer-term effect on future risks (e.g. extreme droughts or floods, damaging tropical cyclones).
- Climate variability is more relevant for our time horizon than projected climate change and hence it is important to understand current variability. Nevertheless, we consider the IPCC Fifth Assessment Report and IPCC special reports as important information sources to identify relevant current risks and impacts and observed changes by region. Projected changes for 2030 can give an indication of potential future changes that in some cases might be relevant in the short term (especially the case for gradual changes such as glacier retreat).
- Surveys on perception of risks are interesting sources of information for assessing future risks as they have a forward-looking perspective by nature. There are, however, very few such data sources (e.g. WEF Risk Report, Perception of political instability indicator). Another source for short-term risk perception may be price developments in agricultural commodity futures.

Annex 3: Climate Risk Index (Germanwatch)

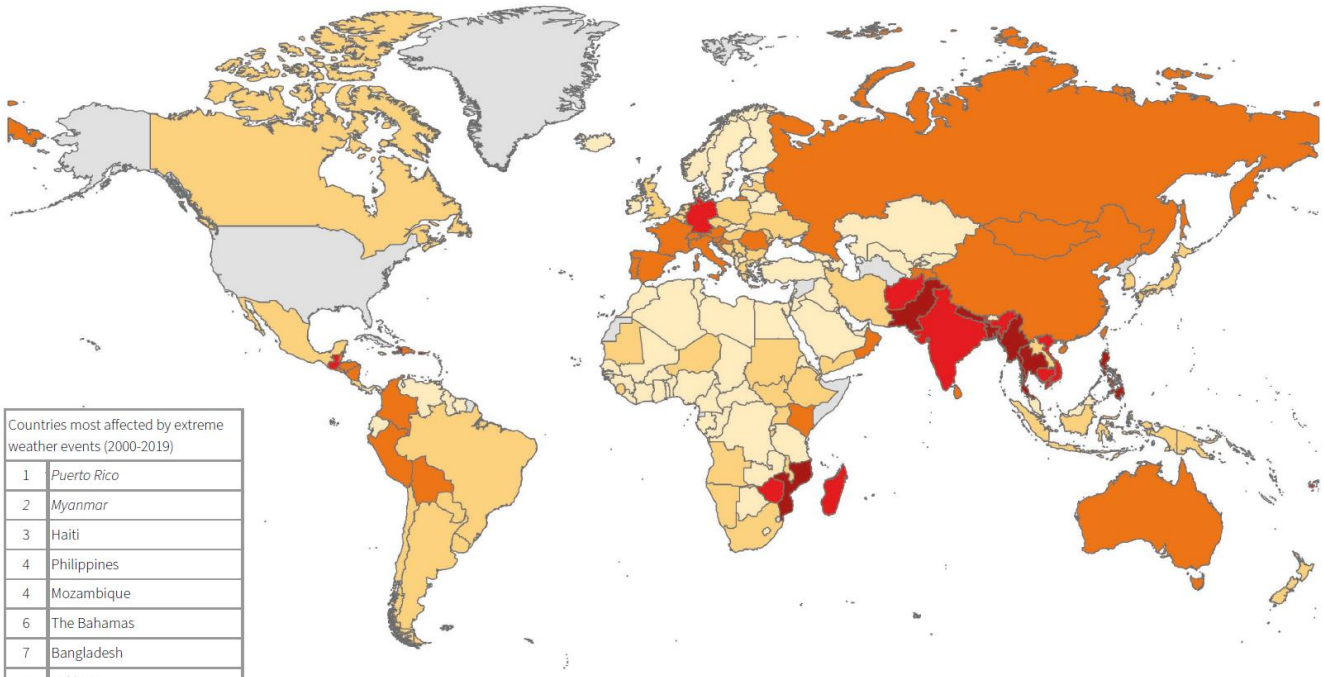
The Climate Risk Index (CRI) analyses the extent to which countries and regions have been affected by impacts of weather-related loss events (storms, floods, temperature extremes and mass movements). It is based on the worldwide data collection and analysis provided by MunichRe's NatCatSERVICE. The CRI includes the following indicators:

1. Number of deaths
2. Number of deaths per 100,000 inhabitants
3. Sum of losses in US$ in purchasing power parity (PPP)
4. Losses per unit of gross domestic product (GDP)

The scope of the CRI is more specific than the ND-GAIN used in the CC foresight analysis, and must not be mistaken for a comprehensive climate vulnerability scoring. In contrast to the ND-GAIN, the vulnerabilities and adaptive capacities are only indirectly considered (e.g. lower number of deaths and losses in regions with low vulnerabilities and high adaptive capacities in case of a hazard). The CRI focuses on extreme weather events but does not take into account important slow-onset processes such as rising sea levels, glacier melting or more acidic and warmer seas. Furthermore, it is based on past data and should not be used as a basis for a linear projection of future climate impacts (Germanwatch 2019).

Figure 5: Climate Risk Index, Ranking 2000-2019

Source: Germanwatch and Munich Re NatCatSERVICE



Italics: Countries where more than 90% of the losses or deaths occurred in one year or event

Source: Germanwatch 2021