8th Roundtable on Financing Water: Thematic meeting focused on Climate Action
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Session 1: Setting the scene: Putting finance to work for a net zero, resilient, water secure future

The interlinkages between water security and climate action
Background Paper

> *"The present state of many aspects of [our] climate system [is] unprecedented over many centuries to many thousands of years".*
>
> *Source: IPCC (2021)*

In August of this year, the IPCC (2021[1]) released a first contribution to its sixth assessment report stressing that the planet's climate is changing at an unprecedented pace. Images of catastrophic flooding and extreme rains in Germany, the Netherlands or Japan, as well as wildfires or major droughts in Turkey, Algeria, Greece, Russia and the US, have dominated the news over the last months. One of the main channels through which the consequences of climate change are manifesting is through changes in the global water cycle (IPCC, 2021[1]; Kerres et al., 2020[2]). Climate-induced risks to water security[1] can entail negative effects on food security, energy production, biodiversity as well as human health and livelihoods and the overall achievement of the Sustainable Development Goals (SDGs) and other policy objectives. (IPCC, 2021[1]; Kerres et al., 2020[2]; Smith et al., 2019[3]; UNESCO, UN-Water, 2020[4])

People's lives as well as many productive sectors, such as agriculture and energy, depend critically on the availability and quality of water resources. Already today, 3.2 billion people live in agricultural areas with high or very high water shortages or scarcity (FAO, 2020[5]) and 1.2 billion people live at risk of floods (UN, 2020[6]). The impact of climate change on the water cycle is projected to increase over time, underscoring the need for ambitious climate action through mitigation and adaptation efforts.

With water being at the heart of a wide range of climate-induced risks and impacts, water-related investments offer ample opportunities to build resilience[2], adapt to climate risks as well as contribute to mitigation efforts. For example, investments in flood protection and sustainable irrigation and water resources management make a vital contribution to adaptation efforts. Similarly, improved energy efficiency of water services, reduced non-revenue water[3], along with greater uptake of wastewater reuse can contribute to the reduction of greenhouse gas emissions. At the same time, the restoration and

[1] The OECD defines water security as achieving and maintaining acceptable levels for four inter-related water risks: too little water (scarcity and droughts), too much water (floods), too polluted water (lack of suitable quality water for a particular purpose), and degradation of freshwater ecosystems. These risks to water security can also increase the risk of (and be affected by) inadequate access to safe water supply and sanitation (OECD, 2013[55]).

[2] Resilience can be defined as a system's ability to resist, absorb, adapt to and recover from the effects of a hazard while preserving and restoring its essential basic structure and functions and maintaining the capacity for adaptation, learning and transformation (UNDDR, n.d.[52]).

[3] Non-revenue water represents water that has been produced and is "lost" before it reaches the customer (either through leaks, through theft, or through legal usage for which no payment is made). (IBNET, 2021[56])

improved management of freshwater ecosystems, such as wetlands, can improve carbon sequestration capacity alongside other benefits, such as improved resilience through flood protection, improved water quality and habitat for biodiversity. However, certain investments can create trade-offs or constraints for other economic sectors. Hydropower and biofuel production as part of a mitigation strategy, for instance, increase demand for water resources, which could reduce water availability for irrigation, food production, industrial and domestic uses, while also reducing water flows with significant impacts on ecosystem services.

This paper provides an overview of the impacts of climate change on water security and its implications for human lives, the economy and the environment. It also highlights the adaptation and mitigation potential of investments in water security and identifies the opportunities and challenges of effectively aligning water and climate action.

Questions for discussion

(1) How can investments in water security contribute to Nationally Determined Contributions, National Adaptation Strategies and other domestic policies and long-term strategies to support climate action?

(2) How can potential trade-offs or tensions be addressed that may arise through increasing pressures on water resources in the context of net zero pathways or strategies for climate resilience (e.g. impacts on water of biofuel production or more extensive irrigation)?

(3) What priority actions should be taken to ensure that finance and investment align with climate action and water security?

