

The background of the page is a complex, abstract pattern of swirling, concentric lines in various shades of teal and light blue. The lines are hand-drawn in style, creating a sense of movement and depth. A solid dark teal rectangular box is positioned in the lower-left quadrant of the page, containing the text 'Executive Summary' in white.

# Executive Summary

**Climate change matters to the water cycle – Impacts vary from one region to another, but we often do not know exactly how.**

**Even small changes in climate can have significant impacts on water availability and extreme events, such as droughts and floods.** The water cycle is an essential part of the climate system, and therefore acutely sensitive to climate change and climate variability. Empirical evidence shows that insignificant climate variations can cause significant changes in hydrological flows and water availability. For instance, a global temperature rise of 2°C could increase the number of people suffering from absolute water scarcity by an additional 40%, compared to the effects of population growth alone. Groundwater is particularly affected by droughts, since only precipitation that has not evaporated or drained off reaches deeper layers.

**It is imperative to take a closer look at the regional and local levels.** In West Africa, for instance, with its main Niger river basin, and in the Upper Amazon region, uncertainty in annual precipitation projections is very high, but there are strong indications that climate variability (more heavy rainfall, but longer dry spells) and seasonal shifts differ in both basins. This means that, even in a wetter climate, there can be more droughts, and that measures to counteract droughts are beneficial, regardless of the direction in general precipitation trends. Droughts are also expected to become more severe in the Limpopo and Tagus basins. Meanwhile, the Blue Nile and Ganges are projected to face increased flood risks.

**In some regions, it remains unclear how climate change will impact the water cycle.** Overall, climate change adds another element to existing pressures on water resources for drinking, energy, and food. These include population growth and mobility, economic development, international trade, urbanisation, diversifying diets, and cultural and technological change. It is often impossible to specifically tie certain phenomena to one of these pressures. Trends in annual precipitation are highly uncertain in many regions, for example in large parts of the sub-tropics, where many Least Developed Countries are located. In fact, in only about two-thirds of the world's land surface area, at least 80% of climate projections agree on the general trend in precipitation under a high emission concentration pathway. Hydrological model uncertainty decreases once regional models consider catchment-specific characteristics. Some uncertainties will, however, inevitably remain.

#### **Concrete approaches and next steps for water action:**

- 💧 Maintain and improve hydro-meteorological monitoring stations and information systems, including capacities for transparent analysis and reporting in order to improve long-term weather and climate observations.
- 💧 Register, connect and integrate data and information from in situ measurements and remote sensing, as well as socio-economic data including land use and population growth.
- 💧 Enhance (coupled) climate and hydrology assessment and modelling capacities including on groundwater in order to improve climate projections and impact scenarios.

**Water provides solutions for dealing with uncertainties, e.g. through resilient water infrastructure and robust and flexible storage solutions.**

**The water sector is the most essential sector for improving the climate resilience of communities and ecosystems.** Seeing as the impacts of climate change directly affect water resources, actions in the water sector are crucial for dealing with them. With regard to increasing water scarcity due to climate change, climate action in the water sector includes water demand management, reduction of water losses, and reuse of treated wastewater, to name merely a few approaches. Enhancing climate resilience in the water sector often goes hand-in-hand with potential co-benefits concerning mitiga-

tion of greenhouse gases (GHG), sustainable development, and protection of ecosystems including their biodiversity. Water-related climate impacts also affect other sectors, such as agriculture (e.g. impacts on irrigation) and energy (e.g. cooling water), calling for a Water, Energy, Food Security Nexus approach. Water management needs to build on thorough climate risk assessments and factor in multiple uncertainties. The impacts of climate change have been mainstreamed into water planning processes. Today, comprehensive environment and climate risk analyses are required for project planning and design in most development agencies. Tools are also available for activities in the private sector, which has become increasingly aware of water and climate risks. These assessments help to identify climate-resilient, cost-effective, and sustainable solutions for improving climate resilience.

**Water resources planners and practitioners have long applied adaptive management and implemented robust solutions to cope with hydro-meteorological variability, now reinforced by a changing climate.**

Robust solutions are those that perform well over a wide range of climate and non-climate scenarios, or can be flexibly adapted to them. Still, it is essential that climate risks are monitored, allowing for adjustments in case of new insights. Projection uncertainties must not be misused as an excuse to label “business as usual” water measures as adaptation activities.

