CHAPTER 9

Achieving climate mitigation through integrated and cross-sectoral approaches

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Water being released from a reservoir spillway gate. Source: Shutterstock.

Highlights

- Integrated approaches address the interconnections between water and climate change mitigation, and are therefore required to achieve water-smart climate mitigation. Integrated approaches draw on systems thinking and, unlike siloed approaches, recognize the systemic and connected nature of climate and water. As such, they assess and address trade-offs and identify synergies.
- Integrated approaches include, amongst others, integrated water resources management (IWRM), the water-energy-food (WEF) nexus approach, source-to-sea (S2S), the landscape approach, and integrated urban water management (IUWM). Successfully delivering integrated approaches requires acknowledgement of the complexities across different geographical and management levels, temporal scales, and contexts.
- Governance systems need to be strengthened to deliver water-smart climate mitigation through integrated approaches. Enabling conditions include building transparency and data-based decision-making, strengthening capacity through inclusive knowledge systems, innovating finance, and enhancing governance across sectors and levels.

9.1 Introduction

We live in an interconnected world. As Chapter 8 makes clear, issues do not exist in isolation, but are intrinsically linked together in a complex system of interdependencies (Tengberg and Valencia 2018; Ostrom 2009; Folke 2006). This is particularly true regarding climate and water; to limit global warming to 1.5°C (above pre-industrial levels), it is necessary to be not only carbon smart but also water wise, as the second part of this report attests to. Water must therefore be mainstreamed into climate mitigation efforts, including the governance processes supporting mitigation pathways (Nielsen et al. 2020).

This chapter examines the pathways towards how this can be achieved. It outlines several integrated approaches that can be used as methods to achieve water-wise climate mitigation (section 9.2). Further, it analyses factors that need to be taken into consideration when implementing such approaches (section 9.3.). Finally, it assesses the enabling governance conditions required to implement integrated approaches and provides guidance on the policy implications for successful implementation of climate change mitigation measures (section 9.4.).

9.2 Implementing climate mitigation measures through integrated and cross-sectoral approaches

Integrated approaches are required to achieve water-smart climate mitigation. As noted in Chapter 8, siloed approaches fail to recognize the systemic and connected nature of climate and water. As such, they are unable to assess and address risks from a holistic perspective, which further implies missed opportunities to identify synergies. Embedded in this more holistic perspective is a recognition of the need to involve multiple stakeholders and engage in participatory processes as these are key pathways towards breaking through traditional silos. As pointed out in Chapter 2, natural systems are not limited by administrative borders. As a result, water-smart climate mitigation will be strengthened through cross-sectoral and cross-border collaboration. Here, 'cross-sectoral' is understood to encompass collaboration across different public departmental responsibilities (e.g., water, land, energy, agriculture, environment, etc.), but also collaboration between different societal sectors (state, civil society, and economy). While governments remain accountable for driving and legislating action in both climate and water, the process of change is always co-produced (UN-Water 2020).

Different integrated approaches will be suitable depending on the issue and the context. This chapter provides an overview of some of these approaches, including IWRM, the WEF nexus approach, S2S, the landscape approach, and IUWM, each exemplified through case studies. The approaches are discussed in this order as, to some extent, it reflects a historical evolution with some approaches building upon others. While not an exhaustive list, the combined approaches demonstrate the strength of managing climate and water in an integrated manner and provide practical pathways to achieve water-smart climate mitigation.

Meandering river, north Australia. Source: Shutterstock.

9.2.1 Integrated water resources management

Box 9.1. How can IRWM contribute to implementing climate change mitigation measures?

- **An approach to understand and plan for the relationship between natural and social systems.** The IWRM approach emphasizes that our natural environment is affected by the social systems that govern them. Drawing on this method can reveal how political structures can alter natural systems, including those critical to climate change mitigation.
- **A model to unveil interconnections between watershed health and other natural systems.** The IWRM approach does not explicitly address climate change mitigation. However, national IWRM plans are often linked to other interventions such as conservation of ecosystems and biodiversity, or development of water infrastructure. These provide entry points to implement climate change mitigation measures.
- **A pathway to design participatory governing structures**. IWRM as a method advocates for the inclusion of a wide range of stakeholders, including gender considerations, in governing processes. Following this method helps to mobilize communities and generate action for climate change mitigation.