Climate change manifesting through the global water cycle

The water cycle is a fundamental part of the climate system. Some of the main effects of climate change manifest through the water cycle and, coupled with changes in land use and growing demand pressures, impact water security, depending on location. Climate-induced risks to water security can entail negative effects on food security, energy production, biodiversity as well as human health and livelihoods and the overall achievement of the SDGs and other policy objectives, such as climate justice and women's empowerment (discussed in Background paper 4). (IPCC, 2021[1]; Kerres et al., 2020[2]; Smith et al., 2019[3]; UNESCO, UN-Water, 2020[4])

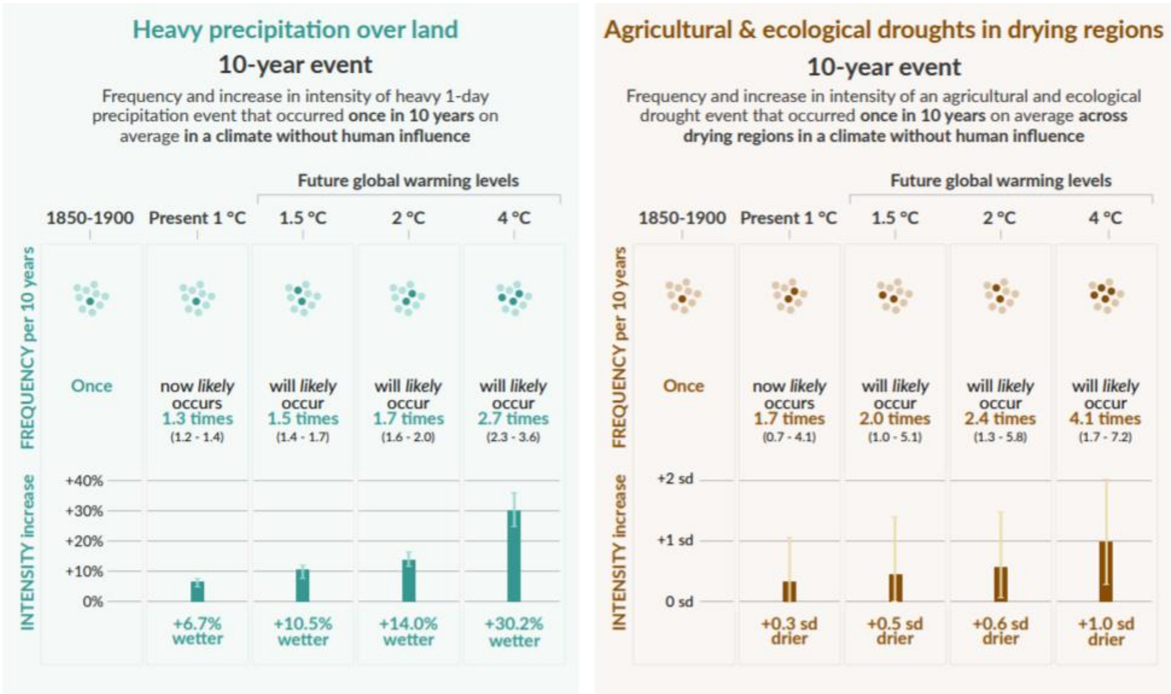
The main components of the water cycle are precipitation, evaporation, local runoff and river discharge, which are mutually interconnected and can influence other hydro-climate variables. A rainfall deficit, for instance, will reduce soil moisture, river flow and groundwater recharge (UNESCO, UN-Water, 2020[4]). According to the IPCC, since 1950, average precipitation over land has likely increased and extreme precipitation events[4] are already 1.3 times more likely than they were on average between 1850 and 1900 (see Figure 1). For each additional degree of warming, extreme daily precipitation events are expected to further intensify by about 7% at the global scale, with heavy rainfall and associated flooding projected to hit many regions of North America, Europe, Africa and Asia. Similarly, drought events are 1.7 times more likely today than they were on average between 1850 and 1950, and are likely to further increase in frequency and intensity, particularly in Africa, South America and Europe (IPCC, 2021[1]).

Further, global warming amplifies permafrost thawing and the loss of snow cover, while on average, late summer Arctic ice between 2011 and 2020 has shrunk to reach its lowest extension in the past 1000 years.

[4] Extreme precipitation events are defined as the daily precipitation amount over land that was exceeded on average once in a decade during the 1850-1900 reference period (IPCC, 2021[1]).

