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Thirsting for a Future

Water and children in a changing climate

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Foreword

Water is elemental. Without it, nothing can grow. And without safe water, children may not survive.

Children without access to safe water are more likely to die in infancy -- and throughout childhood -- from diseases caused by water-borne bacteria, to which their small bodies are more vulnerable.

When these diseases don't kill outright, they can contribute to the stunting of children's bodies and minds – and the blighting of their futures -- by undermining their ability to absorb nutrients.

When a community's water supply dries up or becomes contaminated -- because of drought, because of flooding, because of conflicts that undermine infrastructure and prevent people from reaching safe water sources -- such diseases abound.

Thirst itself kills children and jeopardizes their futures.

And beyond health, a lack of safe water and sanitation exposes children to other threats to their wellbeing. Many children in drought-affected areas spend hours every day collecting water, missing out on a chance to go to school. Girls are especially vulnerable to attack during these times.

The effects of climate change intensify all these risks by reducing the quantity and quality of water. Rising temperatures help bacteria and other pathogens to flourish. Rising sea levels salinate freshwater sources. Increased flooding washes away sanitation systems and contaminates drinking water supplies, bringing cholera and other killer diseases. Disappearing glaciers leave land dry and arid.

We see the terrible effects of water scarcity today all over the world -- and nowhere more tragically than in parts of Nigeria, Somalia, South Sudan and Yemen, where drought conditions and conflict are producing deadly effects. Nearly 1.4 million children face imminent risk of death from severe acute malnutrition as famine grows in these areas. In Ethiopia alone, we anticipate that more than 9 million people will be without safe drinking water in 2017.

As industrialization and demographic shifts increase consumption needs, demand for water will continue to rise – while supplies diminish. By 2040, 1 in 4 children -- 600 million children -- will live in areas of extremely high water stress. It should come as no surprise that the poorest, most disadvantaged children will suffer the most.

But this crisis is not inevitable.

This report is the third in a series that explores different ways that climate change endangers the lives and futures of our children -- and shows how we can and must take collective action to address these threats.

Governments need to start planning for changes in water availability and demand in the coming years. Climate risks should be integrated into all water and sanitation-related policies and services, and investments should be made to target high-risk populations. Businesses also play a role – supporting communities in preventing contamination and depletion of safe water sources. Communities themselves should explore ways to diversify water sources and to increase their capacity to store water safely.

Most important, children's access to safe water for drinking should be made a priority.

In a changing climate, we must change the way we work to reach those who are most vulnerable. One of the most effective ways we can do that is safeguarding their access to safe water.

It's elemental.

Anthony Lake
Executive Director, UNICEF

Executive summary

No one suffers more from a change in climate than a child. Their small bodies are vulnerable to the changes in the air they breathe, the water they drink and the food they eat. For many children, a change in climate is felt through a change in water. In times of drought or flood, in areas where the sea level has risen or ice and snow have unseasonably melted, children are at risk, as the quality and quantity of water available to them is under threat. When disasters strike, they destroy or disrupt the water and sanitation services that children rely on.

Climate change is contributing to a growing water crisis and putting the lives of millions of children at risk.

The changing climate is one of many forces contributing to an unfolding water crisis. In the coming years, demand for water will increase as populations grow and move, industries develop and consumption increases. This can lead to water stress, as increasing demand and use of water strains available supplies.

By 2040, almost 600 million children are projected to be living in areas of extremely high water stress. If action is not taken to plan for water stress, and to safeguard access to safe water and sanitation, many of these children will face a higher risk of death, disease, and malnutrition.

The world is on the brink of a crisis, as the combination of water stress and climate change is creating a deadly outlook for children. As water stress increases, the effects of climate change threaten to destroy, contaminate or dry up the water that remains.

For children, water is life.

Without water, children simply cannot survive. When forced to rely on unsafe water, they are at risk of deadly diseases and severe malnutrition. Every day, more than 800 children under 5 die from diarrhoea linked to inadequate water, sanitation and hygiene.[1] Unsafe water and sanitation are also linked to stunted growth. Around 156 million children under five years old suffer from stunting, which causes irreversible physical and cognitive damage and impacts children's performance in school.[2]

The deprivations caused by a lack of safe water and sanitation can compound and affect children's health, education and future prospects, creating a cycle of inequality that affects generations.

A change in climate is felt through a change in water.

The effects of climate change intensify the multiple risks contributing to an unfolding water crisis by reducing the quantity and quality of water, contaminating water reserves, and disrupting water and sanitation systems. Rising temperatures, greater frequency and severity of droughts and floods, melting snow and ice, and rising sea levels, all threaten the water supplies that children rely on and can undermine safe sanitation and hygiene practices.

Rising temperatures increase the atmosphere's water storage capacity, which essentially reduces water availability on the ground, particularly during the warmer months of the year. Then, when the air eventually cools, more intense rainfall occurs.[3] This can lead to increased frequency and intensity of tropical cyclones and other extreme weather events.

Rising temperatures also impact water by creating an environment for bacteria, protozoa and algae to grow, which can lead to illness and death in children.[4]

More frequent and extreme heatwaves will result in a higher demand for water. Higher temperatures mean that more water for plants, animals and humans evaporates into the atmosphere, increasing demand for already dwindling water sources.

Droughts pose a variety of disastrous risks to children. As temperatures rise, more moisture evaporates from land and water, leaving less water behind for human consumption. Most droughts are slow-onset in nature, but they can be more acute when they occur in arid zones or happen in combination with heatwaves.[5]

For children, dehydration occurs quickly and can be deadly. With less water available, children will eat less nutritious foods and will often have to walk long distances to collect water, missing out on school and other important childhood activities. Without water, many families are forced to migrate in search of it.

A lack of water also inhibits good sanitation and hygiene practices, as supplies are rationed to meet a family's immediate survival needs – drinking and food preparation. This means that practices such as hand washing and toilet cleaning are often minimized in order to conserve water.

Flooding and increased precipitation can be deadly in areas with unsafe water and sanitation services, or where open defecation is practised. Floods can destroy or damage infrastructure such as water distribution points and toilets. When latrines and toilets are flooded, they can contaminate water supplies, making water deadly to drink. Recurring floods can cause communities to abandon safe sanitation and hygiene practices and return to defecating in the open.

Peaks in diarrhoeal mortality and morbidity are commonly associated with seasonal rains, flooding and extreme weather.[6] Cholera, for example, spreads through contaminated water and can kill children within hours if left untreated.

The risk of vector-borne diseases for children also rises with heavy rainfall. That risk escalates with floods – especially where a lack of drainage systems creates stagnant water. Stagnant water increases dangers because it creates favourable breeding conditions for the mosquitoes that transmit such vector-borne diseases as malaria, dengue or Zika.[7] Vector-borne diseases account for more than 17 per cent of all infectious diseases, causing more than 1 million deaths annually.[8]

Melting snow, glaciers and sea ice impact access to water in the present and greatly threaten to change water sources in the future. Around 70 per cent of the world's freshwater is ice and permanent snow cover located in Antarctic, Arctic and mountainous regions.[9] As ice melts, it not only contributes to rising sea levels, but also depletes other freshwater resources. According to the Intergovernmental Panel on Climate Change, this ice and snow cover is decreasing significantly in most regions because of global warming.

Rising sea levels can lead to saltwater infiltrating freshwater sources, rendering the water undrinkable. Rising sea levels are already having a major impact, particularly in low-lying coastal areas and Small Island Developing States, which, when combined, are home to at least 25 per cent of the world's population.[10] These regions 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.[11]

This crisis is not inevitable, if we act now.

There are actions that can be taken at a community, state, national and global level to protect children from the worst impacts of climate change. This includes developing resilient water and sanitation services, particularly in areas that will be hardest hit by climate change.

At the community level: Communities can play an important role in creating more-resilient water and sanitation systems. This might involve diversifying sources of drinking water or increasing storage capacity. In areas prone to flooding and extreme weather, communities can work together to reinforce safe sanitation behaviours to deter open defecation, and to work with local markets to establish affordable and resilient sanitation solutions.

At the sub-national level: At a sub-national level, a strong understanding of available water resources and patterns of use is needed to inform management and planning. In some areas, it will include investing in the protection of river basins and the systematic testing of water quality. Above all, it means prioritizing the most vulnerable children's access to safe water above other water needs to maximize social and health outcomes.

At the national level: For governments, policies need to be in place to plan for future changes in water supply and demand, and to adapt to climate risks. This includes carrying out climate risk assessments and compiling data on the impacts of water stress and climate change on water and sanitation services. Risks should be integrated into national water and sanitation policies, strategies and plans, and high-risk populations should be targeted with investment.

At the global level: Action is fuelled by knowledge. More data and evidence are needed to inform global advocacy efforts. Governments, non-government organizations (NGOs), United Nations agencies, private sector actors, and civil society need to harmonize and align in global action. Children are an important part of the solution and should be given opportunities to actively engage and contribute to climate activities and policies.

Climate change is not just an environmental crisis, it is also a crisis for children.

One of the most effective ways to protect children in the face of climate change is to safeguard their access to safe water and sanitation. Only then, can we begin to create a brighter future, for every child.

For children, water is life.

Chapter 1: Water is the essence of life

Everyone needs water to survive. Water fuels bodies, irrigates crops, drives industry, generates energy and cleans our bodies, clothes and homes. Access to safe water is particularly important to children as they grow. However, many millions of children are at risk because they lack safe water and sanitation or healthy hygiene practices. Diseases related to unsafe water and sanitation remain a leading cause of death for children under 5.[1]

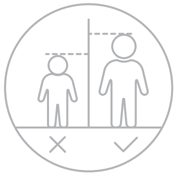
Every day, more than 800 children under 5 die from diarrhoea linked to inadequate water, sanitation and hygiene.[2] Unsafe water and sanitation are also linked to stunted growth.[3] Around 156 million children worldwide suffer from stunting, which causes irreversible physical and cognitive damage and impacts children's performance in school.[4] Indeed, the deprivations caused by a lack of safe water and sanitation compound over time, affecting children's health, education and future earnings, creating a cycle of inequality that affects generations.

According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation, about 663 million people did not have access to improved water sources in 2015.[5] Massive inequalities exist between those who have improved water sources and those who do not. The world's 48 least developed countries have the lowest level of access to improved water sources.[6] Eight out of ten people without access to improved water sources live in rural areas.[7] In parts of sub-Saharan Africa – which is one of the regions expected to suffer most from the effects of climate change – access to improved water sources is very low, and many people rely on unsafe surface water sources

Figure 1. Water and sanitation by the numbers

>800

Every day, more than 800 children under 5 die from diarrhoea, related to inadequate water, sanitation and hygiene.



156 million

Unsafe water and sanitation are linked to stunted growth, which affects 156 million children worldwide.

Source: United Nations Children's Fund, *One Is Too Many: Ending child deaths from pneumonia and diarrhoea*, UNICEF, New York, Nov 2016.; United Nations Children's Fund, World Health Organization, and World Bank Group, *Levels and Trends in Child Malnutrition: UNICEF/WHO/World Bank Group joint child malnutrition estimates.* UNICEF, WHO and World Bank, New York, Sep 2016.

such as lakes and rivers,[8] increasing their risk of diseases such as malaria and dengue that are linked to poor water management and vector control.[9 10 11]

Water alone is not enough to secure children's health and well-being. Sanitation and hygiene play an equally important role. Without adequate sanitation facilities and hygiene behaviours, water sources can become contaminated and foster the spread of disease.

In 2015, 2.4 billion people globally did not use improved sanitation, meaning they did not use a toilet or something similar that hygienically removes human waste from human contact.[12] And 946 million people practised open defecation.[13] Open defecation is one of the clearest markers of inequality and poverty.

Figure 2. Water and sanitation by the numbers

663 million	2.4 billion	946 million	2.6 billion	2.1 billion
663 million people do not have access to safe water.	2.4 billion people do not have access to improved sanitation.	946 million people still practise open defecation.	2.6 billion people have gained access to improved water since 1990.	2.1 billion people have gained access to improved sanitation since 1990.

Source: United Nations Children's Fund and World Health Organization, *Progress on Sanitation and Drinking Water: 2015 update and MDG assessment*. WHO, Geneva, July 2015.

Over the past few decades, a truly global effort has been made to improve water, sanitation and hygiene for millions of people worldwide. Since 1990, 2.6 billion people have gained access to improved water and 2.1 billion have gained access to improved sanitation.[14] During the same period, the under-five mortality rate dropped 53 per cent, from 91 deaths per 1,000 live births in 1990 to 43 deaths per 1,000 live births in 2015.[15] Access to water and sanitation played an important role in helping to save the lives of millions of children.