IWRM started to gain traction around the time of the 1977 United Nations Water Conference in Mar del Plata (Schoeman et al. 2014). While also mentioned at the Copenhagen Preparatory Conference on Water Resources Management in 1991 and the Rio Conference in 1992, it was the Dublin Conference on Water and Development in 1992 that firmly institutionalized the approach through the adoption of the Dublin Principles (Turton et al. 2007). The Dublin Principles state that: a) water is a vulnerable, finite resource; b) water management and development should include stakeholders; c) water is an economic good; and d) women play a central role in the management and conservation of water. Based on the Dublin Principles, the Global Water Partnership (GWP), which was established in 1996, defines IWRM as "a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP 2000). The Dublin Principles still provide the conceptual basis for IWRM and lie at the centre of this approach.

IWRM advocates integration of the natural system with the social system. The rationale is that the former determines the availability and quality of natural resources, and the latter shapes the use and allocation of natural resources (Jønch-Clausen and Fugl 2001). Well aligned with the broader trends of shifting decision-making from only governments to governance, IWRM calls for the inclusion of a wide range of stakeholders in governing processes (Varis et al. 2014), as well as gender mainstreaming (UN-Water 2020) (Box 9.2).

Box 9.2. IWRM in practice: The case of West Africa

A case study from West Africa serves to illustrate the value of IWRM in practice, as well as its challenges in a development context. While IWRM plans do not explicitly address climate mitigation, most examples to date include components related to the conservation of ecosystems and biodiversity, considered important for the hydrological functioning of watersheds and river basins. Considering the strong links between land management and climate mitigation, IWRM plans also provide an entry point for linking IWRM with climate change mitigation.

The project Improving Water Management and Governance in African Countries through Support in Development and Implementation of IWRM Plans was approved in 2007. It was implemented by the United Nations Environment Programme-Danish Hydraulic Institute Centre for Water and Environment in partnership with national institutions in charge of water resources in the participating countries, the Economic Community of West African States and its Water Resources Coordination Centre, and the Global Water Partnership in West Africa. It was funded by the European Commission. It focused on assisting seven West African countries with strengthening their IWRM processes to reach targets set out in the Johannesburg Plan of Implementation. The project succeeded in developing four IWRM roadmaps (for the Gambia, Guinea, Guinea Bissau, and Sierra Leone), and three IWRM plans (for Côte d'Ivoire, Liberia, and Togo).

Several lessons can be drawn from the project by comparing the progress in implementing IWRM in each country:

- **The strength of existing institutional structures matters** in terms of being prepared to implement IWRM processes. While most countries in the project mainstreamed IWRM into their socio-economic development frameworks, preparedness and readiness varied among the countries, with Guinea and Guinea Bissau being the least ready and prepared for the IWRM process.
- **It is important to gain high-level political support** to move the IWRM process forward. This is illustrated by the progress made in Togo where the Poverty Reduction Strategy Paper identified water and sanitation issues as among the main causes of extreme poverty, which led to the designation of IWRM as a national priority. As a result, Togo made considerable progress with policy and legal reforms in support of IWRM. IWRM also enjoyed high-level political support in Liberia, where there was considerable progress in mobilizing and identifying funding to implement the IWRM plan. This lesson also emphasizes the need for continuous awareness raising among policy- and decision-makers of the benefits of IWRM to avoid losing momentum in connection with elections, or changes in political leadership.
- **Working through partnerships** that involve institutions from global, regional, and national levels (as in this context) is a productive way to reach IWRM targets since it enables the provision of combined technical and policy support to countries.
- **Linking IWRM to practical interventions**, such as conservation of ecosystems and biodiversity, or development of water infrastructure, more resources can be mobilized for the IWRM process. For example, in Côte d'Ivoire, IWRM was linked with hydrological infrastructure development, which led to the mobilization of additional funding including from the private sector (Tengberg 2012). Making these connections also provides an entry point for linking IWRM with climate change mitigation.