Glacier shrinkage and snow cover changes have led to changes in streamflow regimes in many mountainous regions, also affecting water resources in adjacent lowlands in recent decades, with tropical mountainous regions being among the most vulnerable (IPCC, 2021[1]; Buytaert et al., 2017[7]; Blanco Gonzalez, Kato and Rambali, forthcoming[8]). Melting glaciers are also one of the drivers of sea level rise. Global sea level has increased by 0.2m between 1901 and 2018, and is projected to rise up to 1m by the end of the century[5], compared to 1995-2014 average levels (IPCC, 2021[1]; OECD, 2021[9]). In addition, temperature rise enhances evaporation, and potentially increasing pressure on local water resources, even in regions subject to increasing amounts of precipitation. Variations in the hydrological cycle stimulated by changes in precipitation and evapotranspiration have further effects on river discharge, resulting in changed water availability, with important consequences for coastal regions and ecosystems (Kerres et al., 2020[2]; OECD, 2021[9]).

Figure 1. Projected changes in extremes depending on temperature increase



Source: (IPCC, 2021, p. 22[1])

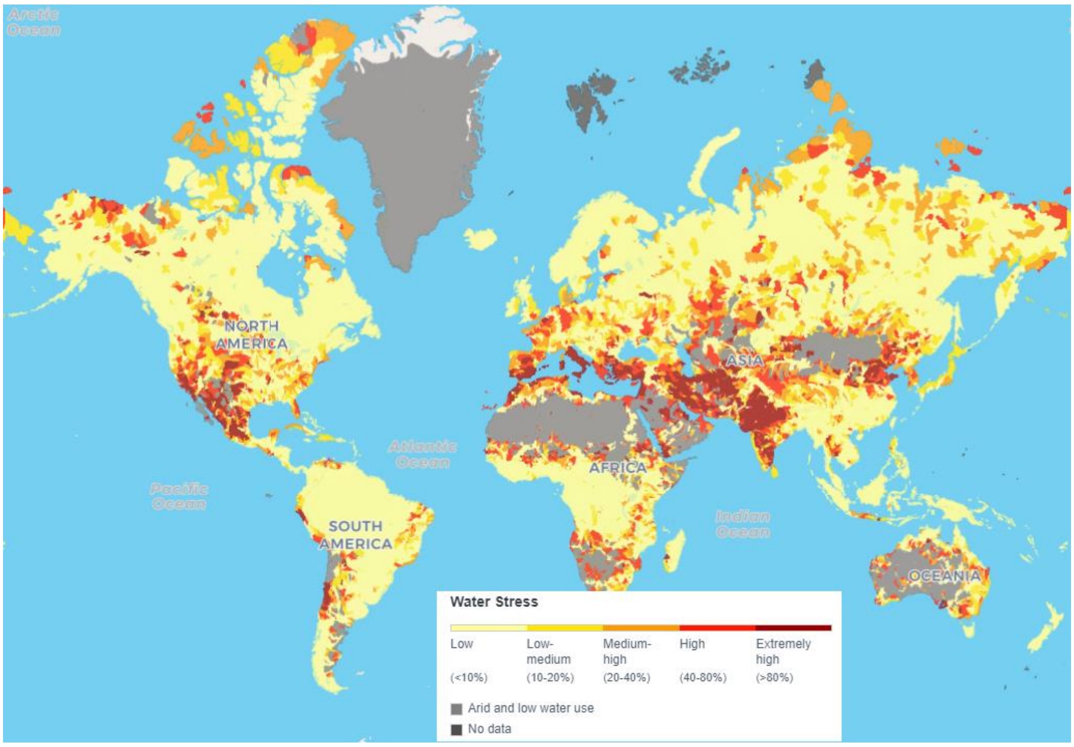
Overall, even small changes in climatic conditions and temperature can have large impacts on water quality, availability and extreme events. However, climate change impacts on the water cycle vary significantly over the globe and are associated with considerable uncertainty about the timing and magnitude of specific impacts. Especially for precipitation, in some regions it remains difficult to model even the direction of change (more or less rainfall) at the relevant spatial scale and related impacts on water security. In some regions, such as northern Europe, shifts in the water cycle will result in earlier snow melt, replacement of snow by rainfall and thus different seasonality of annual water discharge dynamics, whereas in the Mediterranean, increased evaporation and decreased rainfall will translate into less river discharge. All projections on precipitation, river discharge and floods are more pronounced towards the end of the century. (Kerres et al., 2020[2]; IPCC, 2021[1])

5 Under the IPCC's very high GHG emissions scenario (SSP5-8.5)

Already today, the impacts of these changes are evident and severe. Since 2015, the World Economic Forum has consistently ranked water crises as among the top global threats to the planet. Impacts arise in a variety of ways, including:

- **Water-related disasters (floods and droughts):** Over the past 20 years, the number of deaths caused by floods and droughts has exceeded 166 000 and caused economic damage of almost USD 700 billion (EM-DAT, 2019[10]). Economic losses from weather-related disasters are estimated at USD 1 891 billion between 1995 and 2015, which could be largely underestimated, since only 35% of records included information on economic losses (UNISDR, CRED and EM-DAT, 2015[11]).In the future, the impacts of water-related disasters can intensify: The number of people at risk of floods, for example, is expected to rise from currently 1.2 billion to 1.6 billion by 2050 (UN, 2020[6]).
- **Water scarcity and water stress:** Over four billion people live in areas of severe freshwater scarcity at least one month of the year (Mekonnen and Hoekstra, 2016[12]) and about 1.2 billion people live in extremely water scarce agricultural areas (FAO, 2020[5]). Figure 2 gives an overview of annual baseline water stress across the globe. By 2050, the number of people living in water stressed regions is projected to rise to 52% of the world's population (Kölbel, Strong and Noe, 2018[13]) and the number of undernourished or food-insecure people grew to more than 800 million between 2014 and 2017, partly because of climate shocks (FAO, 2018[14]). Without climate action, agricultural yields are projected to decline by up to 30% by mid of this century and an increase of food prices by 20% for billions of low-income people (Nelson et al., 2014[15]).

Figure 2. Annual baseline water stress



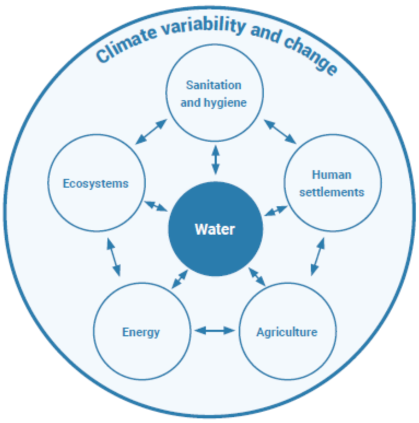
Source: WRI Aqueduct (2019), retrieved September 2021

Looking at the energy sector, water scarcity has negatively impacted energy production, in 2016, for example, the Hoover Dam's generating capacity in the USA was reduced to 30% due to drought, while water shortages caused the shutdown of 14 of the 20 largest thermal utilities in India, resulting in economic losses of USD 1.4 billion (UNESCO, UN-Water, 2020[4]). Overall, water scarcity could reduce growth rates of affected regions by as much as 6% of GDP by 2050 due to impacts in agriculture, health and incomes (FAO/World Bank Group, 2018[16]).

- **Increased competition for water resources:** Reduced water availability will further fuel competition for water resources and make trade-offs between water users increasingly difficult (e.g. allocation of water for energy production or food production during dry season) (Timboe, Pharr and Matthews, 2020[17]; Damania et al., 2017[18]). Water scarcity could lead to conflict, unrest or migration - and is projected to displace between 24 million and 700 million people in some arid and semi-arid places (UN, 2020[6]).
- **Degradation of water quality:** Higher temperatures resulting from global warming stimulate the growth of harmful algae and bacteria. Many lakes and estuaries around the globe already have toxic, food-chain altering blooms of harmful cyanobacteria, which further reduces the water bodies' ability to provide ecosystem services such as drinking water provision (Kerres et al., 2020[2]). For example, over 60% of lakes in China suffer from eutrophication and harmful algae blooms (Shao et al., 2014[19]). Water-related hazards can cause additional water pollution, e.g. floods triggering disruption of treatment facilities and the spread of waterborne diseases, sea level rise leading to saline intrusion to groundwater reservoirs in coastal areas, heavy rainfalls causing pollutant loadings or droughts increasing the concentration of pollutants (UNEP, 2016[20]; Kerres et al., 2020[2]).

These impacts showcase that climate change's impacts on water propagate through many channels, and affect a range of sectors and domains of human lives and livelihoods. Figure 3 illustrates this central role of water and its interaction between major socio-economic sectors. Water insecurity, exacerbated by climate change, poses therefore a menace; but simultaneously, investments in water security are a source of solutions to adapt to the changing climate, to build resilience for societies and systems and can contribute to the transition to a net zero future.