In 2015, the United Nations General Assembly agreed on 17 Sustainable Development Goals (SDGs) that will guide the international development agenda until 2030. These goals aim to end poverty, fight inequality and protect our natural environment. They also include provisions that will improve the lives of millions of children and guide development in a changing climate.

Goal 6 of the SDGs aims to "ensure availability and sustainable management of water and sanitation for all."[16] This goal is more ambitious than previous development goals because it addresses the entire water cycle: It outlines targets to manage water under scarce conditions, maintain water for ecosystems and improve management of wastewater.[17]

While all the goals are integrated and support one another, access to water and sanitation is essential for the attainment of the other 16 goals (*see Figure 3*). For example, Goal 11, on urbanization, includes a target aimed at reducing the number of deaths attributable to water-related disasters. Goal 13, on climate change, calls for urgent action to reduce the impacts of climate change risks.[18]

This interdependency between water and sanitation and the attainment of multiple goals is acknowledged in the SDGs. Indeed, achieving the SDGs will only be possible through an integrated approach that crosses sectors, ministries and administrative levels, takes into account geographical scale and includes all stakeholders.[19]

However, in the coming decades, growing demand for water and the effects of climate change threaten to undermine much of the progress made since 1990.[20] A rise in water stress is likely to pose significant risks to children's health and well-being in the future.

Many factors will contribute to the rise in water stress, including climate change, economic growth, industrialization and higher levels of consumption.[21] Each factor will have different effects in different parts of the world. For example, as demographics shift, economies grow and consumption levels rise in Africa, demand for water will increase substantially.[22] That demand will drive water stress in the region.

As water risks increase, governments and communities need to adapt. They need to evaluate risks and build facilities that can withstand shocks. Building resilience to future risks is much better than dealing with the adverse impacts after they occur, and it is likely to be more cost-effective.[23] Experts and local governments will need better data and evidence on how the availability and quality of water supply is changing as a result of demographic shifts, increasing demands, changing precipitation patterns and increasing temperatures.

National water and sanitation policies and strategies will need to make provisions for water risks in order to secure reliable services in communities, homes, schools and health centres.[24] Globally, the discourse about climate change and water stress needs to focus on the most vulnerable groups, such as children, especially girls and children with disabilities, in the communities most affected.

Figure 3. Safely managed water and sanitation are essential for attaining many Sustainable Development Goals.

Water is a human right – a child's right

Box 1.

Water and sanitation are fundamental to human health and dignity. In July 2010, the United Nations General Assembly acknowledged that clean water and sanitation are essential to realizing human rights.[25]

Acknowledging the right to water was an important step towards realizing many other internationally recognized human rights and established a foundation for public health and universal human development. Several international human rights treaties refer explicitly to the importance of water and sanitation, including the Convention on the Elimination of All Forms of Discrimination against Women, the Convention on the Rights of the Child and the Convention on the Rights of Persons with Disabilities.[26 27 28]

As with all socioeconomic rights, recognizing the right to water and sanitation creates immediate and long-term obligations. In September 2010, the UN Human Rights Council reaffirmed that the right to water and sanitation were part of existing international law, thus confirming that these rights are legally binding on Member States.

However, climate change is increasingly undermining the realization of these rights by affecting the water cycle, a most vital resource. To establish climate change policies that embrace the interconnected and interdependent nature of human rights, a more holistic and intersectoral approach is required. The rights connected to water and sanitation include the basic right to health, food and an adequate standard of living.

Climate change will infringe on children's right to safe water. Action and coherent policy to address the risks of climate change will be needed to safeguard children's right to safe water.

"Children have the right to good quality health care – to safe drinking water, nutritious food, a clean and safe environment, and information to help them stay healthy. Rich countries should help poorer countries achieve this."

– Convention on the Rights of the Child,
Article 24 (Health and health services)

By 2040, nearly 600 million children are projected to be living in areas of extremely high water stress.

Chapter 2: We are at risk of a growing water crisis

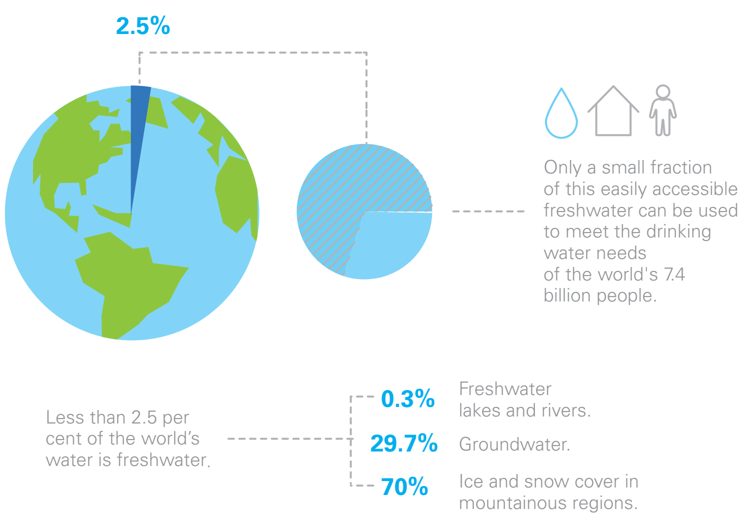
Water is essential for survival. It is necessary for farming, cooking and washing. It is vital for ecosystems, including forests, pastures and marshland. Agriculture, which involves irrigation of crops and livestock operations, accounts for about 70 per cent of global freshwater use.[1]

However, according to one study, some 4 billion people currently experience water shortages for at least one month of the year.[2] *The Global Risks Report 2017*, published by the World Economic Forum, places water crises third in its list of top risks in terms of impact.[3] The report also refers to water crises as an interconnected risk to other sectors. About 36 countries currently face extremely high levels of water stress.[4]

Less than 2.5 per cent of the world's water supply can be classified as freshwater.[5] Of this percentage, more than two thirds is trapped in glaciers and ice, leaving a very small fraction available to meet the water, sanitation and hygiene needs of the world's population (*see Figure 4*).[6 7]

As a new middle class emerges around the world, demand for water will increase.[8] Rising affluence means that a greater number of people are living more water-intensive lifestyles than ever before. They are cleaning cars, irrigating gardens and eating more meat – all of which require large amounts of freshwater. They are also consuming more goods and products – which often requires water to produce.

Figure 4. A small fraction of the world's water can be used for human needs.



Source: UN Environmental Programme, *Vital Water Graphics: An overview of the state of the world's fresh and marine waters*, 2nd ed., UNEP, Nairobi, 2008.; United Nations Environment Programme, *Global Environment Outlook 3: Past, present and future perspectives*, UNEP, Nairobi, 2002.; UN Population Division, *2015 Revision of World Population Prospects*, UN DESA, New York, Jul 2015.

An expanding industrial base and pollution are putting additional pressures on existing water, often leaving it no longer suitable for human consumption.[9] There are multiple ways industry can strain water sources.[10] Water used in industrial processes can be quite substantial in volume, leaving less available freshwater for drinking and sanitation.[11] In some cases, wastewater is discharged into clean water, making it unsuitable for consumption.[12]

Higher demand for energy also contributes to higher demand for water. Energy production uses considerable amounts of water and it can contaminate the water it uses.[13] Energy production that involves damming of rivers can also affect the water cycle. This is because it can restrict the flow of the river, as well as alter the chemistry and change the temperature.[14] These effects can have considerable impact on the livelihoods of people living around river basins.

The effects of growing energy and industry on water can be indirect, too. Air pollution can affect the quality of water. Air pollution can cause acid rain, which affects water quality by destroying important ecosystems such as forests that help to regulate water cycles and purify water.[15]

In addition to the strains from industry and energy production, agricultural production is another stress on water systems. Agriculture, which requires considerable amounts of water, is growing significantly in many parts of the world in an effort to meet increasing demands for food. Moreover, the fertilizers and pesticides often used in agricultural production can render water used in the process undrinkable.[16]

The clearing of forests, including for agricultural production but also for other purposes, can influence the hydrological cycle of a river basin. In particular, it can increase the transpiration and intercepting precipitation and decrease the volume of run-off. It also reduces infiltration, increases flood run-off and peak discharges, which changes the soil's capacity to store water.[17]

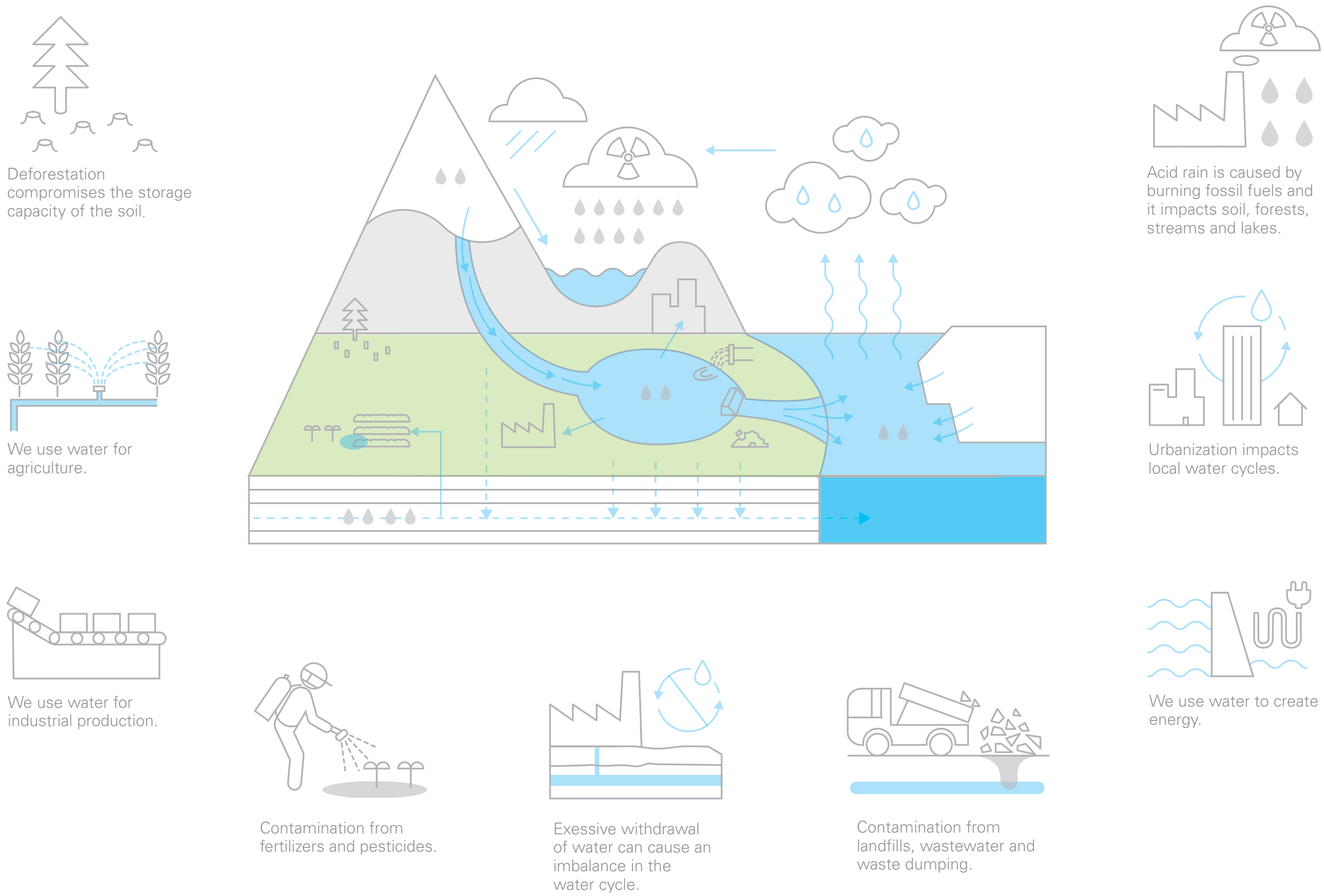
With these changes, including increased demand and use of water, as well as shifts in supply, the future availability of water for drinking and sanitation for many children is at risk.

By 2040, nearly 600 million children are estimated to be living in areas of extremely high water stress, representing an increase of approximately 20 per cent from 2010. Water stress is defined as the ratio of water use to supply. Extremely high levels of water stress are ratios that exceed 0.8 - or in other words 80 per cent water use compared to supply, indicating a very high level of competition for available water. The estimates were calculated using data and maps from the World Resources Institute (WRI) Aqueduct initiative, which measures global water risks, now and in the future (See Annex for full methodology).