9.2.2 The water-energy-food nexus approach

Box 9.3. How can the WEF nexus approach contribute to implementing climate change mitigation measures?

- **An approach to address mitigation beyond the water sector.** The WEF nexus provides an approach to addressing mitigation beyond the water sector by taking into account synergies and trade-offs between sectors, and creating strong links between mitigation and adaptation by boosting the efficient use of resources.
- **A starting point to assess water, energy, and food jointly.** As climate mitigation measures impact freshwater, this approach provides a starting point from which the interdependence of water, energy, and food can be jointly assessed. Addressing the management of these resources simultaneously incentivizes an increase in energy efficiency in the water and agriculture sectors, reduction of the water footprint in the energy and agriculture sectors, and a reduction in the carbon footprint of the water and agriculture sectors.
- **An opportunity to make irrigation systems climate smart.** The nexus approach offers opportunities to prevent further greenhouse gas (GHG) emissions and reduce the carbon footprint of irrigation systems. This includes, for example, the use of solar pumps for irrigation or the implementation of circular models (e.g., water reuse), which help reduce water and energy consumption and strengthen the use of renewable energies.

The impacts of climate change that are manifest in water go beyond the so-called water sector to affect food security, energy consumption, and conflict over resources (GIZ et al. 2020). The WEF nexus was developed to support a more balanced approach to the various interests among sectors (Schmidt and Matthews 2018; Pahl-Wostl 2015; Hoff 2011). The WEF nexus approach seeks to consider the food, energy, and water sectors as an interrelated system (UNSGAB 2014). It thereby acknowledges that access to secure supplies in one sector has an impact on the security of supply in another. Thus, there is a need for a multi-sector approach at the systemic level to optimize supply and demand between water, energy, and food. The approach considers the totality of the available resources for food, energy, and water security and plans holistically how they can most efficiently serve human and conservation needs under a changing climate (GIZ et al. 2020). The approach started to gain traction in international discussions through the activities of the World Economic Forum Water Initiative, laying the conceptual groundwork for the WEF nexus approach (WEF 2009; 2011). It gained further momentum during the 2011 Bonn Conference, and fed into Rio+20 in 2012. The nexus lens identifies advantages concerning food security, and climate mitigation and adaptation, as well responding to possible risks such as groundwater overuse by water and climate projects by considering a holistic understanding of the interplay between sectors (Liu et al. 2018) (Box 9.4).

Solar powered irrigation system. Source: Shutterstock.

Box 9.4. WEF nexus in practice: National coordination of the users of the natural resources of the Niger basin

To contribute to climate change mitigation and support sustainable livelihoods in rural areas, the project National Coordination of the Users of the Natural Resources of the Niger basin in Niger', funded through Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the European Union and the German Federal Ministry for Economic Cooperation and Development (BMZ), financed a WEF security nexus pilot project. This initiative was launched in a village of 1000 inhabitants located in the Kollo department of Tillaberi region. The village faces a range of challenges, with one of the most severe being a lack of access to water. Therefore, the project supported a female cooperative of 180 women, who manage 2 hectares of land for crop cultivation. However, successful crop cultivation has been hindered due to water scarcity and uncertainty impacting the irrigation of the land particularly during the dry season.

Therefore, following a participatory approach working closely with the female cooperative, the nexus project focused on providing an irrigation system. This includes the implementation of solar pumping as well as capacity-building to enable the sustainable use of the system. Four boreholes equipped with four solar pumps, a Californian grid, and four solar fields with a total of 22 solar panels, three generators and four tanks were installed as part of a hybrid system. The solar panels are used to pump and fill the tanks using solar energy (or the generator) to pump water from the borehole to the storage tank. The water in the storage tank is released for irrigation by gravity with pressure depending on the height difference between the tank and the irrigated area. In case of poor solar energy coverage, generators can take over. This approach promotes clean energy and the sustainable use of water resources to enhance food security and mitigate resource-related conflicts through an increase in agricultural production and improved market access.