Figure 3. Interaction between water and other major socio-economic sectors affected by climate variability and change



Source: (UNESCO, UN-Water, 2020, p. 12[4])

Investments in water security contribute to climate action

With many of the impacts of climate change manifesting through the water cycle, investments in water security can serve as a pivotal point for climate action and provides vital opportunities to enhance resilience of systems and communities. The complexity of the climate system requires more cross-sectoral solutions and synergies - and water can be a key cross-cutting enabler to ensure inclusive and holistic mitigation and adaptation efforts and system-wide resilience (Smith et al., 2019[3]). Especially in light of significant climate and water-related uncertainty, sustainable, forward-looking water resource management is vital for a resilient future (Harou et al., 2020[21]).

The Water Dialogues (November 2020) of the Global Race to Zero campaign highlighted the central role of water to achieving a carbon neutral and resilient future, stressing the sector's high and partially untapped potential for mitigation and adaptation. The Global Race to Zero is a campaign initiated by UN Climate Champions and aims at building momentum around the shift to a decarbonised economy ahead of COP26 through a coalition of businesses, cities, regions and investors (UN, 2020[22]). COP26 will also be the first COP to host a dedicated Water & Climate Pavilion demonstrating the numerous ways that water is enabling transformative climate action.

Water security as a key lever for climate adaptation and resilience

With a large number of climate impacts being water-related, water is an essential enabler and entry point for climate adaptation[6] across sectors and systems (SIWI, 2021[23]). Investments in water demand management, reduction of water losses, reuse of treated wastewater and water storage systems are examples of water-related investments that support adaptation to climate-induced increasing water scarcity and variability (Kerres et al., 2020[2]; UNESCO, UN-Water, 2020[4]). Examples for water building the basis for adaptation and resilience in a wide range of sectors and contexts include:

- Adaptation to drought and water scarcity can be achieved through investments in water reuse and recycling, which reduces freshwater demand and thus alleviates stress on local reservoirs and allowing groundwater reservoirs to replenish – and is thus a key element to strengthen the area's resilience to water stress. The Indian city Chennai, for example, constantly facing water scarcity concerns, will be able to recycle 25% of its wastewater for industrial and indirect use by the end of 2021, thus adapting to future water pressures and increasing the city's climate resilience.
- Water-related climate risks for *cities*, such as water scarcity and urban flooding, can be addressed though investments in smart water and digital technology that help tackling leakage, effectively managing water demand and developing climate-proof water infrastructure, and thus strengthen the resilience of cities for future changes.
- For the adaptive response of the *agricultural sector*, water plays a pivotal role: The sector's resilience to droughts and water scarcity can be enhanced through water-related investments in irrigation systems and water resource management, which is also central to ensure *food security* in light of climate change. (UNESCO, UN-Water, 2020[4]).
- Water reuse and water use efficiency measures can reduce the *energy sector's* dependency on water resource availability and thus support the sector's adaptation to future hydrological conditions.
- Effective water policies and management can contribute to adaptation strategies and strengthen resilience of broader systems: Flexible water allocation regimes *across sectors*, for example, which allocate proportions instead of fixed volumes of water, depending on water needs and availability,

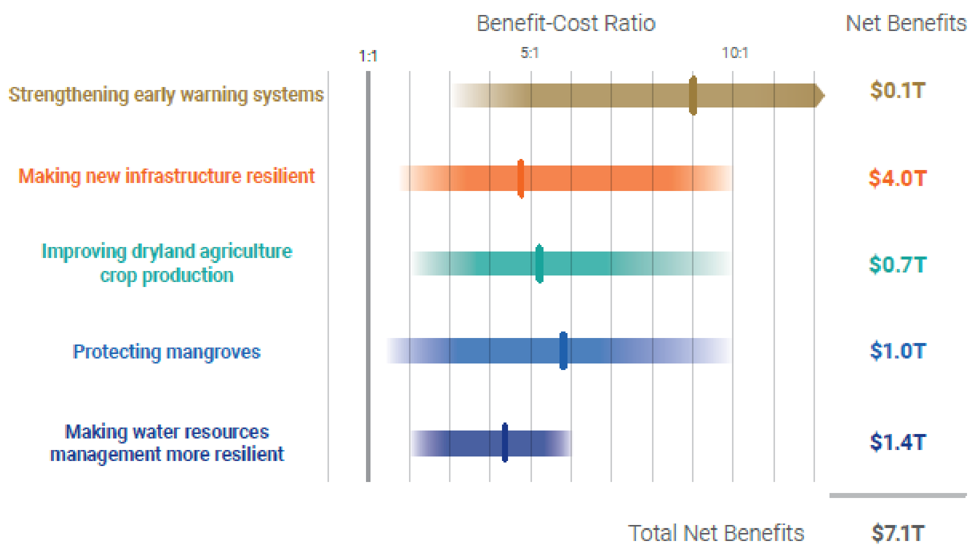
[6] Climate adaptation refers to the actions taken to manage impacts of climate change by reducing vulnerability and exposure to its harmful effects and exploiting any potential benefits (IPCC, 2018[51]).

