**Special thematic report on climate change and the human rights to water and sanitation by the Special Rapporteur on the human rights to safe drinking water and sanitation (January 2022)**

**Part 1: Outlining the impacts of climate change on the human rights to water and sanitation around the world**

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# Introduction

1. The world is facing a global water crisis, and climate change is exacerbating this crisis. It is widely understood and acknowledged that climate change arises as a consequence of the massive emission of greenhouse gases, and therefore no one doubts that mitigation strategies must be led by the energy transition. However, it is rarely explained that the main socio-economic impacts are generated around water: in fact, about 90 per cent of natural disasters are water-related. Therefore, adaptation strategies must be based on a hydrological transition that strengthens environmental and social resilience in the face of climate change. On the one hand, it is urgent to recover the health of wetlands and underground aquifers - true natural lungs of the water cycle - which can and should be strategic reserves for increasingly severe droughts. On the other hand, it is a matter of strengthening democratic governance of water and sanitation services as well as aquatic ecosystems in the face of these droughts, with adaptation plans that prioritize the human rights to drinking water and sanitation, particularly for those living in poverty and vulnerable situations and that have been adapted and implemented with the participation of the affected population.
2. The current report is part of three special thhhematic reports issued by the Special Rapporteur on the human rights to safe drinking water and sanitation.[[1]](#footnote-1) It serves as an intermittent report between the Special Rapporteur's report to the 48th session of the Human Rights Council in September 2021, focused on his plans and vision for the mandate ([A/HRC/48/50](https://ap.ohchr.org/Documents/dpage_e.aspx?si=A/HRC/48/50)) and his next report to the 51st session of the Human Rights Council in September 2022. The current report aims to outline how climate change will impact the human rights to safe drinking water and sanitation, and to describe the main trends in those impacts by region. The second report explores the impacts of climate change on the human rights to safe drinking water and sanitation of specific groups, and the third outlines a human rights approach to climate adaptation, mitigation, financing and cooperation.

# Human rights-based approach to climate change

## Climate change and human rights

1. Previously, discussions about climate change have repeatedly taken place without reference to human rights. Although it is often taken as a purely physical phenomenon, climate change cannot be discussed without acknowledging its wide-ranging social and economic impacts. In 2008, the Human Rights Council (HRC) expressed concerns that climate change "poses an immediate and far-reaching threat to people and communities around the world" (resolution 7/23). In a following resolution in March 2009 (resolution 10/4), the HRC noted that the impacts of climate change on human rights “will be felt most acutely by those segments of the population who are already in a vulnerable situation”.
2. Human rights have also been acknowledged in many of the main global mechanisms created to address climate change. In 2010, the Conference of the Parties to the United Nations Framework Convention on Climate Change adopted Decision 1/CP.16, in which it was noted that the adverse effects of climate change have implications for the effective enjoyment of human rights, that the effects will be felt most acutely by those segments of the population that are already vulnerable, and that State Parties "should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights".[[2]](#footnote-2)
3. Subsequently, a series of HRC resolutions[[3]](#footnote-3) and reports[[4]](#footnote-4) including thematic reports by several Special Procedures mandate-holders[[5]](#footnote-5) affirmed the impact of climate change on human rights and the need for human rights mechanisms to strengthen responses to climate change, as well as highlighted the disproportionate size of this impact on certain groups, including women and girls, children, migrants, persons with disabilities, and older persons. The links between climate change and human rights, as well as State obligations to protect human rights from the impacts of climate change, have also been explored by many Special Procedures mandate-holders, and human rights treaty monitoring bodies, many of which referred to the impact of climate change on the human rights to safe drinking water and sanitation.[[6]](#footnote-6)
4. Most recently, in October 2021, at its 48th session in September 2021, the Human Rights Council passed a landmark resolution 48/13, in which it recognized the human right to a clean, healthy, and sustainable environment. The former Special Rapporteur on human rights and the environment, Mr. John Knox, clarified that this right contains procedural obligations (formal steps and procedures to be taken in enforcing legal rights) and substantive obligations, as well as obligations relating to the protection of groups in vulnerable situations.[[7]](#footnote-7) The substantive elements of the right to a clean, healthy and sustainable include a safe climate[[8]](#footnote-8) and safe and sufficient water,[[9]](#footnote-9) the specifics of which have been outlined in thematic reports by the current Special Rapporteur on human rights and the environment, David Boyd. At the same session, the HRC established a new position of the mandate of a Special Rapporteur on the protection of human rights in the context of climate change in resolution 48/14.

## Climate change and water and sanitation

1. The IPCC introduces several impacts of climate change on hydrological systems across the world. Some of those impacts are illustrated in the current report.[[10]](#footnote-10) First, climate change is projected to reduce renewable surface water and groundwater resources significantly in most arid and semi-arid regions.It has been estimated that about 8 per cent of the global population will see a severe reduction in water resources with a 1°C rise in the global mean temperature, the estimation rising to 14 per cent with a 2°C rise.[[11]](#footnote-11) Second, precipitation variability will increase – , which means, on the one hand, growing risks of heavy rainfall and storms, with stronger river flood peaks, higher flood risks and intensified soil erosion; and on the other hand, more intense and longer droughts. Third, climate change is projected to increase the frequency and intensity of extreme events, including cyclones, hurricanes, and monsoons, destroying local water and sanitation infrastructure. Fourth, sea-level rise is predicted to increase the salinization of coastal aquifers. Finally, the temperature rise will lead to increase in evapotranspiration of vegetation, reducing river flows and favouring the concentration of contaminants in water and the biological processes of eutrophication of water bodies.
2. The hydrological impacts of climate change cannot be divorced from the socio-economic context in which they occur. The severity of climate change impacts depends on the scale of extreme weather events such as droughts, floods or hurricanes, on the one hand, and on the level of vulnerability of communities, on the other. For example, the massive migration accelerated by climate change and informal settlement in flood-prone areas on urban peripheries increase urban vulnerability to flooding.[[12]](#footnote-12) Similarly, vulnerability to the risks of drought is multiplied in territories where aquifers and rivers are overexploited in normal years. Global water use has increased by a factor of six over the past 100 years and continues to grow steadily at a rate of about 1 per cent per year as a result of increasing population.[[13]](#footnote-13) Above all, the prevailing economic development model and consumption patterns are driving increases in water consumption. This growth in demand and future use expectations makes us increasingly vulnerable to the reduction in river flows and infiltration into aquifers that climate change imposes. Climate change increases poverty as it hits hardest those living in the most vulnerable situations, but at the same time poverty generates greater vulnerability to climate change.[[14]](#footnote-14) This perverse circle threatens to trigger the violation of the human rights to safe drinking water and sanitation among the most impoverished and those living in situations and territories most vulnerable to the risks of drought or flooding, as well as rising sea levels, as a result of climate change.