However, it should be noted that even in areas where ratios are considerably lower, many families and children may still find it very difficult to access water, and risk suffering considerably, if there are not adequate safe water and sanitation services nearby. It should also be noted that not all children living in areas of extremely high water stress are impacted in the same way. Children's resilience depends on many issues, including poverty, access to resources and the local context. It also depends on whether communities are able to conserve water, create sustainable and equitable water management solutions, and develop water, sanitation and hygiene services and practices that respond to changing levels of demand and climatic conditions. For a list of potential ways to reduce the impact, see Chapter 4.

Water-use and environmental degradation can affect the water cycle

Figure 5.



Note: These infographics are meant to be illustrative only. The impacts of water-use and environmental degradation vary considerably depending on the context and time in which they occur, and the specific characteristics of the event. These images do not imply strength of association nor causality.

Water scarcity and conflict in the Middle East

Box 2.

Nearly all of the countries in the Middle East suffer from water scarcity, with water consumption significantly exceeding total renewable water supplies. An estimated 66 per cent of available surface freshwater originates outside the region.[18 19]

Most of the countries cannot sustainably meet their current water demand. With current population growth and increased demand, water availability per capita is expected to be cut in half by 2050.[20] As climate change is expected to bring a reduction in rainfall and higher rates of evaporation, water will become even scarcer.[21]

The combination of protracted drought and ongoing conflict in the Middle East have pushed the region's water resources and water service delivery systems close to the breaking point. Throughout the region, people are suffering from severe water shortages that undermine agricultural production, impact livelihoods and affect the local economy.

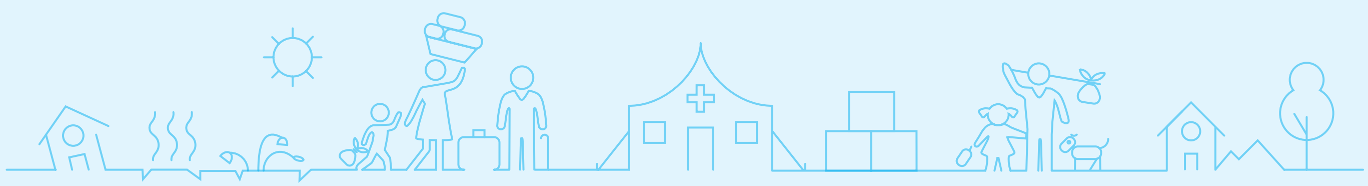
Against this backdrop, the protracted drought has added to the misery of conflict-affected populations in Syria, making them more vulnerable. As of February 2017, 13.5 million Syrians were in need of humanitarian assistance and 6.3 million were internally displaced.[22] Overall, the conflict reduced the availability of drinking water by 67 per cent between 2011 and 2015.[23] In some areas, access to water is only about 10 litres a day per person – a small amount to cover drinking, cooking, washing and personal hygiene needs.[24 25]

Overall, as of mid-2016, there were about 5.3 million registered Syrian refugees.[26] Most live in resettlement camps or host communities in neighbouring countries.[27] As of mid-2016, about 2.7 million lived in Turkey, 1 million in Lebanon and 660,000 in Jordan.[28]

In these three host countries, UNICEF, its partners and inhabitants of the camps design and operate the water, sanitation and hygiene infrastructure, the wastewater treatment plants and the solid waste management systems.

Internally displaced people, refugees and other migrants tend to settle in host communities with already strained social service systems, often resulting in increased social tension. In Lebanon and Jordan, a significant part of UNICEF's work in water and sanitation focuses on providing drinking water to all members of the communities in order to reduce tensions created over already scarce resources.

To reduce the tension and dangers of water crises, governments can improve planning and establish more resilient water systems, strengthen governance and better manage scarce resources.



A change in climate is felt through a change in water.

Chapter 3: Climate change makes it harder for children to access water and sanitation

Climate change is expected to affect the availability of fresh surface water from sources such as rivers, lakes, ice and snow. However, it will also change precipitation patterns and affect the intensity and extremes of those patterns, disrupting the water cycle in many ways (*see Figure 7*). Climate change can also cause increased rainfall variability, leading to prolonged periods of low water availability and potentially having an effect on some groundwater reserves.[1]

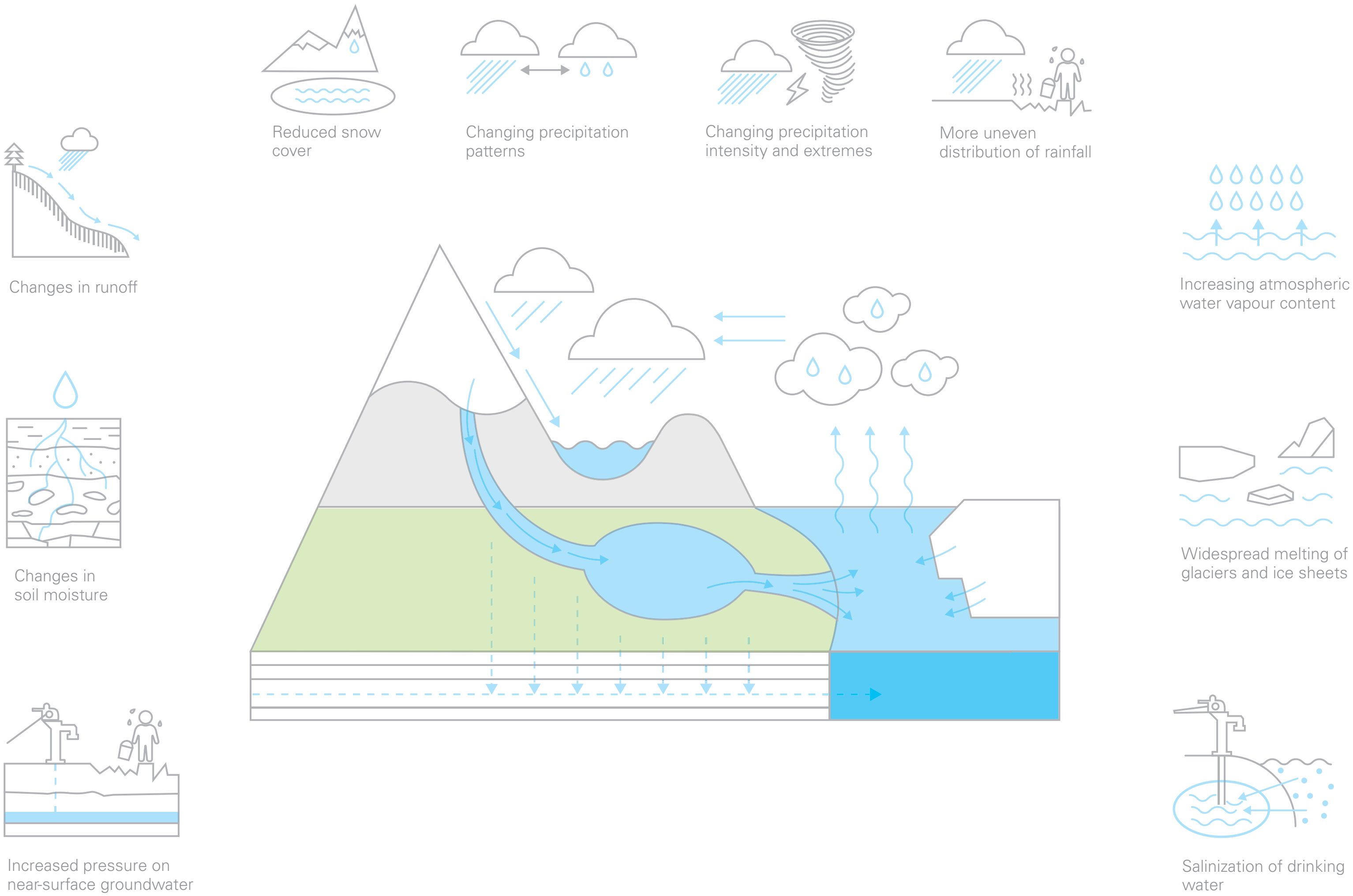
The impact of climate change varies by region. However, most commonly it leads to rising sea levels, higher levels of drought and water stress, heavier rainfall and flooding, and the melting of snow, glacier and sea ice. These processes, in turn, make the provision of water, sanitation and hygiene services more challenging and have a potentially devastating impact on children's health, survival and development (*see Figure 8*).

It is the poorest populations who are the most affected by water crises.[2] It is the poorest who have the least ability to cope when shortages are severe. It is therefore imperative to address climate change as part of overall efforts to increase efficiency and equity in access to and use of freshwater sources. The remainder of this report will focus on the effects of climate change and the resilient solutions being developed to counter the increasing frequency and severity of climate shocks.

Figure 6. Communities vulnerable to climate change.

Climate change can impact the water cycle

Figure 7.



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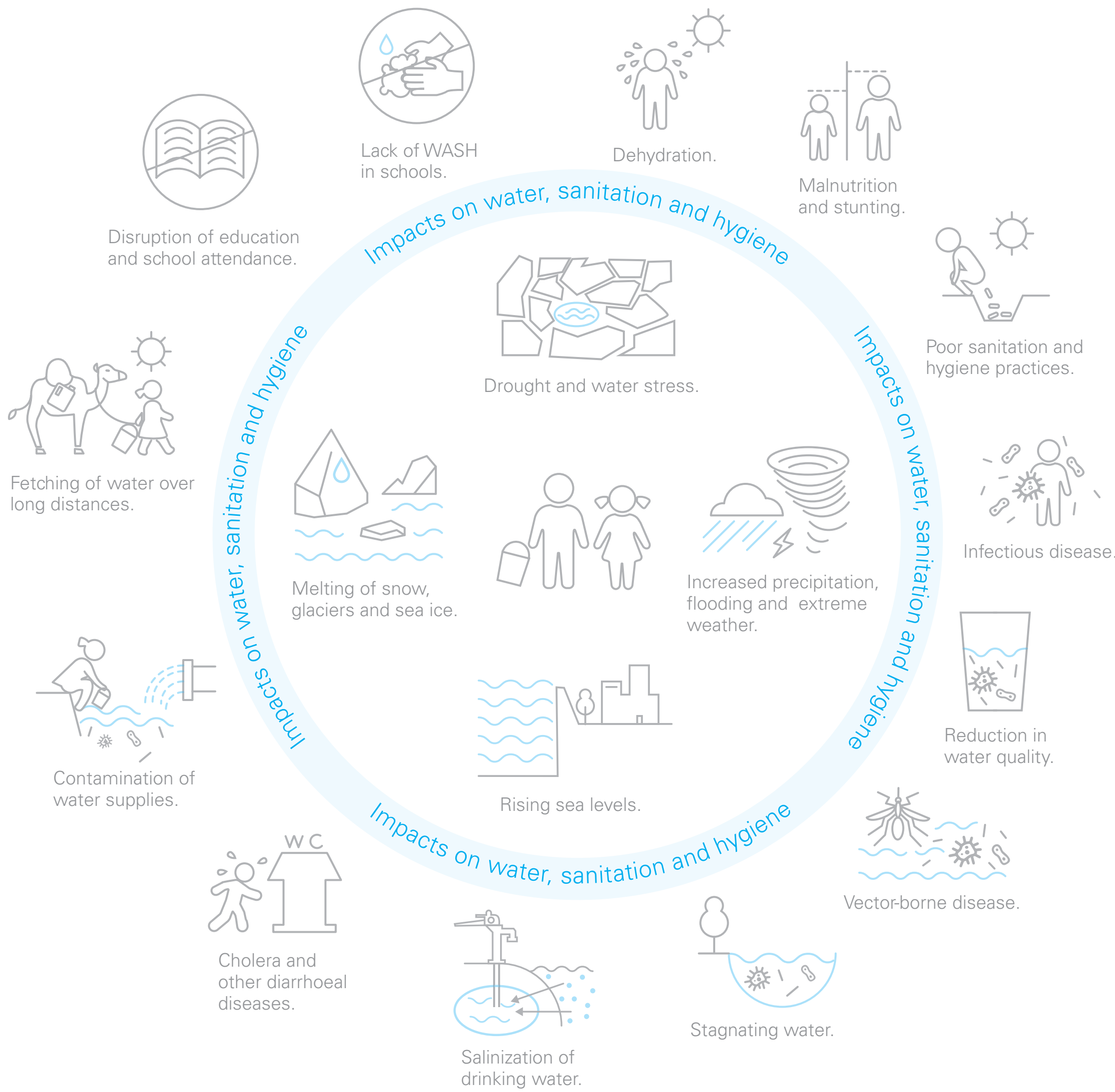
The impact of climate change on water, sanitation, hygiene and children

Figure 8.



