

CHAPTER 1

# Introduction



## 1.1 Background

**Water is at the heart of climate change.** As global temperatures rise, the effects of climate change will be felt most strongly through water; translated and intensified through the water cycle, experienced as changing seasonality and precipitation patterns, and manifest as extreme weather events such as droughts and floods (IPCC 2022a). To improve climate resilience, it is essential to address the drivers of climate change (mitigation) and to minimize the damage and exploit the benefits from climate change (adaptation). Since water is at the heart of climate change, it plays a critical role in both mitigation and adaptation. Moreover, successful mitigation and adaptation go hand in hand, and need to be carefully aligned to achieve their goals. Otherwise, mitigation measures that do not take water into account can further endanger water security and prevent mitigation or adaptation efforts from succeeding over the long term.

A strong emphasis has so far been given to the role of freshwater in climate change adaptation. However, freshwater is still an undervalued factor in climate change mitigation despite, as this report shows, its crucial role as an enabler of mitigation measures.

Means for limiting temperature rise are referred to as mitigation measures. In contrast to climate change adaptation measures, which focus on minimizing damages or exploiting benefits from actual or expected climate change, mitigation measures are aimed primarily at addressing the drivers of climate change. Mitigation includes methods to: a) prevent or enhance absorption of greenhouse gas (GHG) emissions (such as fossil fuel substitution and ecosystem protection); b) remove carbon dioxide from the atmosphere (such as ecosystem restoration); and c) mediate the Earth's energy balance without directly interfering with GHG emissions (such as temporarily reducing or offsetting warming through albedo management) (IPCC 2018). Moreover, mitigation measures vary in the degree of technology involved, and the extent to which they harness ecosystem services while simultaneously bringing multiple co-benefits for nature and human well-being. Mitigation measures may also be hybrid nature- and technology-based solutions as well as serving both adaptive and mitigating functions. Sustainable future scenarios, in which Paris Agreement targets are achieved, typically involve all types of mitigation measures.

Considering the urgency of the situation, it is necessary to make use of all available mitigation opportunities. The latest Intergovernmental Panel on Climate Change report concludes that limiting global warming to 1.5°C (above pre-industrial levels) is still possible. However, global GHG emissions must peak before 2025 at the latest, be reduced by 43 per cent below 2019 levels by 2030, by 84 per cent by 2050, and reach net zero by the early 2050s, meaning that the window of opportunity is closing rapidly (IPCC 2022b). To limit global warming to 1.5°C, it is necessary to be not only carbon smart but also water wise.

## 1.2 Closing the knowledge gap

The lack of attention paid to the connection between water and mitigation stems primarily from a knowledge gap; the interrelations between water cycles, freshwater availability, freshwater limitations, and mitigation of GHG emissions has yet to be clearly articulated and recognized. This report illustrates the urgent need to close this significant knowledge gap.

- **Mitigation does not work without water.** Most mitigation measures needed to reach climate neutrality depend on functional freshwater systems. A great majority of mitigation measures worldwide have a link to water management and water availability in many and diverse ways that must be understood, planned, and accounted for.
- **Water needs to be protected from uninformed mitigation planning.** Most mitigation measures needed to reach climate neutrality also have an impact on freshwater resources. If not planned carefully, negative impacts on freshwater resources might threaten water security, adding additional burdens on adaptation measures or, in some cases, even leading to increased emissions and hindering climate change mitigation. A strong interdependence therefore exists between climate change mitigation, water resources management, and water security.
- **The water sector can actively reduce emissions.** Sustainable water and wastewater management and healthy freshwater ecosystems hold large, untapped GHG mitigation potential and thus, water is a crucial mitigation lever in its own right.





Mammatus clouds gather over parched cropland, Macedonia. Source: Shutterstock.