## Climate change and the human rights to safe drinking water and sanitation

1. The human rights to safe drinking water was recognized by the UN General Assembly (resolution 64/292) and the Human Rights Council (resolution 15/9), which derives from the right to an adequate standard of living, protected under, inter alia, article 25 of the Universal Declaration of Human Rights, and article 11 of the International Covenant on Economic, Social and Cultural Rights (ICESCR). In its General Comment No. 15, the Committee on Economic, Social and Cultural Rights clarified that the human right to water means that everyone is entitled to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses. Furthermore, the UN General Assembly (resolution 70/169) and the Human Rights Council (resolution 33/10) recognized that water and sanitation are two distinct but interrelated human rights. In this regard it is important to underline the explicit recognition that “the human right to sanitation entitles everyone, without discrimination, to have physical and affordable access to sanitation, in all spheres of life, that is safe, hygienic, secure, socially and culturally acceptable and that provides privacy and ensures dignity, while reaffirming that both rights are components of the right to an adequate standard of living”.
2. Climate change affects the enjoyment of the human rights to safe drinking water and sanitation and as part of States' obligation to respect, protect and fulfill those rights, States are required to take steps to assess, mitigate and adapt to the impact of climate change on human rights to water and sanitation. In its General Comment No. 15, the Committee on Economic, Social and Cultural Rights (CESCR) outlines that “States parties should adopt comprehensive and integrated strategies and programmes to ensure that there is sufficient and safe water for present and future generations”, including by “assessing the impacts of actions that may impinge upon water availability and natural-ecosystems watersheds, such as climate changes, desertification and increased soil salinity, deforestation and loss of biodiversity”.[[15]](#footnote-15) Such State obligation was further elaborated by the former Special Rapporteur on the human rights to water and sanitation, Ms. Catarina Albuquerque, who highlighted that States have obligations to address the harmful impacts of climate change on human rights. She considered that the minimum core obligation of States must be considered over the long term, including with respect to the requirements of future generations, and that even if resources are highly constrained, measures taken must include the use of targeted programmes aimed at those most at risk.[[16]](#footnote-16)
3. In 2010, the then Independent Expert on the human right to water and sanitation (whose positions has changed to Special Rapporteur), Ms. Catarina de Albuquerque, produced a position paper highlighting the impacts of climate change on the normative content of the human rights to water and sanitation. In that position paper, the following impacts were highlighted:
* Availability: In order to be available, the water supply for each person must be sufficient and continuous for personal and domestic uses. These uses ordinarily include drinking, sanitation, washing of clothes, food preparation, personal and household hygiene.

Climate change impact: the availability of water will be threatened by increasing water scarcity, both slow-onset and due to increased variability of rainfall and risk of extreme weather events.

* Quality: In order to be of quality, water required for each personal or domestic use must be safe and free from contaminants that threaten health. Water should be of an acceptable colour, odour and taste for each personal or domestic use.

Climate change impact: water quality can decline through overexploitation of groundwater and rivers and the increasing concentration of pollutants as flows decrease.

* Accessibility: In order to be accessible, water facilities and services have to be accessible to everyone without discrimination. Accessibility has four overlapping dimensions: physical accessibility, economic accessibility, non-discrimination, and information accessibility.

Climate change impact: the accessibility of services may be impacted by floods, droughts and other extreme events. As water sources dry up seasonally or in drought cycles, or water quality declines, individuals may be forced to travel further to find alternative sources. These impacts more likely to affect groups living in situations of vulnerability and poverty, with fewer resources to guarantee alternative water and sanitation options.

* Affordability: Affordability of water and sanitation services holds that access to sanitation facilities and services, including construction, emptying and maintenance, must be available at a price that is affordable for all people without limiting their capacity to access other human rights.

Climate change impact: increasing frequency and length of periods of water scarcity due to droughts, declining raw water quality, destruction or damage to facilities due to floods, and increased competition between uses for water is likely to lead to increasing prices.

* Acceptability: In order to be acceptable, water and sanitation services must be culturally acceptable. This includes that they should be safe, and ensure privacy and dignity.

Climate change impact: under increasing stress, it is likely that the cultural acceptability of water and sanitation services is not prioritized and is in some cases ignored.