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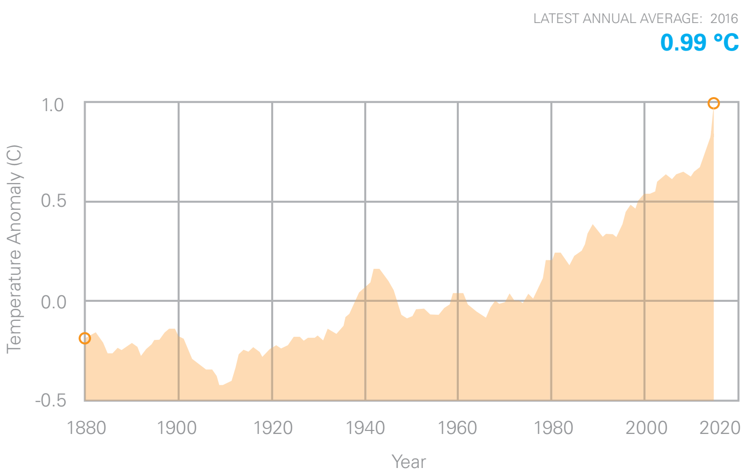
3.1 Rising temperatures

Over the past 50 years, the average global temperature has increased at the fastest rate in recorded history.[1] According to experts, this trend is continuing.[2] In the 136 years of record keeping at NASA, all but 1 of the 16 hottest years have occurred since 2000.[3] The hottest year on record was 2016.[4] The graph (*see Figure 9*) shows that increases in mean global temperature have occurred at greater rates over the past 50 years in particular.

Figure 9. Differences in monthly surface and atmospheric temperatures (1880–2016).



Source: NASA's Goddard Institute for Space Studies (GISS).
Credit: NASA/GISS

While the planet has long experienced warming and cooling cycles, warming is currently accelerating at a much faster rate than before. The Intergovernmental Panel on Climate Change (IPCC), an international panel of scientists and other experts, asserts that human influence is extremely likely to have been the dominant cause of the warming that has occurred since the mid-twentieth century.[5] This warming is linked to increasing levels of greenhouse gases (including carbon dioxide, methane and nitrous oxide) in the atmosphere. Carbon dioxide concentrations have increased by 40 per cent since pre-industrial times, mostly because of fossil fuel combustion and changes in land use.[6] Normally, radiation created by the sun bounces back into space, but these greenhouse gases help to trap the heat, causing surface temperature to increase.

Despite worldwide efforts to curb greenhouse gas emissions, they have not been reduced enough to keep temperatures from continuing to climb. It is estimated that without additional mitigation efforts, by 2100 the world could be 3.7° to 4.8° C warmer than in pre-industrial times.[7] This will likely have major implications for water and sanitation services.

The hydrological cycle is intimately linked with atmospheric temperatures and radiation balance.[8] Rising temperatures increase the atmosphere's water storage capacity, which, in the short term, reduces water availability, particularly during the warmer months of the year.[9] However, when the air eventually cools, more intense rainfall occurs.[10]

One study estimated that 7 per cent more moisture can be held in the atmosphere for every 1° C increase in temperature.[11] This can lead to more intense periods of water shortage followed by extremely heavy rainfall and flooding. It also leads to increased frequency and intensity of tropical cyclones and other extreme weather events.[12]

Rising temperatures melt glaciers, decrease the amount of snow and create a rise in sea levels. Higher temperatures lead to the thermal expansion of oceans, which contributes to the rise of sea levels and flooding.[13]

In addition to reducing water availability, increasing temperatures also affect the physical, chemical and biological properties of freshwater lakes and rivers. Epidemiological studies of climate and disease transmission show that many of the main killer diseases affecting children are highly sensitive to climate changes. For example, recent research has shown an 8 per cent increase in E. coli-related diarrhoea for every 1° C increase in temperature.[14]

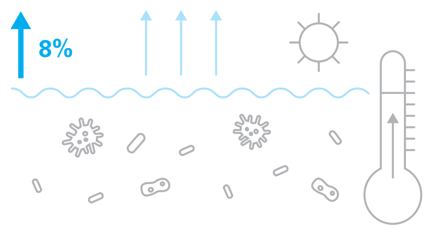
Algal blooms can also occur as temperatures rise, contaminating water with toxins and pathogens that can damage the human liver and nervous systems and can cause the spread of diseases such as diarrhoea.[15] These pathogens and toxins contaminate water and can cause the spread of diseases including diarrhoea.[16] The pattern is cyclical; algal blooms absorb sunlight, making water even warmer and promoting more blooms.[17]

Changes in temperature or precipitation can cause changes in the seasonality of some allergenic species and in the seasonal distribution of malaria, dengue, tick-borne diseases, cholera and other diarrhoeal diseases.[18]

As water evaporates and soil becomes increasingly dry, more water is needed to irrigate the land for agriculture. Water scarcity can exacerbate competition for access to water locally, regionally, nationally and across borders.

For every 1° C increase in temperature there is an 8% rise in E. coli-related diarrhoea.

Figure 10.



Source: Kolstad. Erik W, and Kjell Arne Johansson. *Uncertainties Associated with Quantifying Climate Change Impacts on Human Health: A Case Study for Diarrhea.* Environmental Health Perspect, 2011.

3.2 Droughts

Evidence shows that since 1970, climate change has led to increased water scarcity and drought.[1] Globally, droughts are becoming longer and more intense, and they are covering wider areas.

Most droughts are slow-onset in nature, but they can be more acute when they occur in arid zones or happen in combination with heatwaves.[2] As temperatures rise, more moisture evaporates from land and water, leaving less water behind for human consumption. At the same time, higher temperatures mean increasing demand, too.

Low levels of precipitation also cause reduced river flow and diminished recharge of lakes and ponds. As less water seeps into the soil, subsurface water sources such as aquifers decrease. The result is that water levels drop and boreholes run dry, particularly during the dry season.[3] At the same time, a decrease in water volume can lead to an increase in the concentration of biological and chemical contaminants because less dilution occurs.[4] Exposure to these chemicals and biological contaminants can harm children. For example, long-term exposure to arsenic, a chemical naturally present in the groundwater in many countries, can cause cancer and skin lesions. It has also been associated with developmental effects, cardiovascular disease, neurotoxicity and diabetes.[5]

Similarly, long-term exposure to water with an increased concentration of biological contaminants such as bacteria and protozoa – many resulting from faecal contamination from poor sanitation and open defecation[6]– has been linked to environmental enteropathy, a condition characterized by intestinal inflammation that makes it difficult for children to absorb nutrients properly.[7 8]

Since the 1950s, the Sahel has experienced significant periods of drought. This has led to severe water shortages and famine.[9] It is estimated that currently more than 30 million people in the region face food insecurity and one in five children under 5 suffers from acute malnutrition.[10]

In one of the countries severely affected by drought, Burkina Faso,[11] desertification has increased up to 100 kilometers south from the Sahelian climatic zone over the past 50 years. This desertification affects other countries in the region too.[12] This desertification affects the counting in the region too. It contributes to the further exhaustion of water resources in the countries bordering the Sahel and poses a direct threat to the survival and development of the people living there.

A lack of water severely inhibits good sanitation and hygiene practices for children, as water is rationed to meet a family's immediate survival needs – drinking and food preparation.[13] This means that practices such as hand washing and toilet cleaning are often minimized in order to conserve water. A reduction in hygiene practices places children at an increased risk of malnutrition and diseases such as cholera, typhoid, acute respiratory infections and measles.[14] Chronic diarrhoea and malnutrition can also lead to stunted physical and cognitive development in the long term, undermining children's ability to reach their full potential both at school and in adult life.[15 16] A total of 156 million children worldwide are considered stunted as a result of malnutrition.[17]

Nearly 160 million children live in zones of either high or extremely high drought severity.[18] In the 20 countries with the highest rates of open defecation, almost 40 million children live in areas of high and extremely high drought severity.[19]

Food shortages as a consequence of longer and more frequent droughts can lead to famine, widespread hunger and migration.[20] Usually it is the poorest families that cannot afford rising food prices and the cost of water. In many areas affected by drought and water stress, children – usually girls – have to walk long distances to fetch water. In some places, Ethiopia, for example, the journey can take up to 8 hours a day, leaving less time for children to attend school or spend with family and friends. The long walks for water can also leave children, especially girls, vulnerable to violence.[21 22 23]

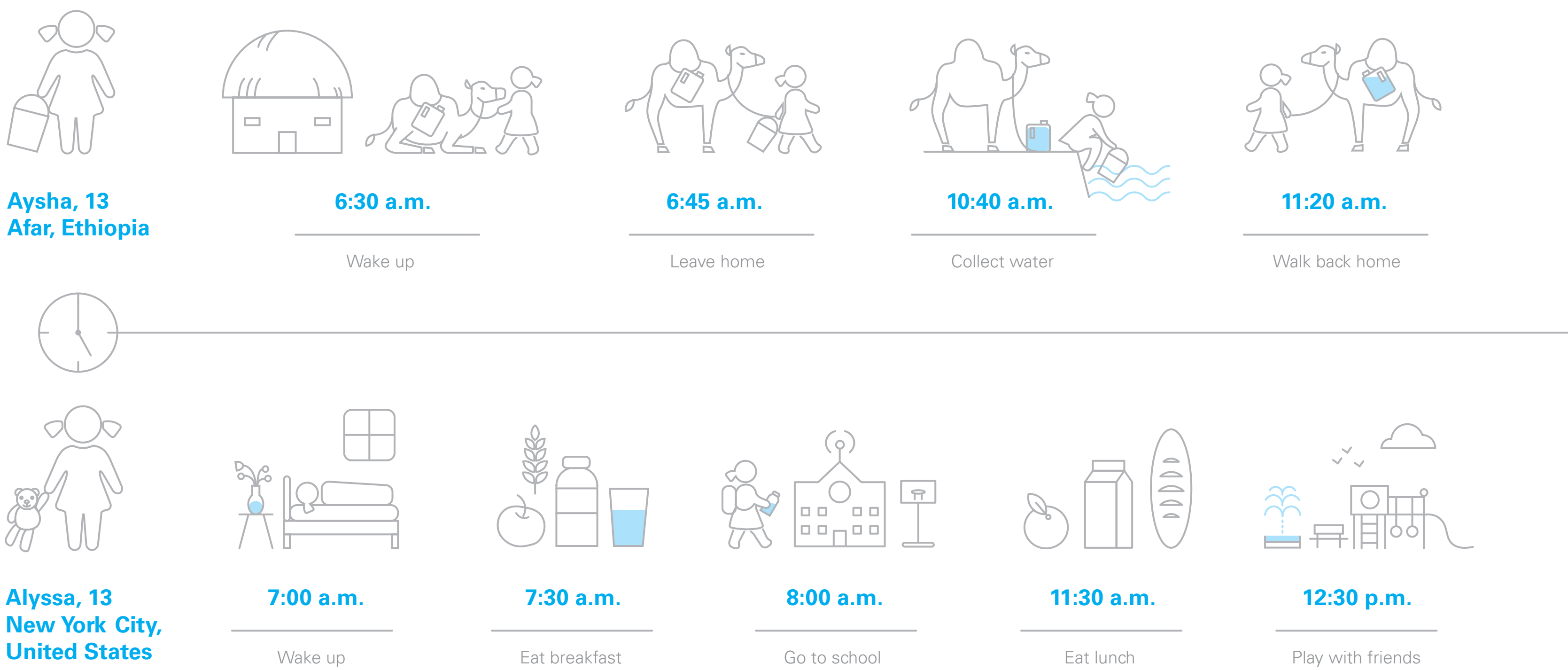
Nearly 160 million children live in areas of high or extremely high drought severity.

Figure 11.

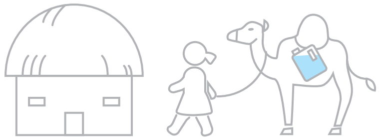
Source: United Nations Children's Fund, *Unless We Act Now: The impact of climate change on children*, UNICEF, New York, November 2015.

A day in the life of two girls

Figure 12. Increasing water stress can exacerbate inequities.



Note: This infographic is for illustrative purposes only. It is used to show how much time women and girls spend in collecting water, and how that can affect how much time they have to do other things such as go to school. It is not meant to be an exact representation of how time is spent.