Several lessons can be drawn from the project:

- **Irrigation through solar pumps offers significant mitigation potential**. A significant amount of energy (and depending on the source of energy, carbon emissions) is needed to abstract, supply, and treat water (GIZ et al. 2020). Concerning agricultural activities, an increasing demand for irrigation caused by the need for higher food production and climate change leading to diminishing supplies of freshwater can be observed. However, in many rural regions grid electricity is not accessible or available only sporadically. Diesel and electricity costs and unreliable services therefore drastically impact farmers' irrigation capacity. Solar water pumping offers an alternative solution that contributes to climate mitigation efforts (FAO and GIZ 2018). Solar pumps do not emit GHGs and therefore contribute directly to reducing the carbon footprint of irrigation.
- **Consideration of possible risks of groundwater extraction and capacity-building are key.** Particularly in water-scarce areas and areas in which erratic rainfall patterns caused by climate change will intensify dry periods, mobilizing groundwater resources through solar pumps not only contributes to mitigation measures but also enables climate change adaptation. The nexus approach highlights the need to analyse the interplay of sectors and consider potential negative effects. When dealing with solar pumps it becomes essential to consider the danger of over pumping. The hybrid pumps will operate with low marginal costs as solar powered devices do not bear cost per unit of power once they have been installed since they are powered by the sun. The lack of financial incentives to save energy for pumping might support unsustainable water management, including wasteful water use and over pumping of groundwater resources (FAO and GIZ 2018). That is why sustainable extraction of water and maintaining the health of the aquifer is of central importance to the sustainability of the project. Various measures have been implemented to ensure that only the necessary water is pumped without causing a negative impact on the water table. Next to sensitizing the users is the coordination and strengthening of the local water authorities, which are responsible for groundwater monitoring in the region. Only their approval followed by regular field visits can assure sustainable resource use. In collaboration with the authorities, the project identifies possibilities to improve groundwater monitoring, through control wells for instance. Capacity-building is a strong focus of the project. Specifically, the project contributes to building the capacity of beneficiaries in innovative concepts for the rational use of water and energy resources, and provides agricultural inputs to increase production. Capacity-building includes training on the nexus approach, raising awareness of rational and sustainable management of water

Box 9.4. Cont.

resources, saving water and energy resources through innovative cultivation techniques, and environmental protection.

- **WEF nexus approach enables wider impact addressing regional risks and opportunities.** The WEF nexus approach goes beyond climate mitigation and adaptation measures within the water sector to promote a holistic concept to face challenges in the regional context. The case study considers women to be at the centre of economic and social recovery in this region, which is affected by terrorist violence and climate risks. This project promotes clean energy and the sustainable use of water resources to enhance food security through an increase in agricultural production and improved market access by providing training on value chain activities. Once accomplished successfully, the experiences will inform activities further afield.

9.2.3 The source-to-sea approach

Box 9.5. How can the S2S approach contribute to implementing climate change mitigation measures?

- **An approach to assess upstream and downstream relationships and implications for resource management**. The S2S approach facilitates complete evaluation of trade-offs and enables identification of co-benefits of mitigation measures across the system. For climate mitigation, such an approach is highly relevant when considering mitigation actions because the flows on which the approach focuses can be altered by climate change but can also affect it.
- **A model for governing across sectors**. The S2S approach was created as a response to traditional governance frameworks that are often structured around individual segments of a system and/or focused on one sector. To achieve climate mitigation, it will be necessary to move beyond sectoral approaches and S2S can provide a model for achieving this in practice.