can address climate-induced increased competition for water (OECD, 2015[24]) (Timboe, Pharr and Matthews, 2020[17]). In light of the rising water needs of both the agricultural sector and the energy sector (by nearly 60%[7]), water governance and investments are particularly relevant for the resilience of food and energy systems.

- *Flood protection* measures that factor in climate-induced increasing intensity of floods over the next decades, can strengthen adaptation and resilience to future risks. Nature-based solutions (NbS) for flood protection and water security are particularly apt to enhance resilience in light of a changing climate: NbS are flexible and adaptive systems and therefore particularly conducive to managing uncertainty related to future hydro-climatic conditions (OECD, 2020[25]; Cooper and Matthews, 2020[26]; OECD, 2013[27]).
- Securing access to water, sanitation and hygiene is a fundamental element for *health and community resilience*, in light of the current pandemic, as well as future risks of viruses and water-borne diseases, including during natural disasters (UN, 2020[22]).

Water is featured in each of the five key investment areas, identified by the Global Adaptation Commission for successful adaptation (see Figure 4). Together, those investment areas are estimated to generate USD 7.1 trillion in total net benefits, with investments in enhanced water resources resilience alone projected to generate around USD 1.4 trillion in total net benefits (Global Commission on Adaptation, 2019[28]). Through their Water Action Track, the Commission aims to accelerate and scale up climate adaptation using water and the water sector as an essential enabler for a resilient future and to mainstream water in the Nationally Determined Contributions and National Adaptation Plans towards COP26 and beyond (Global Center on Adaptation, 2021[29]).

Figure 4. Benefits and costs of five identified investment areas for adaptation



Note: This graph is meant to illustrate the broad economic case for investment in a range of adaptation approaches. The net benefits illustrate the approximate global net benefits to be gained by 2030 from an illustrative investment of $1.8 trillion in five areas. Actual returns depend on many factors, such as economic growth and demand, policy context, institutional capacities, and condition of assets. Also, these investments neither address all that may be needed within sectors (e.g. agricultural adaptation will consist of more than dryland crop production) nor include all sectors. Due to data and methodological limitations, this graph does not imply full comparability of investments across sectors or countries.
Source: Global Commission on Adaptation (2019), p. 13, based on World Water Institute

[7] Water consumption of the energy sector is expected to increase by nearly 60% by 2040 (IEA, 2016[31]).

The mitigation potential of investments in water security

Water does not only provide ample opportunity for climate change adaptation and resilience, but can play a role for climate change mitigation[8]: Water-related activities account for 10% of global greenhouse gas emissions (GHG), stemming from, among others, energy-intensive water supply and treatment processes, GHG emissions from wastewater management and discharge and the degradation and destruction of wetlands[9] (Kerres et al., 2020[2]). Additionally, most of the major water-related sectors present mitigation potentials, including hydropower projects for GHG reduction in the energy sector. Hydropower is today the largest low-carbon source of electricity, and is expected to double by 2050 (IEA, 2021[30]). Investments for mitigation in water-related sectors can often deliver additional benefits for adaptation, biodiversity, human health or cost savings, such as enhanced biodiversity, water quality and recreational space through wetland reconstruction for carbon sequestration. This section highlights mitigation potentials in the water supply and sanitation sector, as well as agriculture, forestry and land use sector, followed by a discussion on synergy effects and trade-offs arising from mitigation and adaptation efforts related to water.

Water supply and sanitation

The abstraction, distribution and treatment of water requires a significant amount of energy, thus leading to CO_2 emissions. In 2014, the water sector accounted for 4% of global electricity consumption and is projected to almost double by 2040 (IEA, 2016[31]). Water and wastewater utilities contribute 30 to 40% to a municipality's energy use (WaCCliM, 2020[32]). For example, in the UK, water companies produce almost one third of the country's industrial and waste process emissions (Water UK, 2020[33]). Increasing water use efficiency, reducing unnecessary water demand and water loss are effective measures to reduce the water sector's energy use – by potentially 15% until 2040 (IEA, 2016[31]) and thus improving the sector's carbon footprint. Such investments can further substantially reduce operational costs for water and wastewater utilities, which can reach up to 40% in developing countries (Liu et al., 2012[34]).