2:45 p.m.

Arrive home

4:20 p.m.

Eat food

5:40 p.m.

Study

8:30 p.m.

Wash

9:30 p.m.

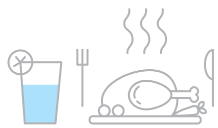
Sleep

3:30 p.m.

Back home

4:30 p.m.

Study and play

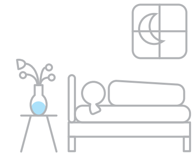


6:30 p.m.

Eat dinner

8:30 p.m.

Bathe



9:30 p.m.

Sleep

Aysha spends about **8 hours** fetching water a day.

And she uses less than **5 litres** a day.

Globally, women and girls spend about **200 million hours** a day gathering water.

3.3 Increased precipitation, flooding and extreme weather

Although the average annual precipitation globally is expected to increase, changes in the amount and intensity of precipitation will vary significantly by region.[1] The intensity of precipitation and the risk of floods depend greatly on how much water the air can hold at a given time.[2] Global warming leads to the expansion of atmospheric water storage capacities, which, in addition to causing longer dry periods, can also lead to heavier rainfall. This does not always mean improved access to fresh water, however, as much of it will, unless effectively captured, quickly run off into rivers to be carried back to the ocean.[3]

Increases in rainfall intensity have already led to more frequent floods and topsoil erosion.[4] In South America, an average of 560,000 people were affected by floods each year between 1995 and 2004.[5] From 2005 to 2014 that number rose to 2.2 million people – almost a four-fold increase.[6]

Flooding occurs when heavy rainfall exceeds the absorption capacity of a drainage basin.[7] This causes water to overflow into areas that are normally dry and exposes floodwater to contaminants, further depleting freshwater sources.

Increases in rainfall intensity can also lead to greater rates of erosion, which can impact water quality, particularly of surface water sources.[8] Heavy rainfall also can trigger landslides, which can lead to mass casualties and the destruction of water and sanitation services.[9]

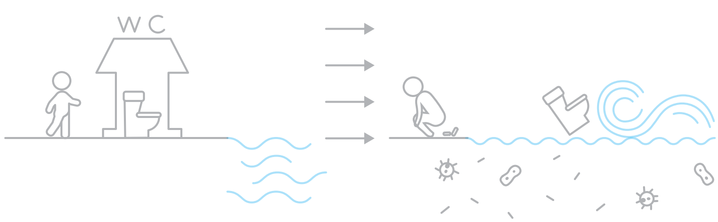
More than half a billion children live in extremely high flood occurrence zones.
Figure 13.

Source: United Nations Children's Fund, *Unless We Act Now: The impact of climate change on children*, UNICEF, New York, November 2015.

More than 270 million children currently live in extremely high flood prone zones in countries where less than half of the population has access to improved sanitation facilities.[10] Exposure to floods can cause sanitation problems for these children. For example, when toilets are flooded or damaged, communities sometimes abandon recently acquired and important sanitation and hygiene behaviours and return to open defecation. Damaged latrines and neglect of safe sanitation practices, in turn, can lead to a sharp degradation in water quality as heavily polluted floodwater contaminates surface waters and vulnerable groundwater aquifers.[11]

Over 270 million children live in extremely high flood prone zones where less than half of the population has access to improved sanitation facilities.

Figure 14.



Source: UNICEF analysis based on United Nations Children's Fund, *Unless We Act Now: The impact of climate change on children*, UNICEF, New York, November 2015.

Additionally, heavy rainfall can lead to increased leaching from hazardous waste landfills and contamination from agricultural activities and septic tanks.[12] These hazards can affect groundwater and surface drinking water sources.[13] Exposure to toxic chemicals can threaten children's lives and have a lifelong impact on their health and well-being.[14]

Research in 2003 showed that peaks in diarrhoeal mortality and morbidity are commonly associated with seasonal rains, flooding and extreme weather.[15] Cholera, for example, spreads through contaminated water and can kill children within hours if left untreated.[16] The risk is substantial. Worldwide, in epidemic countries, an estimated 1.4 to 4.0 million cases of cholera occur each year, causing 21,000 to 143,000 deaths.[17]

Cryptosporidiosis, caused by the intestinal parasite Cryptosporidium, is another disease that can cause severe diarrhoea and death in children. It is also an example of a bacterial and protozoan disease triggered when faecal contamination is washed into drinking water sources by heavy precipitation and flooding.[18 19]

The risk of vector-borne diseases for children also rises with heavy rainfall.[20] That risk escalates with floods – especially where a lack of drainage systems creates stagnant water.[21] Stagnant water increases dangers because it creates favourable breeding conditions for the mosquitoes that transmit diseases such as malaria, dengue or Zika.[22 23] Vector-borne diseases account for more than 17 per cent of all infectious diseases, causing more than 1 million deaths annually.[24]

3.4 Melting snow, glaciers and sea ice

Around 70 per cent of the world's freshwater is ice and permanent snow cover located in Antarctic, Arctic and mountainous regions.[1] According to the IPCC, this ice and snow cover is decreasing significantly in most regions because of global warming.[2] The result is a loss of freshwater flow into the oceans and the subsequent rising of sea levels.[3]

Recent estimates suggest that Greenland and Antarctica are losing between 150 and 250 cubic kilometres of ice per year.[4] In addition, Arctic sea ice is declining at a rate of 13.3 per cent per decade relative to the 1981 to 2010 average.[5]

Inland glaciers are also retreating almost everywhere around the world – including in Africa, Alaska, the Alps, the Andes, the Himalayas and the Rocky Mountains.[6] The glacier on the Tien Shan, Central Asia's largest mountain range, has lost 27 per cent of its mass and shrunk 18 per cent during the past 50 years.[7]

According to IPCC 2007, up to one sixth of the world's population (1.1 billion people) lives in river basins fed by glaciers or melting snow.[8] These communities depend on this freshwater flow for their survival. Evidence has shown that glaciers in the Himalayan Hindu Kush are shrinking so rapidly that they could lose between a third and a half of their mass by 2100.[9]

Up to one sixth of the world's population in 2007 (1.1 billion people) lives in river basins fed by glaciers or melting snow.
Figure 15.

Source: Parry, Martin, et al., eds., 'Climate Change 2007: Impacts, adaptation and vulnerability', Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, Cambridge, 2007.

In South America, the Andean mountain glaciers are also dramatically decreasing, leading to a significant impact on the millions who depend on them for their freshwater supply.[10] In Bolivia in 2016, for example, the government declared a state of emergency when the country faced a drought that affected an estimated 100,000 families in 109 municipalities – one of the strongest impacts of El Niño phenomenon in 65 years.[11] Water rationing meant that families were unable to access enough water to meet their daily needs, putting serious pressure on daily sanitation and hygiene practices such as hand washing.[12] Additionally, food prices soared as crops failed, exacerbating poverty and putting the poorest children at risk of malnutrition.

3.5 Rising sea levels

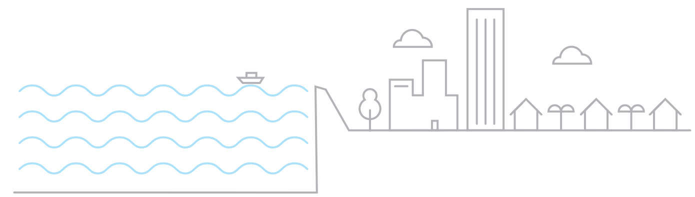
While experts agree that sea levels have risen and fallen substantially over the Earth's 4.6-billion-year history, the recent rate of change has accelerated well beyond previous rates, and sea levels are rising more rapidly than ever before.[1]

Between 1901 and 2010, global sea levels rose by 19 centimetres – an average of about 1.7 millimetres per year.[2] But during the past few decades, it has become clear that the rate of sea level rise is increasing. Between 1993 and 2010, sea levels rose by 3.2 millimetres per year – almost twice the previous average.[3]

Rising sea levels are already having a major impact, particularly in low-lying coastal areas and for Small Island Developing States, which, when combined, are home to at least 25 per cent of the world's population.[4] These regions have less than 10 per cent of the world's renewable water supply, leaving populations dependent on groundwater sources – the sources most vulnerable to rising sea levels and the impacts of salinization.[5]

Rising sea levels, combined with the increased frequency and intensity of extreme weather events such as cyclones, have doubled the number of storm surge events in the twentieth century, a trend that is set to continue.[6] Storm surges can lead to the destruction of crucial water and sanitation infrastructure and the salinization of groundwater sources.[7 8]

A global temperature rise of 2° C is estimated to leave 130 million more people per year affected by coastal flooding.
Figure 16.



Source: Strauss, B. H., S. Kulp, and A. Levermann, *Mapping Choices: Carbon, Climate, and Rising Seas, Our Global Legacy.* Climate Central Research Report, Princeton, 2015.

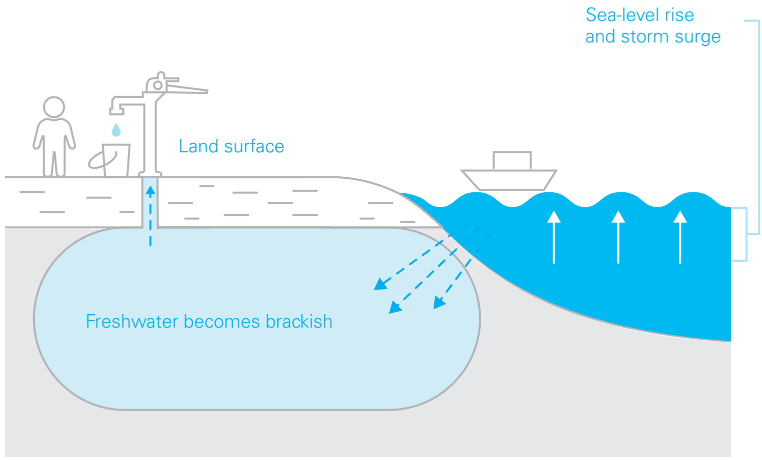
Salinization occurs due to the vertical and lateral intrusion of seawater via coastal aquifers. When freshwater and saltwater are mixed, brackish water is created (*see Figure 17*). Salinization affects both the quality and quantity of freshwater resources, making water unsafe for human consumption and threatening livelihoods, public health, agriculture, aquaculture, infrastructure and coastal ecosystems.

An estimated 600 million people live in low-elevation coastal zones that will be affected by progressive salinization.[9] Research suggests that rising sea levels could increase the number of people vulnerable to the impacts of salinization to about 1 billion by 2050.[10]

One of the countries worst affected by saltwater intrusion and groundwater salinization is Bangladesh, where approximately 20 million people living in coastal areas are already affected by drinking water salinity.[11] By 2050, soil salinity in the country is projected to increase by an average of 26 per cent, with increases above 55 per cent expected in some areas.[12]

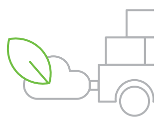
The salinization of freshwater sources may increase the risk of health hazards such as diarrhoea and cholera, since cholera bacteria survive longer in slightly saline waters.[13]
Outbreaks of cholera can occur when freshwater supplies become contaminated after flooding, often the result of storm surges.[14][15] For example, in Haiti, a strong storm surge and heavy rains after Hurricane Matthew in 2016 led to 8,457 suspected cases of cholera, and 2,417 of the cases were in children.[16]

Figure 17. Saltwater intrusion creates brackish water.

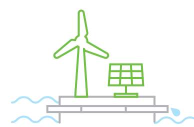


Towards a low-carbon WASH sector

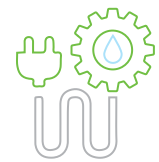
The world has to move towards sustainable systems and the WASH sector is no exception. How can we secure WASH services for a growing population that is increasingly urban and more exposed to climate change impacts?



Efficient and low-emission transport and logistics systems for the WASH sector.



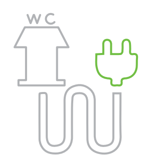
Use renewable energy to pump and desalinize water.



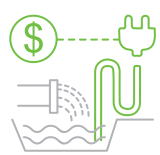
Energy efficiency applied in tandem with effective water management.

Wastewater treatment that reduces emissions and facilitates the re-use of water.

Maximize use of storm water for purposes other than drinking.



Use human waste to generate bioenergy.



Use wastewater to create energy, which helps improve the environment, is cost-effective and can help expand the reach of services.

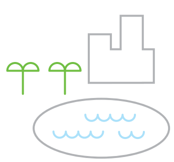
By 2050, 2 in 3 people are projected to be living in cities.[17] What can we do to adapt to this change and sustainably deliver WASH services to growing urban populations?