To raise awareness of the urgent need to recognize the crucial role of freshwater in mitigating climate change and understand the complex interrelations, this report provides a comprehensive scientific assessment attesting to freshwater's essential role in and for climate mitigation. As such, it outlines how freshwater is not only a key component in realizing most mitigation measures, but also that freshwater management can contribute directly to reducing emissions. Reviewing mitigation measures across sectors and biomes, for instance in natural ecosystems, land systems, and energy systems, the report also aims to guide future action. It identifies high-potential water-related mitigation opportunities across the sectors and biomes where water management and wider Nature-based Solutions can contribute to reduced GHG emissions and thus address global warming. It further points out the water-related risks to be avoided in mitigation planning to prevent uninformed and therefore unsustainable GHG mitigation planning from negatively impacting water resources. Water management solutions need to be clearly integrated within broader mitigation strategies at the local, national, regional, and global levels to take advantage of the potential freshwater has to offer. As such, there is a strong argument to make use of substantial co-benefits through integrated approaches, which include climate change mitigation in water resource management, and vice versa. Overall, the report presents both guard rails and leverage points for accelerating water-wise mitigation action and making headway on embedding freshwater perspectives within climate mitigation governance and management.

### 1.3 Structure of the report

Recognizing the strong interdependence between water and climate mitigation, and the existing knowledge gap, this report provides a comprehensive review of how climate mitigation measures depend substantially on or impact freshwater, and which water and wastewater solutions can contribute to climate change mitigation (Figure 1.1). It is organized in three parts:

- **Part I** provides the background and context within which the report operates. It starts by offering a synthesis of the bio-geophysical processes governing the role of freshwater in climate mitigation, and the human-nature system drivers of climate and water use change (Chapter 2). It then sets out an overview of the governance

context of water-related management and climate mitigation measures (Chapter 3).

- **Part II** maps the climate mitigation potential and the associated possibilities and challenges in different biomes and sectors. Specifically, it examines drinking water and sanitation services (Chapter 4), freshwater ecosystems (Chapter 5), land systems (Chapter 6), and energy systems (Chapter 7). Through this analysis, Part II provides an overview of water-related climate change mitigation measures. This includes assessment of synergies and trade-offs between mitigation measures in relation to adaptation measures and other important benefits for human well-being and healthy ecosystems, including provision of food and water; water quality improvement; disaster risk reduction; habitat protection; sediment retention and nutrient cycling; and economic, cultural, and recreational benefits. Thereby, the chapters provide a comprehensive foundation to support in-depth, sector-specific characterization of the role of water in climate mitigation and taking water-informed mitigation action.
- **Part III** builds on the findings presented in Parts I and II, and points to the importance of taking a systems-wide perspective to fully address the complex interrelation between water and mitigation. It identifies risks and win-wins at the intersection between water and climate mitigation (Chapter 8), offers guidance for action to achieve water-wise climate mitigation (Chapter 9) and provides concluding remarks (Chapter 10). Part III explains how identified risks and opportunities can help address multiple challenges as well as the value added to climate mitigation potential by water-wise holistic management through integrated approaches.

### 1.4 Call to action: Guidance on how to achieve water-informed mitigation action

This report provides useful guidance for decision-makers and practitioners in both public and private sectors as well as climate funding institutions. It underscores the necessity of water-wise policies and climate mitigation measures, and provides guidance on how to achieve