# Impacts of climate change on the human rights to safe drinking water and sanitation

1. Climate change will impact the human rights to safe drinking water and sanitation on multiple levels. The primary driver of climate change is the warming of the earth’s atmosphere, due to the accumulation of greenhouse gases caused by human activity. The increase in temperatures will have as a direct consequence an increase in the water consumed by plant masses (cultivated or wild) by evapotranspiration, just as humans need to consume more water at higher temperatures. This increased evapotranspiration from plants can reduce runoff, river flows and those that infiltrate and feed aquifers by between 20 per cent and 40 per cent, which can exacerbate water stress in sensitive regions. Another direct impact of rising temperatures is the melting of masses of ice and snow with the consequent rise in sea level. Rising temperatures will also have indirect impacts on the climate, with changes in precipitation patterns and greater climate variability that increase the risk of extreme weather events, such as droughts, heavy rains, hurricanes, cyclones, and typhoons. These phenomena generate situations of scarcity or destruction of facilities and water contamination, seriously affecting water and sanitation services and putting at risk the human rights to drinking water and sanitation of the most impoverished and of those who live in situations of greater vulnerability.
2. This section will outline the impacts of climate change that are relevant to the realization of the human rights to water and sanitation.

## Changing patterns of precipitation

1. On a global scale, rising temperatures will lead to increased evaporation of surface water. This means that more water from the water cycle will be held in the atmosphere, and average precipitation will increase. There will be significant regional variations in this increase in precipitation. Substantially higher precipitation is to be expected in northern latitudes in India and parts of central Asia, in regions that are rainy, while levels of precipitation will likely reduce in subtropical latitudes, in the Mediterranean, Central America, and in parts of Australia, where today there is little rainfall.[[17]](#footnote-17)
2. In addition to changes at local and regional levels, the amount of precipitation falling at once will become increasingly unpredictable and variable over the year. While the average global yearly precipitation is expected to increase, precipitation is not necessarily going to become more frequent, but rather more intense. In fact, periods of lower precipitation and droughts are expected to become more severe and longer, while periods of precipitation, storms and hurricanes will become more intense.[[18]](#footnote-18)

##### *Impacts on the human rights to safe drinking water and sanitation*

1. These accelerated changes in rainfall patterns not only have a serious impact on water availability in sensitive areas, affecting access to drinking water and sanitation for the most impoverished, but also disrupt agricultural and livestock production traditions essential to the food sufficiency of vulnerable communities, who also have serious difficulties in adapting due to lack of means. In addition, the need for adaptation measures that diversify sources of supply, strengthen storage and storm drainage, and make infrastructure functionality more flexible entail costs that can hinder the affordability of services for poor households.

##  Droughts

1. Periods of drought, during which precipitation is greatly reduced and water sources are depleted, are predicted to become longer and more frequent in certain regions of the world which already face overall dry conditions, and dry seasons.[[19]](#footnote-19) These regions include Southern Europe and the Mediterranean region, central Europe, central and southern North America, Central America, northeast Brazil, and southern Africa.[[20]](#footnote-20)

#### Impacts on the human rights to safe drinking water and sanitation

1. Droughts have wide-ranging impacts on human rights to safe drinking water and sanitation. Firstly, they threaten the availability of water which can lead to water supply restrictions. When water sources dry up, individuals, mainly women and girls, may spend more time collecting water from sources that are farther away, threatening accessibility.[[21]](#footnote-21) Droughts also have implications for the availability of sanitation, particularly when sanitation services rely on water flow to remove fecal matter. Reduced water flow can lead to a backup of piped systems, or contamination of local water sources where the previously fecal matter would have been washed out. Water shortages, especially in drought, when supply networks have many leaks, often lead to discontinuous supply to save losses; but this leads to pollutant intrusions through leakage points when there is no pressure in the pipes.
2. In impoverished rural communities, the provision of water for domestic supply and sanitation is often linked to the water needed for agricultural and livestock production necessary for food sufficiency and food sovereignty. For these communities, increasingly long and harsh drought cycles can make arid and semi-arid territories uninhabitable and generate massive migration processes.
3. Periods of water stress have also been shown to threaten the affordability of water services. If the priority of drinking water supply is not ensured, increasing competition between uses of water (industrial, agricultural, hydropower, drinking water), often leads to tariff increases, especially if water markets and privatisation of services are in place. The need to diversify sources of supply, integrating surface and groundwater management, larger storage infrastructure and treatment of available water, if its quality degrades, as well as higher maintenance costs, will lead to higher tariffs. If the necessary public funding for these investments is not secured, local governments may turn to privatization of services, which may lead to higher tariff increases. In rural areas and impoverished suburbs, where the necessary investments are not forthcoming, private tanker supply will grow at much higher costs and with no guarantee of safe drinking water.

## Floods

1. During 1995-2015, floods accounted for 43 per cent of all documented natural disasters, affecting 2.3 billion people.[[22]](#footnote-22) Climate change is projected to increase flood hazards over more than half the planet, both through increased heavy rainfall, and increases in the intensity and frequency of cyclones, hurricanes and tropical storms. These risks can be exacerbated particularly in small catchment areas and drainage basins, as larger basins have more capacity for integrating sudden increases in river flows.

#### Impacts on the human rights to safe drinking water and sanitation

1. Flooding threatens the human rights to safe drinking water and sanitation in multiple ways. Water and sanitation infrastructure can be damaged or destroyed, leading to important consequences for the availability and accessibility of water and sanitation services. Water quality can be threatened by pollutants such as pesticides and fertilizers, residues and sediments carried by runoff; in addition, in a coastal strip of up to 10 km, saltwater intrusion into coastal aquifers can threaten the potability of their waters. Floods can collapse sewage systems and produce "black floods" inside houses through toilets.
2. Individuals living or working on flooded land can suffer economic consequences, exacerbating poverty and impacting their access to water and sanitation services.[[23]](#footnote-23) Recurring floods can cause communities to abandon safe sanitation and hygiene practices and return to defecating in the open.[[24]](#footnote-24) Floods can put large numbers of people into refugee camps or temporary accommodation with water and sanitation facilities that are less likely to be culturally acceptable, meet the menstrual hygiene needs of women and girls, or serve groups in vulnerable situations, such as LGBTQ persons, children, persons with disabilities and older persons.