Make sure that urban development plans anticipate population growth and WASH demands.

Use smart urban planning techniques to minimize the damage that can occur to natural ecosystems from the pollution of surface and groundwater resources and riverbank and coastline erosion.

Prepare for floods, drought and other emergencies by strengthening water system infrastructure in cities so it can be consistently managed and treated and so that wastewater and storm water can be reused.

Integrated design of water management infrastructure...



in and around cities. Use natural systems such as green areas and wetlands for storage, retention and purification of water sources.

&

in and around buildings. Construct green roofs, store water so it can be reused, and install greenery in streets to absorb water run-off.

To protect children in the face of climate change, we need to safeguard their access to safe water and sanitation.

Chapter 4: Protecting children from changing water risks: Community, sub-national, national and global action

The following are some practical steps that can help us to understand the risks facing children, inform policy and planning, set technical standards and develop resilient and climate-smart water, sanitation and hygiene programmes at the global, national, sub-national and local levels.

4.1 Creating resilient water and sanitation systems

As climate change continues to have an impact on children's access to safe water and sanitation, communities will need to adapt their coping strategies accordingly; they will need to build toilets and water services that are resilient in the face of climate disasters and encourage individuals to change their water, sanitation and hygiene (WASH) behaviours and practices.

It is therefore vital that we protect children and their families from the challenges of climate change and make sure that children everywhere are able to live in safe and sustainable environments. To do this, it will be essential to:

Invest in good analysis and apply robust technical standards to the design of water and sanitation systems.

This is a critical first step to help make sure that water, sanitation and hygiene (WASH) facilities can withstand the increasing incidence of drought and also survive the potential physical damage of floods, landslides and extreme weather.

Diversify sources of drinking water and increase storage capacity.

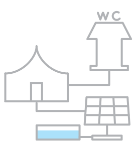
Communities are vulnerable when they rely on a single source of drinking water and do not have storage or reserves to act as a buffer in times of emergency. Groundwater sources can be complemented, when feasible, with rainwater, springs and properly treated surface water. Rainwater tanks, solar-energy-fed water tanks, small multi-purpose dams, including sand dams, and artificial groundwater recharge are all examples of climate resilient options that can provide storage and buffer capacity if primary water sources fail.

In areas prone to flooding and extreme weather, reinforce safe sanitation behaviours as a deterrent to open defecation and work with local markets to establish sanitation solutions that are resilient in times of emergency.

In communities where open defecation is the norm, behaviour change programmes need to focus on eliminating the practice and on encouraging communities to construct and maintain latrines resistant to climate change. Simple measures that can be discussed with communities include: avoiding areas where water stagnates after intense rain and raising and sealing latrines to protect them from rising flood waters. Sanitation system managers will need to understand the market for goods and services to determine if there are existing products adapted to the local context that could be scaled up for wider use.

Protect water from contamination.

Where water systems are managed locally, community risk management approaches can be employed to identify typical hazards such as animals grazing near water distribution points and microbiological contamination from poor sanitation practices. To protect water safety, communities need to identify control measures and put them in place.



Plan the equitable and sustainable provision of water supply in communities and resettlement camps that host people displaced by the effects of climate change.

In the most extreme cases, the impacts of climate change may force people from their homes, leaving them no option but to live in resettlement camps or host communities. In order to avoid any potential conflict over water resources in these situations, it is vital that solutions support both the entire displaced population and, where necessary, the local population. For long-term resettlement camps, smart technical options such as solar-powered water systems and resilient latrine designs can be promoted.

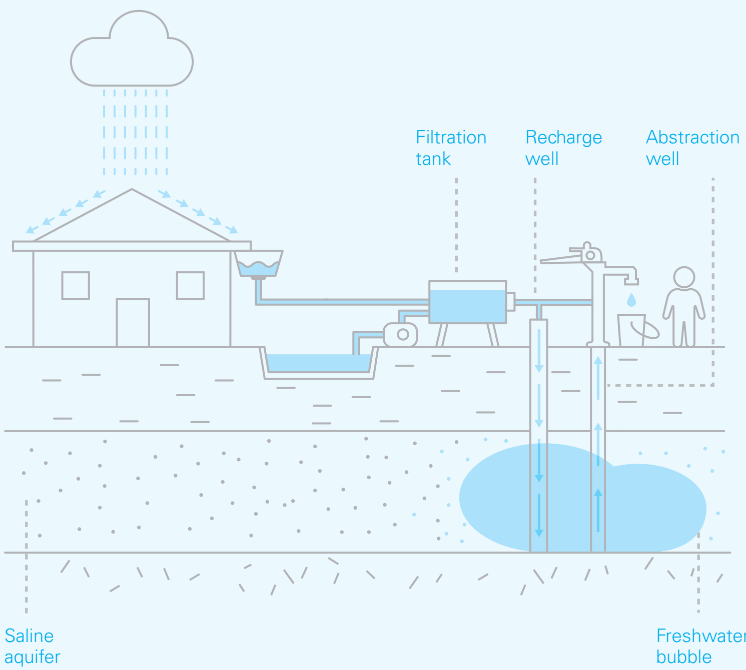
Case study: Aquifer innovations in Bangladesh.

Because of the country's low-lying topography and its location on the Bay of Bengal, most of Bangladesh's coastal communities are exposed to frequent flooding caused by cyclonic storm surges. Climate change leads to more frequent and intense storms and rising sea levels. In addition to destroying WASH facilities, these climate hazards can also cause the salinization of the coastal aquifers that communities in the region rely on for drinking water.

With the goal of establishing more reliable drinking water sources for these communities, UNICEF and partners have worked with the University of Bangladesh and the Government of Bangladesh to pilot a Managed Aquifer Recharge (MAR) system. Application of the MAR concept is simple: Water is collected from ponds and roofs, passed through a sand filter, then injected into the shallow saline aquifer to create a freshwater bubble of drinkable water. Each MAR system can serve several hundred people and can be easily maintained by the communities themselves.

Storing freshwater in the ground is an important climate-resilient option that can help overcome the impacts of cyclonic surges. The MAR system provides safe water when other traditional sources have been damaged by floods. The approach has been scaled up and currently more than 100 MAR systems are operational. Their success so far indicates that the MAR system has the potential to be used throughout Bangladesh and in low-lying areas around the world.

Figure 18. Managed Aquifer Recharge (MAR) System.



Source: United Nations Children's Fund, *Managed Aquifer Recharge: An innovation to provide safe and reliable sources of water in water-scarce areas of Bangladesh*, UNICEF, Bangladesh, Sep 2014.

Case study: Planning in advance to overcome vulnerability in Pacific Island countries.

Given their small sizes, unique geography and fragile base of water resources, Pacific Island countries face particular challenges when attempting to provide access to safe water and sanitation. These underlying conditions are further challenged by population growth, urbanization and changing land-use patterns. Climate change poses further risks by increasing the frequency and severity of natural hazards such as cyclones.[1]

In Fiji and Vanuatu, UNICEF provides support to governments so they can ensure sustainable access of good-quality water using a Drinking-Water Safety Planning (DWSP) approach. The DWSP approach combines the concepts of water security with the Water Safety Plan (WSP) method established by the World Health Organization.[2]

In Fiji, UNICEF works through non-governmental organizations (NGOs) to engage communities in improving the quality of water systems. Village water committees are trained and prepare water safety plans, with assistance from NGOs. The plans identify, prioritize and mitigate existing risks, and their use provides immediate health benefits; in addition, they help build a solid foundation for planning future infrastructure improvements.

Once the village committees have made improvements and are engaged in management activities agreed on by the partners, additional support is provided to develop an investment plan to ensure that enough water is available throughout the year – in other words, a plan to achieve water security. When required, training is also provided to enhance operation and water system maintenance skills.

In Vanuatu, the Department of Water Resources and its NGO partners used the same approach to 'build back better' following Cyclone Pam, a Category 5 tropical cyclone that hit in March 2015. The water safety plan process ultimately resulted in rehabilitated or replacement water supply systems that were more resilient than those previously in use.

Figure 19. Combined drinking water safety and security planning (DWSSP) approach in Fiji and Vanuatu.

Source: United Nations Children's Fund, *Community Drinking Water Safety and Security Planning in Pacific Island Countries*, UNICEF, Vanuatu, 2013.

Case study: WASH facilities to withstand extreme weather in Mongolia.

According to the *Mongolia Second Assessment Report on Climate Change – 2014*, temperatures in Mongolia increased 2.07° C from 1940 to 2013.[3] This increase is more than double the average rise of global temperatures.[4] Except in the western regions, precipitation also decreased.[5]

But increasing temperatures are not necessarily making the winters warmer. Climate change is increasing the variability of temperatures and the frequency of the uniquely Mongolian weather phenomenon known as the *dzud*, which, every few years, creates a particularly dry summer with drought conditions followed by a particularly cold winter and heavy snowfall.

Forty per cent of Mongolia's population did not use improved sanitation facilities in 2015.[6] There are disparities between urban and rural communities that affect access to improved sanitation. The proportion of the population without access is 34 per cent in urban areas and 57 per cent in rural areas. The per cent of the population that does not use improved water sources is 34 in urban areas and 41 in rural locations.[7]

In the winter, extremely cold temperatures, which can drop to -40° C, prevent children from walking the full distance to use outdoor latrines. This contributes to open defecation in school and dormitory yards and negatively impacts children's health.

To improve access to WASH in schools, dormitories and kindergartens, UNICEF Mongolia has developed a low-cost and high-quality innovative WASH facility in a container. The containers are equipped with flushing toilets, urinals, wash basins and a shower room and each can serve 30 to 60 students. They can be attached to a building or a *ger*, the traditional portable dwelling common in Mongolia. They also can be connected to an existing water supply and sewage system without major renovation work. The container has an integrated ventilation system, electric connections and insulated walls and ceilings to protect the facilities from freezing temperatures and heat loss.

The containers, introduced in 2014 and installed in the Khuvsgul province and the Nalaikh district, have served about 1,400 children, and private sector companies and international NGOs in Mongolia are already replicating them. In schools, the containers have had a positive effect on children's hygiene and behavioural outcomes, helping to create healthy, child-friendly learning environments. With increasing climate variability in the coming decades, solutions such as the WASH container will become increasingly important for children.

Innovative WASH facility in a container installed at schools in Mongolia

Figure 20.

40%

40 per cent of Mongolia's population did not use improved sanitation facilities in 2015.

-40° C

Temperatures in Mongolia can drop to as low as -40° C during the winter.

WASH facilities

WASH facilities equipped with toilets that flush, urinals, wash basins and a shower room.

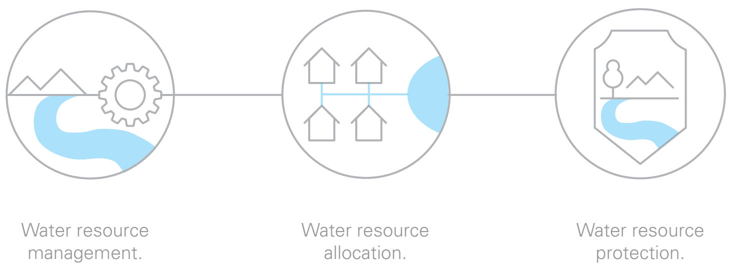
System functions

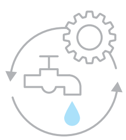
The container has integrated ventilation system and electric connections.

4.2 Keeping the water flowing at the subnational level

Though domestic use is typically a small part of total freshwater use, it is expected to increase. As pressure on water systems increases, the WASH sector must play a much more active role in policy and planning debates on water resource management, allocation and protection.

Figure 21. Keeping the water flowing.





Understand water resources and patterns of use as a prerequisite for planning WASH services.

Investment in assessment and monitoring as a basic public good is needed to support water resource management. The knowledge gained from this investment will inform site-specific investigations and build an evidence base on how water resources will be impacted by climate change and socio-economic drivers.[1]

Prioritize children's access to safe water and sanitation.

Putting children first means that water and sanitation professionals need to consult and agree on water allocations with other actors managing water resources outside the regular water and sanitation sector. Priority must be given to ensuring access for the most vulnerable populations. It will also be vital to protect domestic supplies from both pollution and competing demands and, where water is part of the sanitation process, to ensure that systems remain effective in removing and treating waste. All of this has to be achieved in the face of accelerating climate change to avoid potential conflict.

Invest in the protection of river basins and systematically test water quality.