**Nature-based Solutions offer additional opportunities for effective, robust, and flexible climate change adaptation.**

Water managers have long relied on natural processes, for example by using wetlands to treat wastewater. The water community has also gained experience with governance mechanisms that help implement Nature-based Solutions, including through Water Stewardship approaches.

**Safeguarding and providing water storage capacity is crucial for climate adaptation.** Water storage offers multiple answers to the impacts of climate change. Storage provides a buffer against both floods and droughts, balances increasing water variability, and compensates for the loss of natural water storage systems, such as glaciers and wetlands. In order to manage climate risks, while safeguarding freshwater ecosystems, it is necessary to rethink how nature-based, “green” (e.g. wetlands, groundwater), and infrastructure-based, constructed “grey” storage systems can best be combined. To this end, the whole range of water storage options needs to be considered.

Transboundary water management complements the country-led climate approach, and it deserves even stronger attention. Neither do rivers nor the impacts of climate change stop at administrative borders. Adaptation in one country can potentially mean maladaptation to a neighbouring country. The success of the Transboundary Water Management approach can be further developed into Transboundary Resilience Management. Innovative activities in this field already exist.

**Concrete approaches and next steps for water action:**

- ◆ Improve water storage capacity and water conservation, e.g. through permeable soils (rainwater management), protection of wetlands, and support of traditional water storage methods, demand management, and reducing water losses.
- ◆ Explore the use of alternative water resources, including reuse of treated wastewater and desalination – provided they comply with social and environmental safeguards.
- ◆ Apply and mainstream approaches for economic analysis of climate change impacts and climate risk assessments in public and private sector activities. These should combine bottom-up water risk assessments with top-down information on climate impacts as a basis for water adaptation planning.
- ◆ Incorporate the potential of Nature-based Solutions by promoting integrated and flexible approaches that combine nature-based and infrastructure-based infrastructure in adaptation planning.
- ◆ Integrate the transboundary perspective in NDCs during current and future NDC ambition-raising processes, as well as in the NAP process, and advise on regional initiatives for transboundary climate resilience.

## Sustainable water management holds large GHG mitigation potential, part of which is still largely untapped.

**Unsustainable water and wastewater management is a major source of GHG emissions.** The supply, conveyance, and treatment of water are energy-intensive processes, contributing to carbon emissions, if they are powered by fossil fuels. Energy use by water and wastewater activities accounts for about 4% of the international electricity consumption and might double by 2040. The treatment of wastewater can generate emissions of methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O), both with a much stronger global warming potential than CO<sub>2</sub>. Emerging and developing countries are engaging in reducing these emissions, including through improving energy efficiency and upgrading treatment technologies. Such interventions often cut operational costs for utilities. Some activities can generate co-benefits on climate resilience, for instance the reduction of water losses. Existing tools help utilities in all parts of the world to assess, reduce and report their emissions in line with national mitigation goals.

### Untreated and poorly treated wastewater and sludge are silent but significant GHG emitters.

It is estimated that more than 80% of the global wastewater does not receive any kind of treatment. When disposed into surface waters, the amount of nutrients and organic matter within the respective water body increases. This spurs the formation of CH<sub>4</sub> and N<sub>2</sub>O – turning surface waters into a source of GHG with particularly high global warming potential. Watershed management and extended water treatment capacities can positively effect GHG emissions by reducing organic matter and nutrient inputs into surface water bodies. Preventing the inflow of insufficiently treated wastewater can contribute to national climate change mitigation efforts, while protecting water quality and safeguarding aquatic ecosystems.