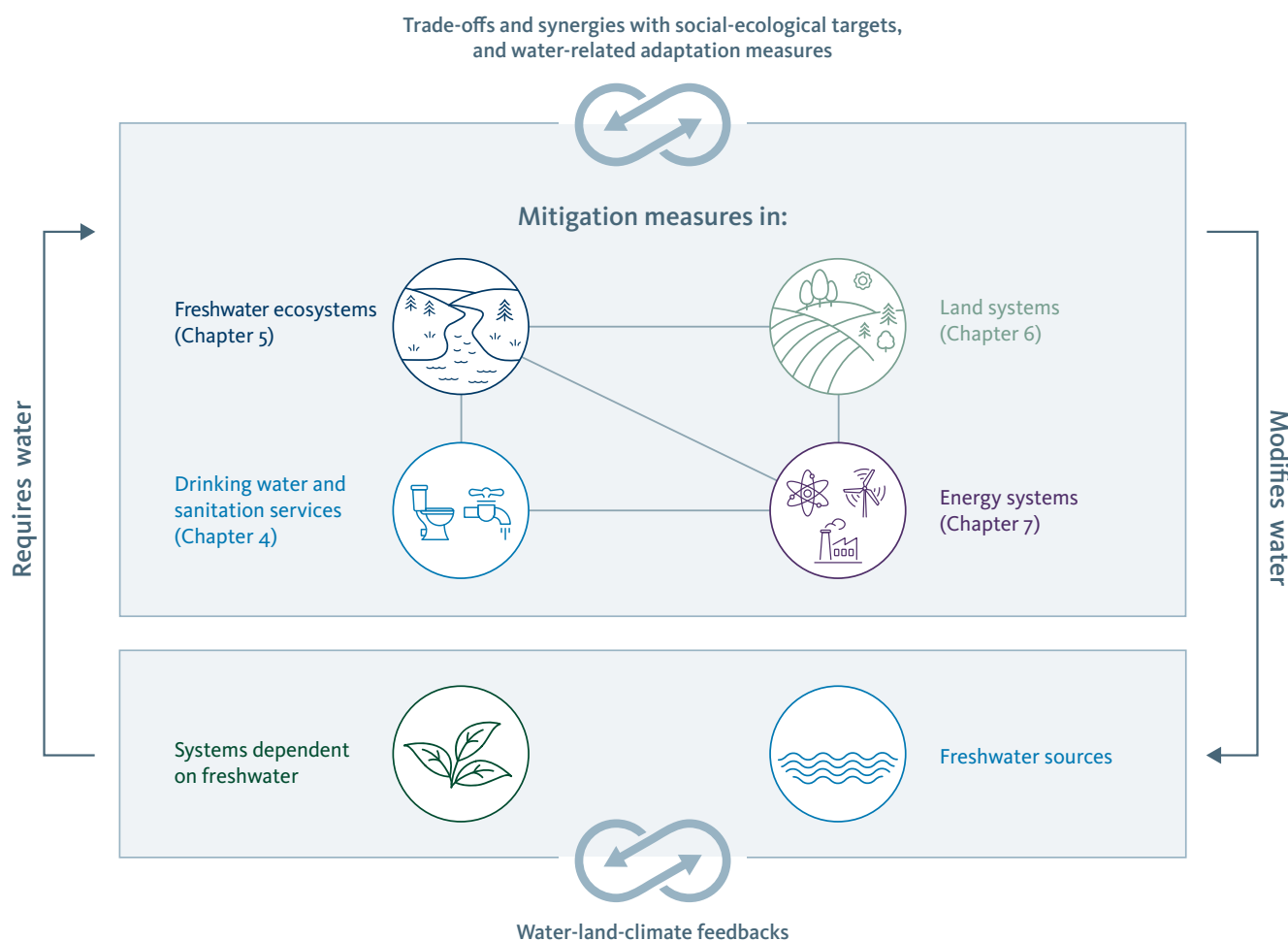


Figure 1.1. This report reviews climate mitigation measures that require and modify freshwater sources and freshwater-dependent ecological and social-ecological systems. Water-land-climate feedbacks mediate those relationships, and multiple freshwater-related synergies and trade-offs exist between climate mitigation and adaptation measures. Source: SIWI.

this integration. It also addresses the climate-, water-, energy-, and land-related communities, providing a solid knowledge base that can be used to build capacity around how water-related activities in these sectors and biomes can contribute further to climate mitigation. This is particularly important as freshwater has the potential to be an enabler of integrated action. However, as demonstrated by this report, there are still substantial data and knowledge gaps in the ways in which water and climate mitigation are linked. The report is therefore also a call to the research community to build a more comprehensive evidence base around these topics.

Finally, the report calls out to funding institutions across the public and private spheres. Making a clear case for the pivotal role of freshwater in mitigating climate change emissions, it is evident that additional water-wise investments will be needed to implement the required measures.

At its core, the report shows that the only way forward is to work together across sectors and institutions to jointly and coherently enhance collaboration and achieve greater impact by acknowledging the role of freshwater as a precondition and leverage point for successful climate mitigation action.

## 1.5 References

IPCC. (2018) *An IPCC Special Report on the Impacts of Global Warming of 1.5 °C Above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways*. Masson-Delmotte, V., Zhai, P., Pörtner, H-O. et al. (eds) Cambridge University Press: Cambridge, UK and New York, NY, USA

———. (2022a) Summary for Policymakers. In *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Pörtner, H-O., Roberts, D. C., Tignor, M. et al. (eds) Cambridge University Press: Cambridge, UK and New York, NY, USA

———. (2022b) *Climate Change 2022: Mitigation of Climate Change*. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Shukla, P. R., Skea, J., Slade, R., et al. (eds) Cambridge University Press: Cambridge, UK and New York, NY, USA