In flood-prone river basins or where rainfall is projected to increase, reforestation and the construction of horizontal contours will help avoid erosion and damage to water and sanitation infrastructure. This construction also facilitates infiltration into groundwater. To assess water quality, programmes to systematically sample water sources need to be in place. A baseline also needs to be established so that it is possible to compare changes in quality with norms that have been agreed on by the sector. Assessing whether water sources are vulnerable to pollution and developing vulnerability maps will help plan for the provision of safe water supply.

Pay special attention to groundwater resources where the knowledge base is weakest.[2]

Monitoring systems should be developed which record groundwater level fluctuations over time and be used to make comparisons with rainfall records. At the same time, monitoring systems create important hydrogeological databases of regional aquifers and groundwater supplies. Maps can then be developed to indicate areas that are vulnerable to drought or long-term declines in rainfall.

Case study: Hourly drought predictions in India.

Maharashtra is a state, with a semi-arid climate, located in western India. Around two-thirds of its area is drought-prone, with droughts being declared in 2011–12, and most recently in 2014–15. Both were classified as moderately intense based on a rainfall deficiency between 25 per cent and 50 per cent compared to the region's long-term average.[3]

In Maharashtra, groundwater is the main source of drinking water in nearly 85 per cent of rural areas, with populations depending heavily on boreholes or wells to meet their domestic water needs. The state's Groundwater Survey and Development Agency (GSDA) monitors groundwater levels in 1,531 watersheds on a quarterly basis. The agency's periodic evaluations have revealed that very few watersheds in the state experience groundwater over-exploitation. However, with more acute droughts and sharp seasonal reductions in water levels, hundreds of thousands of wells have run dry in the past 10 to 15 years.[4]

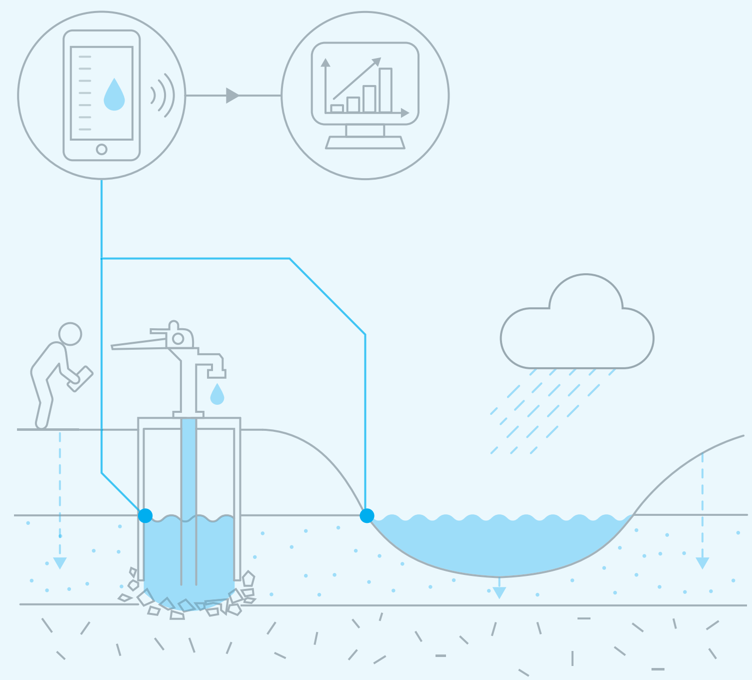
Because the assessment methodology and monitoring system in place were not robust enough to capture the dynamic water situation, especially when monsoon rains fail, UNICEF collaborated with the Government of Maharashtra to improve the processes for predicting droughts and water availability. A model that could predict the probability of meteorological droughts occurring in a particular year based on the start date of a monsoon was developed and tested in the Chandrapur district. The model can also estimate the amount of groundwater that will be available and predict crop and irrigation demands. It does this calculation based on data about rainfall water and fluctuation in wells during monsoon months.

To feed the model, GSDA developed a real-time monitoring network for observation of wells and rain gauges. A water quality monitor appointed by the government collects data from this network in each village using mobile technology.

To make the data readily available to decision makers and the public, a web-page dashboard was developed. The tool helps communities better manage their groundwater resources and better allocate water for drinking, irrigation and other purposes.

Based on the success of this intervention, the government of Maharashtra is working to scale up the project throughout the state by the middle of 2018.

Figure 22. Real-time monitoring and drought prediction programme in India.



Source: Groundwater Survey and Development Agency, Institute for Resource Analysis and Policy, and UNICEF Mumbai, *Using Technology to Ensure Ground Water Safety and Security in Tribal Blocks of Maharashtra: A tool kit for developing a decision support tool on planning drought mitigation measures*, UNICEF Mumbai, Mumbai, January 2015.

Case study: Using remote sensing to find groundwater in Ethiopia.[5]

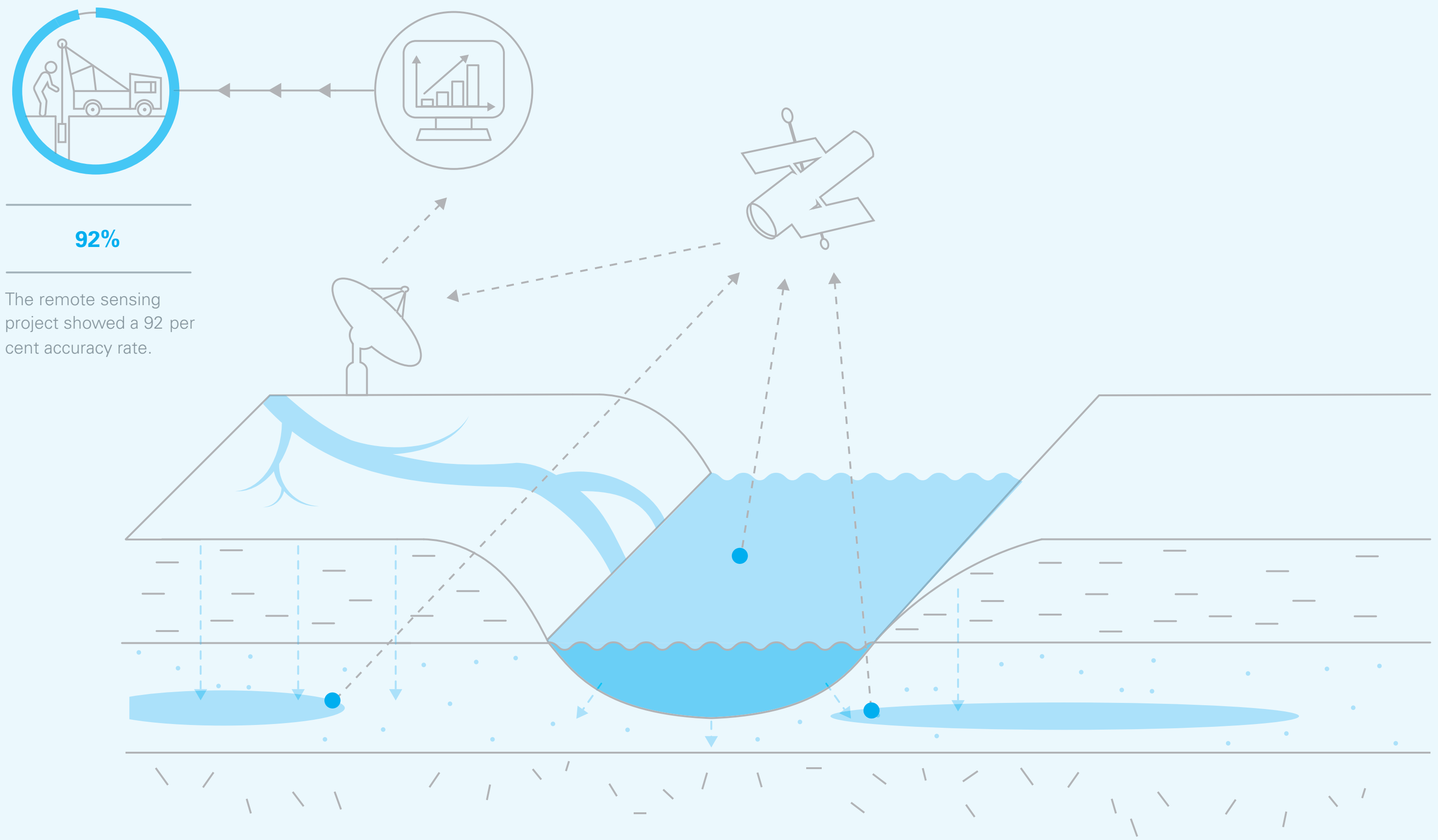
In 2016, Ethiopia experienced one of its worst droughts in decades. The rainy season, which normally falls between June and September, failed in 2015. These rains are vital for the meher harvest, which accounts for more than 80 per cent of the country's agricultural yield.[6] To make matters worse, the drought occurred when Ethiopia was still reeling from two previous poor rainy seasons, meaning communities had been desperately waiting for the rains.

In anticipation of the drought in 2015, UNICEF, in collaboration with the European Union and the Government of Ethiopia, piloted the use of remote sensing, which combines scanning of the Earth by satellite with hydrogeological investigation techniques that look for freshwater sources located deep in the ground.[7]

The first test was carried out in northern Ethiopia, in the Elidar district of the Afar region. Elidar is one of the areas most affected by water insecurity, and there is growing evidence that the lack of water is being caused by climate change.[8] Average temperatures in Elidar often exceed 40° C; the district receives only about 6 inches of rainfall per year.[9] The majority of the population is highly dependent on pastoralism for its survival and many live in extreme poverty. On average, there is just one water distribution point for every 2,300 people in the district.[10] Besides its arid climate, the region has a complex geology and a highly variable topography, making it difficult to successfully locate groundwater sources.

The remote sensing project aims to improve drilling success rates and ensure that more people, particularly children, have access to safe water closer to home. The first phase of the project combined satellite data with additional sources of hydrogeological, meteorological and geophysical data in order to develop maps for nine drought-prone districts that showed the best locations for groundwater drilling. In the project's second phase, 12 boreholes were drilled. The results showed a 92 per cent accuracy rate compared with less than 50 per cent previously. This success has meant that approximately 42,000 people have gained access to safe water.[11] In 2017, UNICEF will be working with partners to scale up the remote sensing project to 39 further lowland districts with the aim of ensuring safe water access for thousands more children living in the most drought-prone areas.

Figure 23. Improving deep groundwater supply availability in Ethiopia.



Source: Godfrey, S., and G,Hailemichael, *Three-phase Approach to Improve Deep Groundwater Supply Availability in the Elidar District of Afar Region of Ethiopia.* International Water Association Publication, UNICEF Ethiopia, 2016.

4.3 Managing national climate and water risks

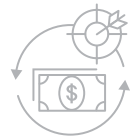
Different countries face different levels of climate and water risk, and threats vary over time. But one thing is clear: Climate-related disasters have a larger impact in countries with low levels of access to safe water and sanitation. Marginalized communities in dry lands, low-lying lands, coastal zones, near wastewater and drainage channels, or in urban slums are particularly vulnerable. The specific ways that climate change and water risk will affect communities and the capacity of each community to respond needs to be properly understood, so that they can be supported more effectively.

Develop risk assessments and compile data on the impacts of climate change on children and WASH services.

Risk assessments need to be carried out in order to identify the most exposed and vulnerable communities. Data and evidence need to be generated on how risks impact water and sanitation services and children's health and development.

Integrate risks into national water and sanitation policies, strategies and plans.

Basing WASH policies and programmatic responses on the best available data and comprehensive evaluation of risks will help make services more sustainable and address potential equity considerations. Evaluation needs to be a participatory process involving stakeholders and communities to make sure that all risks are considered and all opportunities and best practices are available to achieve impactful and sustainable results.[1]



Target high-risk populations with investment for climate resilience.

Funding and support must be provided in order to protect the health and development of the children most at risk.

Promote water conservation and efficiency.

Demand for water may be reduced through a range of policies that encourage efficient water use, including education, voluntary compliance, pricing policies, legal restrictions on water use, rationing of water or the imposition of water conservation standards on technologies.[2]

Set standards and provide guidance.

Governments can pre-screen water and sanitation technologies and approaches to determine if they are resilient and can adapt to the specific local risks posed by climate change as well as increasing demand. The best technical options should be made available on the market in partnership with the private sector. For example, solar power water pumping schemes have proved more cost-effective and sustainable than hand pumps or diesel generators and could therefore be considered a smart investment in the long term.[3]

A policy shift towards professionally managed service delivery is an opportunity to integrate measures that are sustainable in the face of climate risks.