## Deglaciation

1. Glacial and snow masses around the world are predicted to reduce significantly over the course of the 21st century. In regions where rivers are fed by glacier meltwater, climate models analysed by the IPCC predict an increase in river flows, followed by a reduction after the exhaustion of ice as a regulator of river flows.[[25]](#footnote-25) The seasonality of the river flows will change. Spring melt floods will become smaller, and without regulation of these snow masses and glaciers, runoff will depend on rain, rather than snow. Over one-sixth of the world’s population resides in glacier-fed river basins, particularly in South and Central Asia and in Latin America.[[26]](#footnote-26) The glaciers of the Himalayas and Tibet alone feed seven of the world’s largest rivers—the Brahmaputra, Ganges, Indus, Irrawaddy, Mekong, Salween, and Yangtze—and provide more than 2 billion people with water with a dramatically changing flow regime.[[27]](#footnote-27)

#### Impacts on the human rights to safe drinking water and sanitation

1. Melting of ice and snow in mountain areas will have consequences primarily for inhabitants of these regions, and for those living downstream, who will have to adapt to shifting seasonal flow patterns and reduced natural storage and regulation capacities provided by snow masses and glaciers, with a corresponding reduction in spring and summer flows, when agriculture usually needs more water. [[28]](#footnote-28) Storage alternatives may be unaffordable, or culturally unacceptable in regions where populations rely mostly on the usual river regime.

## Temperature rise

1. As the primary vector of climate change, temperature rising is a major driver in all climate-related impacts on water and sanitation. Higher temperatures lead to higher evaporation from water bodies, higher evapotranspiration from vegetation, and greater water needs, both for drinking water supplies and especially for irrigation. This has consequences: lower flows in rivers and less infiltration into aquifers, as well as increasing urban and irrigation demands. Additionally, higher temperatures associated with climate change can degrade vegetation cover and increase the risks of forest fires and consequent increased soil erosion. All this implies an increase in runoff when there is heavy rains, which accelerates the processes of erosion and clogging of the reservoirs by sediments, in addition to less infiltration into the aquifers and, ultimately, a lower water storage capacity.

#### Impacts on the human rights to safe drinking water and sanitation

1. The serious loss in the capacity for storage and flow regulation in river headwaters due to the melting of glacial masses, is coupled with the already explained reduction of river flows, due to increased evapotranspiration and the lesser storage of water in the aquifers and reservoirs, due to less infiltration and accelerated soil erosion and clogging of reservoirs. All this, together with the growth in the demand for urban and irrigation needs at high temperatures, suggests an aggravation of water stress problems, with consequences on the availability of drinking water, rising water tariffs and problems of drinking water affordability, especially for the most impoverished.[[29]](#footnote-29) Moreover, rising temperatures may have important impacts on the quality of drinking water: for every 1° C increase in temperature there is an 8 per cent rise in *E. coli*-related diarrhea.[[30]](#footnote-30) Finally, high temperatures with an increasing concentration of organic pollutants promote the eutrophication of water bodies and the appearance of cyanobacteria that produce toxic contamination, which impact the potability of water.

## Sea-level rise

1. Sea-level rise predicted because of climate change will threaten access to water and sanitation on low-lying coastal areas for two main reasons. First, it will increase the vulnerability of infrastructure in low-lying coastal areas to flooding. Compounded with higher sea levels and more intense storms, storm surges may reach further inland at faster speeds. In addition, rising sea levels could cause the intrusion of saltwater into coastal aquifers.[[31]](#footnote-31)

#### Impacts on the human rights to safe drinking water and sanitation

1. Rising sea-levels combined with storm surges can threaten water quality in low-lying areas. Storm surges can salinize water sources, and destroy local sanitation infrastructure, causing public health risks due to wastewater contamination. The progressive salinization of coastal aquifers impacts the quality of drinking water and can have important health implications.

## Groundwater storage aquifers

1. An important key to tackling climate change to ensure safe drinking water and sanitation lies in the great inertia and relative stability of groundwater, stored in aquifers. Aquifers are nature's water lungs, storing and protecting huge quantities of water underground, under fairly and more stable conditions than surface water bodies. Depending on how they are managed, the water levels and quality of aquifers can and should be strategic drinking water reservoirs for managing future droughts.
2. It is important to note, however, that climate change may impact groundwater stores directly through less infiltration (due to degradation of vegetation cover, erosion and increase in the proportion of runoff against infiltration); but the main risks of aquifer degradation come above all from the expansion and intensification of groundwater exploitation as well as from processes of contamination from land-use and economic activities, rather than climate change.[[32]](#footnote-32) The volume of groundwater recharged is thrice that of total surface water flows over the last 50 years but its abstraction is rising by 3 per cent annually.[[33]](#footnote-33)

#### Impacts on the human rights to safe drinking water and sanitation

1. Over-pumping can deplete the aquifers, breaking their vital function as strategic reserves for droughts, and can lead to declines in water quality by increasing the concentration of pollutants and/or favouring saline intrusions in coastal aquifers. Therefore, over-pumping puts at risk the availability of quality resources for the supply of drinking water in critical situations of shortage due to drought, which will undoubtedly induce higher costs and rates that may not be accessible to those living in situations of greater vulnerability. The exploitation of deeper groundwater may be a short-term alternative but it has no prospects for sustainability and may have implications for the affordability of water and sanitation services, especially if water markets are in place, enabling speculative businesses based on people´s most basic need, including their human rights to safe drinking water and sanitation.