Wastewater, in particular, contributes to GHG emissions – and offers further mitigation options. Untreated sewage emits about 40 kg of CO_2eq per year per person and over 80% of wastewater is released to the environment without treatment (UN, 2020[6]). Investing in water treatment, especially in developing countries, hence lowers GHG emissions, and simultaneously improves water quality and indirectly human health. Further, the organic matter in wastewater and faecal sludge contains energy, which can be captured and processed into biofuels, heat and electricity. With specific treatment approaches, a plant can cover 50 to 75% of its own energy consumption (McCarty, Bae and Kim, 2011[35]). Examples of electricity and energy self-sufficient water treatment plants exist in the US and Europe (Maktabifard, Zaborowskam and Makinia, 2018[36]) and Box 1 highlights examples of mitigation action taken by water utilities.

Another significant water and energy-saving potential lies in the reuse of water from wastewater and faecal sludge treatment for purposes with less strict water quality requirements (Grant et al., 2012[37]). One example is the use of treated wastewater for irrigation, particularly as an alternative to costly long-distance transfer systems (Kerres et al., 2020[2]).

Nature-based solutions, such as constructed wetlands present another option to effectively treat wastewater with little or no additional energy inputs, especially in contexts where low technology and low

[8] Mitigation is defined as a human intervention to reduce the sources or enhance the sinks of greenhouse gases as well as other substances. (UNFCCC, n.d.[53])

[9] Kerres et al. (2020[2]) identified the following six water categories which collectively account for more than 10% of global anthropogenic GHG emissions: Energy-intensive processes for purifying, supplying and treating water and wastewater; methane and nitrous oxide emissions from wastewater and faecal sludge management and discharge; emission of GHG from surface water bodies; decomposition of organic material in reservoirs; degradation and destruction of wetlands, in particular peatlands; and different flooding regimes for rice paddy irrigation.

maintenance represent operational constraints. Deriving co-benefits are increasing biodiversity and carbon sequestration.

Agriculture, forestry and land use sector (AFOLU)

The AFOLU sector is estimated to account for 23% of total human induced GHG emissions (2007-2016 period (IPCC, 2019[38]), which have to fall significantly in order to achieve global mitigation objectives. Simultaneously, the sector offers various options to reduce and capture GHG emissions. Up to 2.07 gigatonnes of CO_2 can be saved or sequestered from agriculture and food systems through the widespread deployment of smart and efficient irrigation technologies. An estimated further 13.8 gigatonnes of CO_2 could be reduced through the application of alternate wetting and drying cycles in rice production and other measures (UN, 2020[6]).

Nature-based mitigation solutions could contribute to around one third of overall GHG mitigation efforts until 2030 to which wetlands could contribute a share of 14% (Griscom et al., 2017[39]). Wetlands and peatlands have an enormous carbon storage potential – with peatlands storing twice as much carbon as the planet's forests. Overall, 24% of the land sector's needed mitigation could come from the restoration of coastal wetlands, drained peatlands and forests which could remove up to cumulative 90 gigatones of CO_2 by 2050 (Roe et al., 2019[40]). There is growing awareness that nature-based solutions can provide significant co-benefits related to climate mitigation while simultaneously contributing to improved water management and climate adaptation. Healthy wetlands restore carbon while reducing flood risk, improving water quality, recharging groundwater, supporting fish and wildlife and providing recreational and tourism benefits (OECD, 2021[41]).

At the same time, the majority of the world's water-related ecosystems is degraded or polluted (UNESCO, UN-Water, 2020[4]) and the extent of wetlands is sharply declining (by 35% between 1970 and 2015 (Crump, 2017[42]). This trend poses the risk of releasing GHGs into the atmosphere which have been stored in wetlands for decades and centuries. Investments in wetland conservation and freshwater ecosystem protection are hence even more vital for a successful global climate change mitigation strategy.