A professionally run water service can integrate climate resilient modifications into the operation and maintenance of water and sanitation services by reducing non-revenue water and engaging in water conservation measures. Utilities also need to lower their carbon footprint by investing in emission-reducing technologies. A professional service provider can be held accountable for effective service delivery by both the government and communities.

Governments play an important regulatory role in the identification and enforcement of performance indicators.

Clear performance indicators for service delivery, including resilient water and sanitation services, can be a basis for the effective national monitoring of water and sanitation services.

Case study:
Climate risks and Rwanda's new water supply policy and strategy.

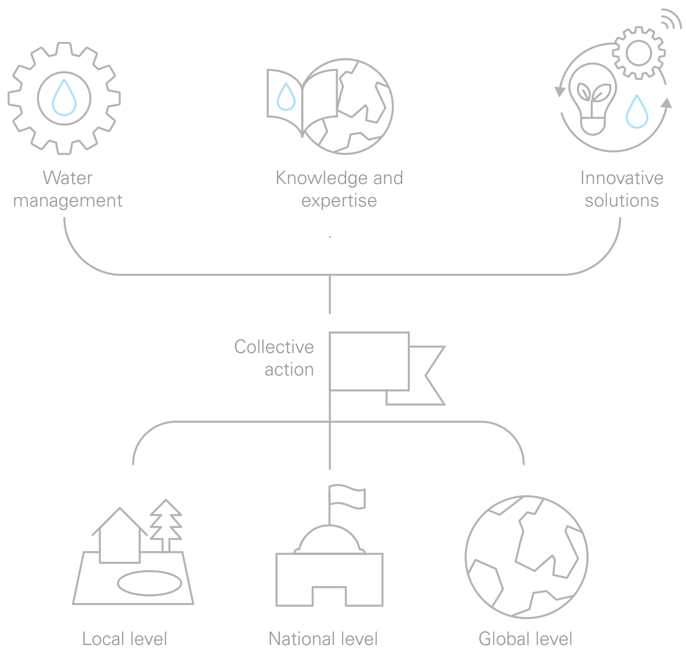
In December 2016, the Government of Rwanda took an important step towards protecting children from climate risks by approving a new National Water Supply Policy and Implementation Strategy. The policy provides clear guidance on improving the country's climate resilience at the national, regional and community levels.[4] It specifically calls for programmes that address the risks posed by climate change and aims to climate-proof new large water supply programmes. An entry point for WASH resilient service delivery is the prioritization and implementation of cost-effective, environmentally sustainable options.

These measures are more likely to be successful in the face of increased uncertainty due to climate change now and in the future. They help protect existing WASH systems against present climate variability and future change. In addition, the policy also includes provisions for risk-informed planning, prioritizes conservation and protection and mandatory water safety planning.

4.4 Global advocacy and collective action

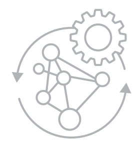
The risks facing children will require collective action at local, national and international levels. Water management will require the integration of systems, often across borders. Knowledge and expertise will be needed from all parts of the world. We will need to combine forces to create innovative solutions to the problems that children face, as they evolve.

Figure 24. Taking collective action for children.



Anyone can be an advocate, and everyone has a role to play.

Climate change is a global phenomenon that affects all of us, especially children. Every one of us can play a role in advocating for action, whether it is sharing climate facts and figures, asking governments for specific policy changes, or simply keeping the issue high on the global agenda. As demonstrated in this report, the effects of climate change are tangible and largely felt when access to safe water and sanitation is scarce. There are concrete solutions for protecting children. However, they require support not just from governments or donors, but from the global community.



Action is fuelled by knowledge.

More data and evidence on the impact of climate change on children and on water and sanitation are needed to fuel global advocacy efforts. In particular, innovative solutions and response strategies need to be shared so governments and communities can take action.

Children are an important part of the solution.

Children should be given opportunities to actively engage and contribute to climate activities and policies. They play an important role in enhancing community capacity and promoting environmentally sustainable lifestyles. In 2015, for example, around 60 children from 12 countries attended the International Children's WASH Forum in Tajikistan. The forum mobilized the children to call on world leaders to take action on climate change and water security for children. In another example, thousands of children from around the world submitted photos for the 2016 World Water Day #ClimateChain campaign at the United Nations.[1]

There is power in partnering, and doing this together

Governments, NGOs, United Nations agencies, private sector actors and civil society need to harmonize and align in global action. We need to explore ways to make climate financing, adaptation, and mitigation measures better incorporate access to safe and sustainable water and sanitation for children.

Climate change is not just an environmental crisis, it is also a crisis for children.

Climate change is associated with natural disasters and is often perceived as an environmental crisis. However, it is the most vulnerable and marginalized children who will bear the brunt of the effects of climate change.

Case study: Financing for climate-resilient WASH in Madagascar.

In 2015, UNICEF Madagascar teamed up with the United Nations Development Programme and the Malagasy Climate Change Coordination Office (Ministry of Environment, Ecology and Forests) to apply for US$5.8 million in climate financing from the Least Developed Countries Fund, managed by the Global Environment Facility. The funds were intended to undertake a programme to support vulnerable rural communities so they can cope with the risks posed by climate change, specifically those relating to water and sanitation.

Globally, Madagascar has one of the worst levels of access to safe water and sanitation. The most recent data from the WHO/UNICEF Joint Monitoring Programme reveals that only 52 per cent of the population has access to safe water and just 12 per cent has access to improved sanitation, a figure that has actually declined in the past three years.

Malagasy children are facing multiple climate risks, as the country is prone to cyclones, droughts and floods. At the same time, Madagascar is burdened with one of the highest rates of chronic malnutrition in the world. All of these risks are expected to increase as the impacts of climate change worsen and threaten children.

The programme, four years in duration, has three main components: strengthening of rural institutions; production of agro-meteorological and hydraulic information to help facilitate climate-smart programming decisions; and support for community-based climate resilience programming.

UNICEF will help improve the resilience of the country’s poorest communities, particularly in rural areas, by conducting risk assessments, carrying out emergency preparedness planning, and increasing climate resilient WASH services and technologies. This work, worth US$1.9 million, will form an integral part of the UNICEF Madagascar Country Programme, which includes climate resilience and sustainable WASH services as major priorities.

Figure 25. Financing for climate-resilient WASH in Madagascar.

52%

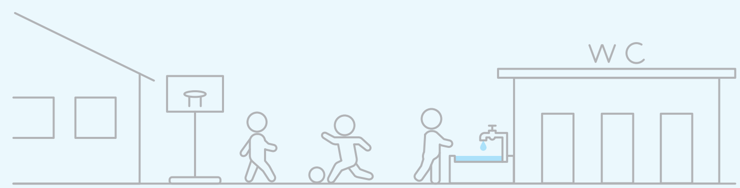
52 per cent of the population has access to safe water.

12%

12 per cent has access to improved sanitation.

1.9 million

US$1.9 million is invested to improve these low access rates.

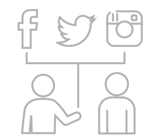


Source: United Nations Children’s Fund and World Health Organization, *Progress on Sanitation and Drinking Water: 2015 update and MDG assessment.* WHO, Geneva, July 2015.

What you can do to help:

Get the facts:
Find out more about the issue, and the people whose lives have been impacted. Learn more about what solutions work best.

Be the change you want to see:
Do what you can to reduce greenhouse gases emissions in your own life. Do what you can to prevent water from being wasted.



Raise awareness:
These are urgent global issues and more people need to be involved in solving them. Start a conversation with your friends and family, share facts on social media. Tell your local leaders why this matters to you, and ask them to take action.


UNITED NATIONS
PARIS CLIMATE
AGREEMENT
SIGNING CEREMONY
22 APRIL 2016

"We expect more than words on paper and promises. We expect action."

16-year-old Getrude Clement addresses world leaders at the opening ceremony for the signing of the Paris Climate Agreement at United Nations headquarters.

Annex:

METHODOLOGY FOR GIS ANALYSIS

Version 4 of the Gridded Population of the World (GPWv4) from the Center for International Earth Science Information Network (CIESIN) was used as the basis for this analysis. The information was derived from best available administrative boundary population counts for the 2010 Network at Columbia University. GPWv4 is the best available global population data. It is constructed from national or sub-national input areal units of varying resolutions, which will show differences in the visual display of information depending on the resolution of the input boundaries.

The GPWv4 data was then augmented by incorporating the best available, higher-resolution data from WorldPop for Africa, Asia, and South America. WorldPop uses census, survey, satellite, social media, cell phone and other spatial data sets, integrated into peer-reviewed statistical methods, to produce open, fully documented and consistent gridded maps of population distributions. WorldPop works with statistics agencies, ministries of health and other organizations to construct databases of the most recent and most spatially detailed population census data available.

The new hybrid gridded population data was calibrated to the 2015 revision of the United Nations' World Population Prospects, so that the national population totals equalled those from the United Nations. The percentage of the population under 18 years of age was then calculated on a national level and enhanced with sub-national boundaries and percentages for 58 countries provided by ICF International through the Demographic and Health Surveys (DHS) Program. The percentages were then used to estimate the number and location of children under 18 years of age in 2015 around the world. For future populations, gridded population data was augmented by United Nations population projection data for the year 2040. Note: Population figures do not account for migration, which could be a significant factor in areas of extremely high water stress.

We used the World Resources Institute (WRI) Aqueduct Water Risk Atlas as the basis for assessing water risks to children. We overlaid the child-population map with the Water Stress map for the year 2040. Using a high resolution child-population density data, this gave us an estimate of the number of children that live in areas of extremely high water stress. According to the WRI, projections for water stress are driven by general circulation models from the Coupled Model Intercomparison Project (CMIP) Phase 5 project, as well as the Shared Socioeconomic Pathways database from the International Institute for Applied Systems Analysis. For the purposes of this analysis we assume a 'business as usual' climate change modelling scenario (RCP8.5), and the 'business as usual' Shared Socioeconomic Pathway (SSP2). RCP8.5 is a scenario of the increase in radiative forcing, with temperatures increasing between 2.6 – 4.8°C by 2100 relative to

1986–2005 levels. SSP2 is a scenario of socioeconomic drivers, reflecting only intermediate challenges associated with variables such as population growth, GDP growth, and urbanization.

Water stress is a measure of the ratio of water withdrawal to water supply. It therefore captures the variety of factors that can lead to water stress, including increasing demand and competition for water resources associated with higher levels of economic growth and industrialization, as well as the effects of climate change as per the climate modelling scenario. Extreme water stress occurs when up to 80 per cent of the available surface water is withdrawn and used. It should be noted that even in places where the water stress level is considerably lower it can still be extremely difficult for families and children to access the water that they need, especially where adequate and safe water and sanitation services are not in place. We evaluated the difference between more recent 2010 levels and 2040 levels and estimate that approximately 20 per cent more children will live in areas of extremely high water stress in 2040. However, the impacts further into the future are likely to be even greater unless action is taken.

Assumptions and caveats:

Firstly, it should be noted that our modelling does not account for demographic movements and migration in 2040. Because it is very difficult to predict where people will move and migrate from/to, this model assumes the same proportions of population density in 2040 as currently. However, water stress is likely to encourage international as well as internal migration, as it puts strains on families and affects livelihoods, particularly for communities relying on agriculture. But by contrast, greater levels of urbanization will likely put increasing strains on water resources in and around urban areas, causing more people to live in areas with potentially high levels of water stress. These are nuances that we were not able to capture in this estimate.

Another caveat is that not all children living in areas of extremely high water stress are impacted in the same way. It is usually the poorest children living in areas of high water stress that are most affected. Wealthier children living in areas of high water stress may be able to pay higher prices for access to safe water and sanitation. Children's resilience depends on many issues, including poverty, access to resources and the functioning of water and sanitation systems in their local context. It depends on whether communities are able to conserve water, create sustainable and equitable solutions for access, and develop water, sanitation and hygiene services and practices that respond to changing levels of demand and climatic conditions. It also depends on national policies aimed at better and more sustainable and equitable water management practices.

Finally, while in many cases demand for water has a dominant effect on water stress, it should also be noted that climate change will have a much broader impact on the water and sanitation services beyond water stress. As this report demonstrates, climate change affects the full range of water and sanitation services on which children rely. Storms and floods can damage or contaminate water reserves; prolonged and severe droughts can cause a more rapid depletion of groundwater reserves; and rising sea levels and storm surges can cause salinization of freshwater reserves. It will be necessary to prepare for the multiple effects of climate change in order to adequately address the evolving needs of children and the risks that they face in terms of access to safe water and sanitation.

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