## Wetlands, riparian ecosystems and vegetation cover

1. Strengthening the resilience of aquatic ecosystems is one of the keys to climate change adaptation strategies, and to this end, it is essential to recover and conserve, not only of aquifers, but also of the most inertial surface water ecosystems: wetlands and riparian river ecosystems. Wetlands are surface water reserves, which regulate river flows. They expand river floods and soften their destructive energy, while, on the coasts, mangroves protect coastlines from major storms. They are natural macro-purifiers that regenerate water quality, prevent eutrophication processes and sustain a large part of the biodiversity on continents and coasts.[[34]](#footnote-34) On the other hand, we must be aware of the importance and functions of riverside ecosystems and riparian forests, as part of river channels. These have functions of expansion and brake of river floods, and of green filter, by absorbing nutrients and purifying both surface waters and those that run underground in alluvial aquifers. Even the vegetation cover of islands and continents is key in protecting the water cycle from the impacts of climate change, since they prevent soil erosion and favour the infiltration of aquifers.

#### Impacts on the human rights to safe drinking water and sanitation

1. As mentioned above, rivers, and especially riparian ecosystems and wetlands, if they are in good condition, are natural macro-purifiers and flow regulators that reduce the risks derived from droughts and floods. The degradation of vegetation cover facilitates soil erosion, accelerating the clogging of reservoirs and reducing infiltration and recharge of aquifers. In sum, the natural functionality of these ecosystems reinforces the availability of drinking water in drought and reduces the risks of flooding, to the benefit of the whole society, but especially of those who, because they live in situations of poverty and vulnerability, depend more directly on its natural environment.
2. The degradation of ecosystems is an element that threats the enjoyment of human rights to safe drinking water and sanitation through lost opportunities for low-cost, sustainable, and culturally appropriate climate adaptation. Restoring and maintaining the good condition of aquatic ecosystems and vegetation cover increases drought buffers, by providing water sources that are much less dependent on precipitation, and regenerate water quality, while smoothing floods, in the most cost-effective way.

# Regions

## Sub-regional areas with specific vulnerabilities

1. Access to drinking water and sanitation will be more impacted by climate change in certain areas than in others. The geographical characteristics of those areas lend them specific vulnerabilities to climate change, and populations living in those areas face additional threats to the enjoyment of human rights to safe drinking water and sanitation, and as such, must be prioritized in adapting to climate change.

### Small Islands

1. Small islands mostly refer to States and territories located within the tropics of the southern and western Pacific Ocean, central and western Indian Ocean, the Caribbean Sea, and the eastern Atlantic off the coast of West Africa, and the Mediterranean Sea.[[35]](#footnote-35) These islands share common vulnerabilities that arise due to the impacts of climate change. One of those vulnerabilities is related to rising sea levels which has a major impact on water sources. These regions, particularly islands in the Caribbean, have less than 10 per cent of the global renewable water supply, leaving populations dependent on groundwater sources – which are highly vulnerable to the impacts of salinization.[[36]](#footnote-36) Another vulnerability is related to the increased risk of flooding during extreme events. While it is unlikely that small islands will be entirely submerged, in most cases, projected increases in sea-level combined with predictions of extreme events, including storm surges and El Niño-Southern Oscillation, puts much of their low-lying land at risk of flooding.

#### Impacts on the human rights to safe drinking water and sanitation

1. Of particular importance to the human rights to safe drinking water and sanitation is that flooding in small islands can lead to the destruction of water supply and treatment infrastructure impacting the availability and quality of water. Flooding is also likely to increase saltwater intrusion into both surface and groundwater, without alternative natural sources. This phenomenon has already occurred, for example, in Fongafale Island (Tuvalu), where during extreme high tides, large areas of the inner part of the Island become inundated with salty waters.[[37]](#footnote-37)

### Polar regions

1. In the Arctic, many public and domestic water and sewage infrastructures are failing under the effects of permafrost thaw, and the high costs of maintenance and operation.[[38]](#footnote-38)

#### Impacts on the human rights to safe drinking water and sanitation

1. As permafrost thaws, pipes, roads, and storage and treatment facilities in the Arctic will likely shift and become damaged, with rising maintenance costs that could impact the affordability of water and sanitation services for the users.[[39]](#footnote-39) Water quality is also predicted to be affected by rising temperatures, as higher temperatures speed up eutrophication processes in organically polluted water bodies.[[40]](#footnote-40)

### Mountainous areas

1. There is growing evidence that high-mountain areas are warming faster than lower elevations.[[41]](#footnote-41) This acceleration in warming makes mountainous areas exceptionally vulnerable to climate change. Such vulnerability is evident from the impact on mountain glaciers and snowcaps, which show a decreasing trend almost everywhere globally.[[42]](#footnote-42)

#### Impacts on the human rights to safe drinking water and sanitation

1. Mountainous areas will see changing seasonality of water flow, as glaciers begin to melt steadily throughout the year, and precipitation increasingly falls as water rather than snow. Initially, river flows will grow, which will imply greater risks of flooding, which could put local water and sanitation infrastructures at risk. Once glacier melt goes past a critical point, flows and the availability of drinking water will decrease.

### Coastal areas

1. More than 600 million people (around 10 per cent of the world’s population) live in coastal areas that are less than 10 meters above sea level. This includes delta areas, which tend to be agriculturally productive regions where large populations live close by, and depend on productive activities for their livelihoods. Coastal areas are vulnerable to the increase in sea levels, and flooding due to storm surges.[[43]](#footnote-43)

#### Impacts on the human rights to safe drinking water and sanitation

1. Sea-level rise in coastal areas will have severe impacts on water supply and sanitation infrastructure due to an increase of flooding. Sea-level rise can also lead to the salinization of coastal aquifers rendering their waters undrinkable.[[44]](#footnote-44)

## Main trends by region[[45]](#footnote-45)

### Africa

1. Between 2000 and 2020, the population with access to drinking water increased from 67.91 per cent to 78.69 per cent in North Africa and from 17 per cent to 30 per cent in the sub-Saharan region. The population with access to sanitation grew from 24.79 per cent to 41.73 per cent in North Africa and from 14.3 per cent to 21 per cent in Sub-Saharan Africa.[[46]](#footnote-46) Despite these efforts, Africa continues to be the continent with the largest proportion of the population without drinking water and sanitation, and living under the greatest risks in the face of climate change.