The S2S approach aims to provide a holistic alternative that features the complex relationships within a source-to-sea system and addresses the need for coordination to confront the upstream and downstream implications of resource management, an aspect critical to consider in relation to both climate mitigation and adaptation. A source-to-sea system or continuum is the land area that is drained by a river system, its lakes and tributaries (the river basin), connected aquifers, and downstream recipients, including deltas and estuaries, coastlines and near-shore waters, the adjoining sea and continental shelf, as well as the open ocean (Granit et al. 2017). The linkages that are important to consider as part of climate mitigation can be described as six key flows: water, biota, sediment, pollutants, materials, and ecosystem services (Granit et al. 2017). This broad perspective is important for climate mitigation because it allows a more complete evaluation of trade-offs and enables identification of co-benefits of mitigation measures across the system (Pharr et al. 2019). Additionally, it is highly relevant when considering mitigation actions because the flows on which the approach focuses can be altered by climate change but can also affect it. Climate actions such as building reservoirs and dams affect sediment flows to the sea; this contributes to the erosion of riverbeds and coasts and the starvation of deltas downstream. These impacts combined with sea-level rise can have serious consequences on the flows and the system. However, the flows can have an impact on climate change as the carbon sequestration potential of the ocean is affected if the water quantity that reaches the ocean is greatly reduced or if it is highly polluted.

The S2S approach addresses the links throughout the system and provides a structured process for the design, planning, implementation, and evaluation of projects and programmes with the goal of supporting source-to-sea management (Mathews et al. 2019). The approach was created as a response to traditional governance frameworks that are often structured around individual segments of a system and/or focused on one sector. This can result in benefits for one sector, or in one source-to-sea segment, with negative consequences on other sectors, often making traditional governance frameworks poorly suited for managing the source-to-sea system as a whole.

The approach includes six steps (Figure 9.1), through which linkages between source-to-sea segments and sectors are considered to identify and prioritize issues to be addressed across the system (Box 9.6). The approach begins by understanding the pressures and drivers of altered key flows (Mathews et al. 2019). This, in combination with selecting an appropriate scale of intervention, engagement of stakeholders (both upstream and downstream), and a thorough understanding of the governance context sets the basis for defining a theory of change to guide planning of the intervention and implementation. Monitoring and adaptive management is used to refine the theory of change and ensure continuous improvement toward long-term outcomes. Increased collaboration and coherence among stakeholders across the source-to-sea system is critical to manage key flows that connect land, freshwater, coasts, and oceans, and to avoid jeopardizing mitigation targets and other negative impacts. The importance of confronting fragmented governance across sectors and jurisdictions when implementing climate actions in the ocean and cryosphere was highlighted by the 2019 Intergovernmental Panel on Climate Change (IPCC) Special Report on the Ocean and Cryosphere (IPCC 2019).

The S2S approach in practice: Examples from different geographies

The S2S approach is starting to be implemented around the world, for example in Brazil (IUCN 2021), Central America (GEF 2018), Southern Africa (ORASECOM 2021), and Ethiopia and Vietnam (Groeneweg Thakar and Mathews 2020). For example, GIZ, the Stockholm International Water Institute (SIWI), and International Union for Conservation of Nature are working with local stakeholders to implement the approach to address the problem of sediment and plastic waste leakage from river basins to recipient waters in Hawassa, Ethiopia and Hoi An, Vietnam. The activities were initiated in 2019 and, while not targeting climate mitigation specifically, they provide valuable lessons that are also applicable to mitigation efforts. Specifically, activities include efforts to improve coordination among local stakeholders from source to sea and increase commitments for collective action to identify and address downstream impacts from activities in the basin. A key feature of the approach is to bring together different sectors and stakeholders across a geographical area that is not always consistent with administrative jurisdictions (e.g., national or municipal borders).