Box 1. Mitigation action of water utilities

Water UK race to Zero

Water UK has joined the UNFCCC's Race to Zero campaign and published a Roadmap in 2020 to achieve net zero on an industry-wide basis by 2030. Reaching net zero emissions by 2030 would save 10 million tonnes of GHGs compared to the Government's legally binding net zero target by 2050. The strategy includes water and energy savings through accelerated leakage reduction, consumer good labelling and demand-side efficiency measures to reduce household water consumption, as well as the production of biogas from sewage waste treatment, the restoration of 20,000 ha of owned peatland and grassland and tree planting, as well as carbon offsetting. Required capital investments are estimated at GBP 2 - 4 billion.

WaCCliM

The Water and Wastewater Companies for Climate Mitigation initiative (WaCCliM), financed by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety supports water utilities in Mexico, Jordan, Thailand and Peru to take and measure steps towards low-carbon operations which simultaneously plan for climate risks and improve resilience of their services. As part of this project, the Peruvian utility SEDACUSCO invested 528 000 EUR by their own resources to improve operations in the anaerobic sludge digester and thus reducing sludge management and disposal costs, as well as reducing annual GHG emissions by 5,300 tons of carbon. The company considers using biogas to generate energy and thus obtain annual savings of 256 000 EUR on electricity costs while additionally avoiding 544 tons of carbon per year. A similar WaCCliM project in Jordan received additional funding from the US Agency for International Development and is exploring options to tap into green finance.

Source: (Water UK, 2020[33]; WaCCliM, n.d.[43]; WaCClim, n.d.[44]; Water UK, 2020[45])

Synergies and trade-offs between climate strategies

Mitigation and adaptation strategies can be mutually reinforcing or positively affect water resources. Wetlands, for example, can both store carbon (mitigation) and provide flood protection (adaptation); mitigation efforts promoting solar and wind power could reduce the energy's sector water demand, and reduce water withdrawals of over 25% in the US, UK, Germany and Austria (IRENA, 2015[46]).

On the other hand, climate change strategies can also compromise each other or negatively affect ecosystems or water resources. Some low carbon energy technologies, for example, can have high water needs, such as biofuels, concentrating solar power, carbon capture and nuclear power (IEA, 2020[47]). The production of biofuels requires both water and arable land, leading to trade-offs between energy security, food security and water use and thus exacerbating the water challenge (UNESCO, UN-Water, 2020[4]). Biogas production has led to drainage of wetlands, thus compromising their mitigation potential. Dams, built for hydropower, can have potential negative effects on river ecosystems and fisheries, and can "consume" water through additional evaporation and, under certain conditions, become net GHG emitters (World Bank, 2016[48]). Reforestation for mitigation can affect both nearby and distant water supplies and the expansion of flood retention areas can increase disease vectors (OECD, 2021[41]).

These examples highlight the importance of featuring water resource consideration in climate strategies across all sectors and to interconnect efforts in order to avoid negative impacts and maladaptation, and instead embrace synergies and foster co-benefits (AGWA, n.d.[49]). Box 2 presents an example of an integrated approach to promote water use efficiency in agriculture and solar energy production in India.

Box 2. Combining solar power and water use efficiency in agriculture: Solar-based irrigation in India

In Gujarat's Dhundi village, the world's first solar irrigation cooperative was created with the support of the International Water Management Institute (IWMI) and CGIAR. Solar panels near agricultural fields were installed to generate energy for lifting groundwater for irrigation. The solar pumps were installed at an elevation, such that the land underneath the panels can also be cultivated. The irrigation system strengthens farmers' resilience to water shortages and simultaneously promotes low-carbon energy production. Further, it allows increased and stable yields and income generation. Farmers can sell surplus energy to the local electricity utility under a power purchase agreement for 25 years. In order to incentivise efficient groundwater use and green energy production, IWMI offers a top-up on the feed-in tariff. After over two years of full-scale operations, the cooperative has avoided 136 tons of CO_2 emissions and gained about USD 12 500 from sale of solar power surplus.

Source: (IWMI, 2018[50])

Concluding remarks

The various examples presented in this paper highlight that water is a key enabler and entry point for effective and sustainable climate action. Investments in water security can make considerable contributions for mitigation, e.g. through water efficiency improvements or carbon sequestration in wetlands and for adaptation efforts, e.g. though sustainable water management and irrigation systems in rural areas. Embracing climate considerations in water-related project planning and investment decisions as well as placing water at the heart of climate action strategies can help yield a variety of synergies and co-benefits and is crucial to for the transition to a carbon-neutral, water secure and resilient future.

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