#### Changing patterns of precipitation

1. Climate change is expected to change patterns of precipitation, concentrating it during heavy rainfall events. While total precipitation is expected to reduce in some regions of Africa such as southern Africa, the heaviness of rainfall is expected to increase across the continent. Heavier rainfalls will lead to a significant increase in the risk of flooding, which can disrupt the availability of water by damaging infrastructure, and can contaminate both groundwater and surface supplies. The IPCC found evidence of increased cholera outbreaks during periods of intense rainfall in Ghana, Senegal, South Africa, Zanzibar, Tanzania and Zambia, as well as a selection of coastal West African countries.[[47]](#footnote-47) Heavy rainfall will also increase the erosion of fertile land and soils, clogging reservoirs with sediment carried by rainwater. In Kenya, excess sediment from eroding soil has reached the Tana River, which provides water for 95 per cent of Nairobi's residents, reducing reservoirs' capacity and increasing water treatment costs.[[48]](#footnote-48) This can threaten the quality, affordability, and extreme cases, the availability of water of local populations. In areas such as the Sahel, torrential rains and long droughts accelerate mass migration processes.[[49]](#footnote-49)

#### Droughts

1. Climate models predict longer and more frequent droughts across the continent, as periods between rainfall become longer. Therefore, shortages of water, and particularly potable water are expected to increase during long periods of drought, as the continued availability of potable water and sanitation services is not guaranteed. For example, in Ethiopia, the 2011 audit of actual access to drinking water within households (registered as having piped access to services) showed that climate variability and infrastructure breakdown, caused drinking water to be unavailable for long periods of time, most notably during dry seasons.[[50]](#footnote-50)
2. Parts of Africa, including most southern Africa, are predicted to see a long-term decline in rainfall and water flows.[[51]](#footnote-51) Declining annual rainfall will lead to reductions in river flows, especially in conjunction with population growth and the need to grow more food. This, in turn, could increase competition between different uses of water, if the use of drinking water is not prioritized, which could raise its price and render services unaffordable for the population, particularly those living in poverty. Conflicts can also be generated or aggravated between territories and countries that compete for available flows.

#### Groundwater storage

1. Africa has significant groundwater stores, the importance of which grows with climate change. Although in most of these aquifers no strong impacts on recharge due to climate change are expected, drought-sensitive territories such as the Sahel, the Horn of Africa and southern Africa may experience a decrease in groundwater recharge, especially in shallow aquifers.[[52]](#footnote-52) In addition, as exploitation of these aquifers increases, due to hardening droughts and population growth, their sustainability may be put at risk and the quality of water may be degraded by overexploitation, contamination and intrusion of saltwater in coastal aquifers.[[53]](#footnote-53)

### Asia

1. In central and southern Asia, access to safely managed drinking water grew from 46.06 per cent in 2000 to 62.36 per cent in 2020. In the same period in eastern and south-eastern Asia, access to basic drinking services grew from 80 per cent to 94 per cent. Asia has seen large improvements in access to sanitation: between 2000 and 2020, access to safely managed sanitation services grew from 12.2 per cent to 46.57 per cent in central and southern Asia, and from 20.73 per cent of the population to 60.22 per cent in eastern and south-eastern Asia.[[54]](#footnote-54) Unfortunately, the lack of attention in economic development towards the sustainability of aquatic ecosystems generates multiple fronts of vulnerability to climate change.

#### Droughts

1. The scarcity of drinking water will be one of the major challenges for the Asia region, as a consequence of the combined effects of climate change, poor water management, contamination, aquatic ecosystems degradation and rapidly growing water demands. Increased industry, urbanization, and economic development are leading to a general sharp growth in water use and an accelerated degradation of the quality of available flows. Alongside this growth in demand, the ability and quality of water supplies is expected to become increasingly uncertain.[[55]](#footnote-55) In many southern Asian regions, especially western India and southern and central Pakistan, their traditional droughts will be exacerbated. In Nepal, where the National Action Plan on Adaptation identified that 22 of the 75 districts are highly vulnerable to drought,[[56]](#footnote-56) less availability and greater contamination of drinking water are expected, forcing people, especially women and girls, to seek the water further afield.

#### Deglaciation

1. On a long-term basis, droughts will also be intensified by increasing deglaciation. About 1.3 billion people in South Asia rely on freshwater obtained directly or indirectly from the Hindu Kush mountains, which feed 10 river basin whose flows are regulated by the masses of ice and snow from the mountains.[[57]](#footnote-57) Climate models predict a significant acceleration of glacier melt in the first half of the 21st century, and a drop-off in water flow afterward. The impact of this decrease will be felt mostly within the populations living in the mountains, who rely almost exclusively on water that regulates glaciers, and of those living downstream, particularly in arid lowlands surrounding the Himalayas.[[58]](#footnote-58) This reduction flows, together with massive pollution and competition between uses of water, can fuel conflicts and increase rates, aggravating the non-compliance with human rights to safe drinking water and sanitation among the most impoverished.