### Natural wetlands are substantial global carbon pools that usually also function as carbon sinks.

Particularly peatlands constitute major carbon stocks of global importance. Peatlands store twice as much carbon as the earth's forests in their biomass-making peatlands the most space-effective carbon storage systems of all terrestrial ecosystems. The degradation and destruction of peatlands alone might be responsible for 5% of global anthropogenic CO<sub>2</sub> emissions. Nature-based Solutions, such as Ecosystem-based Mitigation (EbM) approaches, can significantly contribute to global GHG mitigation efforts through water. Safeguarding the integrity of natural wetlands through conservation and rewetting measures is a low-hanging fruit to foster climate ambitions through EbM approaches. The sustainable management of water resources is an essential part of protecting carbon-rich freshwater ecosystems and their ecosystem services, while creating multiple co-benefits for climate adaptation, the conservation of biodiversity and human well-being. Based on the chosen irrigation regime, rice paddies can be significant sources of GHG. The formation of CH<sub>4</sub> and N<sub>2</sub>O in flooded rice paddies is estimated to be responsible for at least 2.5% of global GHG emissions. The underlying formation process is essentially influenced by the type of water management strategies and irrigation/flooding regimes in place. In this regard, institutions responsible for water management, such as ministries, agencies as well as other water stakeholders can support and enhance existing efforts by the agricultural sector to reduce GHG emissions.

### Concrete approaches and next steps for water action:

- 💧 Assist in incentivising and implementing energy efficiency activities in water and wastewater utilities, in line with national mitigation efforts.
- 💧 Further increase coverage of low GHG wastewater management to improve human and ecosystem health and reduce GHG emissions.
- 💧 Provide and institutionalise accurate, but user-friendly methodologies and tools for assessing, reducing, and reporting GHG emissions and energy costs in the water sector.
- 💧 Support data gathering and inventory of CO<sub>2</sub>, methane (CH<sub>4</sub>), and nitrous oxide (N<sub>2</sub>O) emissions due to nutrient inputs into surface water bodies, e.g. through poorly treated wastewater. Also consider GHG formation in dam reservoirs.

- ◆ Initiate and support capacity-building in countries and communities to measure and monitor wetlands, in particular peatland ecosystems. Enhance mapping and (carbon) inventory efforts regarding the extent and status of global freshwater ecosystems to assess their mitigation potential and to inform decision-making on climate, conservation, and restoration action.
- ◆ Include all water-related GHG emissions in Nationally Determined Contributions (NDCs), while highlighting the untapped mitigation potential of the water sector. In doing so, stress the opportunities of Nature-based Solutions, such as Ecosystem-based Mitigation measures in the water sector, for enhanced GHG mitigation efforts and NDC ambition-raising.

### **Water is in an ideal position to bridge development and climate agendas by emphasising mutual benefits.**

#### **Emerging and developing countries have prioritised water action when it comes to climate resilience.**

Analyses show that water is the most prioritised sector in the adaptation components of NDCs, underlining both its crucial role and strong demand for water action by the parties. National Adaptation Plan (NAP) processes also often build on water action. Activities should ideally already be included at the NAP level, which in turn might prominently inform the next round of NDCs. Water is less present in national climate strategies when it comes to GHG mitigation, both in NDCs and long-term strategies. Strategy update processes open opportunities for concretising adaptation action and increasing water ambitions for decarbonisation.

**Water action stands for achieving multiple climate and development goals.** Co-benefits might also support efforts at preserving biodiversity and reducing disaster risks. One activity can contribute to several objectives at once, and the specific impact chains in reaching the respective goals are often interdependent and hard to disentangle. Nonetheless, activities marked as relevant for achieving a particular goal must prove their respective contributions, in particular if finance used is earmarked for that goal.

**Resilient Water Management promotes coherence between major global agendas in responding to (climate) risks, including the Paris Agreement, the 2030 Agenda for Sustainable Development, and the Sendai Framework for Disaster Risk Reduction (DRR).** About 90% of natural disasters are water-related, mostly droughts and floods. A better understanding and communication of water-related impacts can help identify solutions to minimise risks. Disaster risk reduction and management activities need to be considered for water-related climate action in order to use synergies with existing activities under the Sendai Framework. To this end, different initiatives are already underway, such as the Global Initiative on Disaster Risk Management (GIDRM).

#### **Concrete approaches and next steps for water action:**

- ◆ Start from the NAP process as a main entry point to ensure the consideration of relevant national adaptation priorities in the water sector.
- ◆ Provide guidance and checklists on addressing water adaptation and mitigation issues in climate plans and strategies.
- ◆ Promote the inclusion of water-related GHG mitigation contributions, including Ecosystem-based Mitigation activities, in NDCs.
- ◆ Promote holistic approaches to address water, climate, and development interlinkages by exploring co-benefits among the Paris Agreement, the 2030 Agenda, and the Sendai Framework on DRR.