#### Groundwater storage

1. Increased water stress is also predicted to put pressure on Asia’s groundwater resources. Groundwater use in the region could increase by 30 per cent by 2050.[[59]](#footnote-59) The increase in demand for irrigation has already led to severe groundwater stress in the north China Plain and northwest India.[[60]](#footnote-60) Overexploitation of groundwater can lead also to a reduction in water quality, and in moments of drought, interruption in the continuity of services. The OECD found that 79 per cent of countries in the Asia-Pacific region had no policy instrument to monitor or allocate groundwater.[[61]](#footnote-61) The study found that in Japan and the Republic of Korea, aquifers were being exploited faster than they could be replenished, with groundwater levels falling, rising pumping costs and degradation of water quality.[[62]](#footnote-62)
2. The overexploitation of groundwater impacts drinking water availability and affordability especially in the Middle East, where many aquifers have been depleted. Saudi Arabia has invested heavily in the development of desalination technologies, which now have replaced groundwater as the primary source of drinking water.[[63]](#footnote-63) These methods are costly and demanding in energy and have implications for the affordability of services.

#### Floods

1. Increased heavy rains and particularly monsoons, coupled with less regulation of melting glacial masses, are expected to increase flood risks, in most of the region, in particular East, South, and South-East Asia. These regions are highly vulnerable to these disasters, which disproportionately burden the poorest who live in areas of greater vulnerability. In August 2017 alone, intense monsoon rains affected 40 million people in Bangladesh, India and Nepal, with 1,300 deaths and 1.1 million people forced to relocate to relief camps.[[64]](#footnote-64) Such flooding can destroy drinking water points and sanitation facilities, damage delivery and treatment infrastructure, and contaminate water sources.[[65]](#footnote-65)
2. Increased flood risks are exacerbated in the low-lying coastal areas of the region, including Bangladesh, parts of the Malayan peninsula, and the Mekong delta, where storm surges and sea-level rise create flooding of saltwater.[[66]](#footnote-66) The drastic reduction of flows, their contamination and even their salinization, due to the overexploitation of rivers, aggravate these impacts in densely populated coastal areas. River salinity and land salinization in the southwest coastal belt of Bangladesh is on the rise and freshwater river area is expected to decrease by half due to climate change by 2050 (from 40.8 per cent at present to 19.7 per cent), further affecting the supply of drinking water.[[67]](#footnote-67) WaterAid reports that the coastal populations of India, Bangladesh and Pakistan rely on rainwater harvesting with tanks and ponds for drinking water.[[68]](#footnote-68) In the dry season, when pond water becomes saline and rainwater is used up, people are inevitably forced to use contaminated river water.[[69]](#footnote-69)

### South and Central America

1. Between 2000 and 2020, access to safely managed drinking water grew from 70.1 per cent to 75.34 per cent of the population and the proportion of the population with access to safely managed sanitation services grew from 15.18 per cent to 34.07 per cent.[[70]](#footnote-70) These figures highlight the vulnerability of a high proportion of the population in a general context of increasing pollution of rivers and aquifers, deforestation and growing risks of droughts and floods due to climate change.[[71]](#footnote-71)

#### Droughts

1. Despite sub-regional variations, the region is expected to face widespread water stress. The IPCC predicts that water supply shortages will increase in already vulnerable semi-arid regions, with reduced precipitation and increased evapotranspiration due to higher temperatures.[[72]](#footnote-72) Increasing dryness is expected in countries in Central America, with greater uncertainty in the south of the subregion.[[73]](#footnote-73) Rainfall is expected to decrease in the Caribbean, with severe impacts on the availability of drinking water, as water sources dry up during periods of low precipitation.
2. Drought is predicted to increase competition between water uses and between territories, pushing up water and sanitation rates in South and Central America. Water demand is outstripping availability in many places, and climate change is likely to increase water stress in already water-stressed areas.

#### Deglaciation

1. Glaciers in the Chilean and Argentine Andes have been retreating during the last decades. Ice mass loss has accelerated since 2010, in line with an increase in seasonal and annual temperatures and a significant reduction in annual precipitation in the region.[[74]](#footnote-74) Glacial melting has important consequences for drinking water and sanitation, particularly in mountain regions, where the seasonality of water flow can be disrupted, meaning that the availability during certain months of the year can be limited. Availability of drinking water will also be threatened long-term, as after a peak in melted water flow as the glacier melts gradually, runoff will decrease permanently. This has happened in the Cordillera Blanca of Peru, where 7 out of 9 river basins are estimated to have crossed a critical threshold, exhibiting permanently decreasing water levels.[[75]](#footnote-75) Glacial melt in the Andes could also affect the risk of flooding in the short term, with glacial lake outbursts occurring in the ice fields of Patagonia. In the medium and long term, the disappearance of flow regulation generated by glaciers will make flows more irregular and floods more likely when there is intense rainfall that will tend to be rain rather than snow.

#### Floods

1. In addition to drought, the region faces a high vulnerability to flooding. Central America, for example, has been identified as one of the most responsive regions to climate change, seeing a steady increase in extreme events such as storms and floods. The toxic diffuse contamination affecting drinking water by pesticides increases with the intense rains when "washing" phenomena of contaminated land take place. On the other hand, the growth of toxic open-pit mining is multiplying massive deposits of toxic tailings without surveillance or maintenance, which increases the risks of overflows and collapse of these infrastructures. Finally, the Caribbean is facing increased incidences of hurricanes: in the period 2000–2009, 39 hurricanes occurred in the Caribbean basin compared to 15 and 9 in the 1980s and 1990s, respectively.[[76]](#footnote-76) Alongside sea-level rise, these hurricanes cause widespread flooding, often destroying drinking water infrastructure, rendering services inaccessible. It can also lead to massive declines in water quality: as less than 50 per cent of wastewater in South and Central America is treated adequately, there is widespread risk of drinking water contamination during flooding events, as water overflows from latrines and sewers.[[77]](#footnote-77)

### Europe

1. Access to safely managed drinking water in Europe is high, growing from 86.98 per cent of the population to 91.33 per cent of the population between 2000 and 2020. Access to safely managed sanitation is also high, growing from 61.6 per cent to 70 per cent to the same period – although 96.26 per cent of the population has access to basic services.[[78]](#footnote-78)

#### Droughts

1. Europe will experience a wide range of hydrological impacts of climate change. In particular, projections suggest that there will be an increase in the frequency and severity of droughts due to reduced river flow in southern and south-eastern Europe, the United Kingdom, France, Belgium, the Netherlands, and Luxembourg, and western parts of Germany over the coming decades.[[79]](#footnote-79) There will be a strong reduction in average flows in rivers, especially in Mediterranean Europe (between 20 per cent and 40 per cent), and in infiltration to aquifers, due to increased evapotranspiration as temperatures rise.[[80]](#footnote-80) Future water quality is expected to decrease resulting from the reduced dilution capacity of the rivers.[[81]](#footnote-81)

#### Groundwater storage

1. Overexploitation of aquifers, due to irrigation demands and tourism growth, especially in southern Europe, increases the vulnerability of sensitive areas to drought risks, which climate change tends to aggravate. In the medium and long term, the progressive salinisation of coastal aquifers, due to rising sea levels, threatens the potability of water in highly populated areas. In this context, competition for available water, if drinking water supply is not prioritised, may drive up tariffs and make them unaffordable for the poorest, especially if free markets for water concession rights are developed.

#### Floods

1. Climate models suggest that Europe will experience a drastic increase in the frequency and intensity of floods. In particular, flash and urban floods, triggered by local intense precipitation events are likely to be more frequent throughout the continent, and in particular in Mediterranean Europe.[[82]](#footnote-82) Even in regions where average river flows will drop significantly, as in the Iberian Peninsula, the expected increase in rainfall variability will increase flood risks and their consequences on water and sanitation services.[[83]](#footnote-83)

### Australasia

1. Access to basic drinking water services in Australia has been over 99 per cent since 2000. Access to safely managed sanitation, however, grew from 60 per cent to 75.5 per cent between 2000 and 2020.[[84]](#footnote-84)

#### Changing patterns of precipitation

1. Australasia will face high levels of uncertainty regarding projected rainfall, creating significant challenges for adaptation. Projections for average annual runoff in far south-eastern Australia range from little change to a 40 per cent decline for 2°C global warming above current levels.[[85]](#footnote-85) Freshwater resources are projected to decline in southwest and southeast Australia, and New Zealand. Stress on water resources in the southern Australia, driven by rising temperatures, with associated increases in plant evapotranspiration, and reduced cool-season rainfall are already being felt, as in the Murray Darling Basin, previously subject to over-exploitation of available flows and over-allocation of use rights. Such stress on water source can have important consequences for the availability of drinking water. For instance, the unprecedented decline in river flows during the 1997–2009 “Millennium” drought in south-eastern Australia resulted in low irrigation water allocations and severe urban water restrictions. The impact of water scarcity on water and sanitation tariffs can be exacerbated by water markets and speculative strategies that increase the risk of non-compliance with the human rights to safe drinking water and sanitation for those who cannot pay.

#### Floods

1. Rising sea levels and increasing heavy rainfall are expected to increase erosion and flooding, particularly in northern Australia and southern New Zealand.[[86]](#footnote-86) Flood risk in low-lying coastal areas will be exacerbated by storm surges, leading to the salinization of water sources. Higher rainfall intensity with associated river flooding highlight the deficits and ageing of urban storm drainage infrastructure, as well as sewerage and wastewater treatment systems in cities.[[87]](#footnote-87)

### North America

1. Access to safely managed drinking water services in America grew from 95.27 per cent in 2005 to 97 per cent in 2020, and access to safely managed sanitation grew from 75.65 per cent to 81 per cent in the same period.[[88]](#footnote-88)

#### Floods

1. A significant impact of climate change on North America will be the increase in frequency, intensity, and consequences of floods. The frequency of floods caused by extreme weather events, in particular, is predicted to increase steadily. These floods are projected to decrease drinking water quality by damaging and saturating urban drainage throughout most of North America.[[89]](#footnote-89) Extreme events have already caused significant damage to infrastructure. As an example, Hurricane Katrina caused loss of power and pressure, and damage or destruction to treatment plants and water distribution systems across New Orleans, leaving over 100,000 people without drinking water, or exposed to *E.coli* and cholera. The disproportionate number of victims in impoverished African-American neighbourhoods was also evident. Beyond emergency measures, recovery took a long time - many neighborhoods went without drinking water for more than a year due to unprecedented damage.[[90]](#footnote-90)

#### Droughts

1. Observed climate trends in North America include longer and more frequent droughts and an increased occurrence of severe hot weather events with extreme heat waves that trigger unprecedented wildfires, such as in California, exacerbating erosion processes, accelerating the clogging of reservoirs and reducing infiltration to aquifers. Overexploitation of surface flows and especially of underground aquifers in sensitive regions of North America, such as the southwestern USA, northern and central Mexico (particularly Mexico City), southern Ontario, and the southern Canadian Prairies are multiplying the vulnerability of these territories to future droughts. As a consequence of overexploitation also, toxic pollutants are emerging, such as arsenic, which is naturally present at the bottom of certain aquifers, affecting more and more populations. The existence of water markets and even the fact that water rights are listed on futures markets, as is the case in California, under speculative strategies, can drive urban drinking water rates unaffordable for populations living in poverty or situations of vulnerability.
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7. A/HRC/25/53 [↑](#footnote-ref-7)
8. A/74/161 [↑](#footnote-ref-8)
9. A/HRC/46/28 [↑](#footnote-ref-9)
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