Several lessons can be drawn from the project:

- **It is critical to bring together different sectors and stakeholders across a geographical area.** This is also where the most effort is needed in early stages of application.
- **The approach has proven valuable in terms of building on local knowledge** through its participatory focus. The development of a baseline analysis of the key governance instruments and institutions influencing decisions on the source-to-sea flow in question has been able to quickly convey areas where enhanced collaboration is needed.
- **The flexibility of the approach has also proven valuable.** It can be applied easily to different contexts; for example, a river basin and downstream coastal and marine areas, or an endorheic (closed) system in a landlocked country.
- **Applying the S2S approach requires local commitment**, adequate funding, and time to engage key stakeholders in a defined geographical area and to carry out all stages of the process.. Experiences in applying the approach are analysed in workshops, studies, research papers, and webinars facilitated by the Action Platform for Source-to-Sea Management (S2S Platform, 2022).

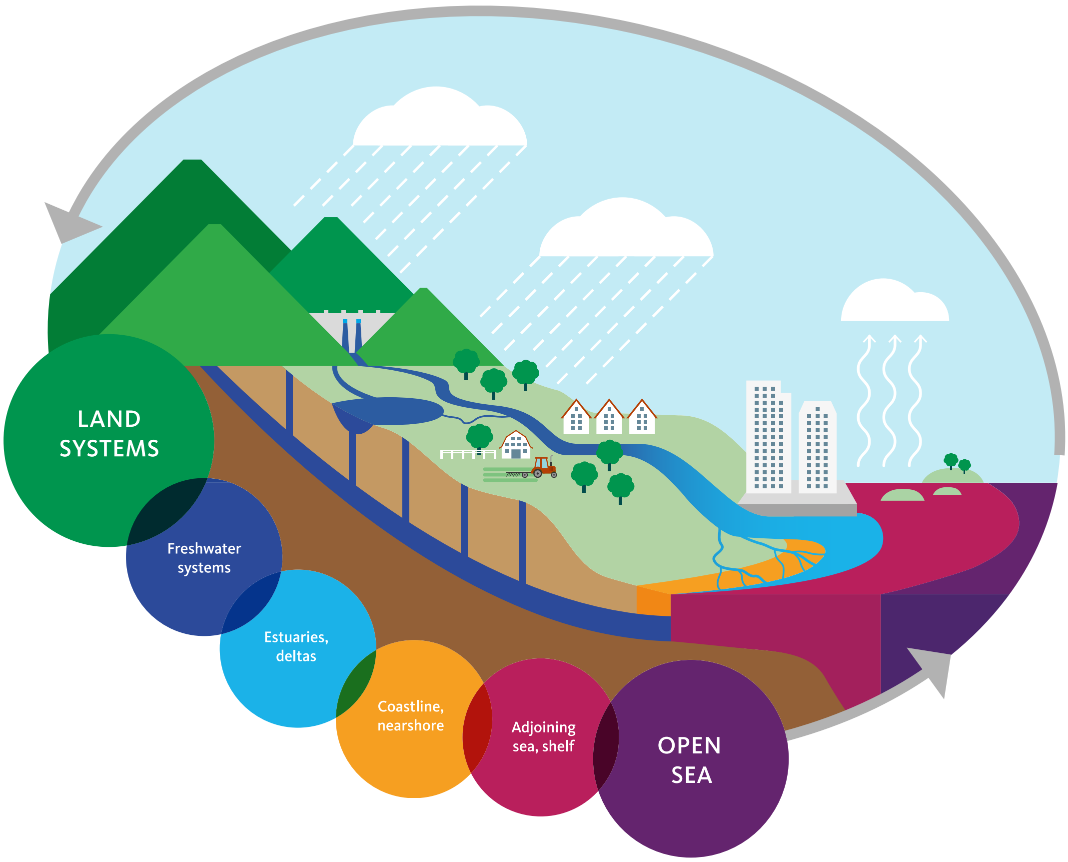

Figure 9.1. The six steps of the source-to-sea across the land-freshwater-marine continuum. Source: The Action Platform for Source-to-Sea Management.

9.2.4 The landscape approach

Box 9.7. How can the landscape approach contribute to implementing climate change mitigation measures?

- **An approach to understand system interactions.** A landscape will hold potential to implement a range of mitigation measures within the boundaries of that landscape, with some options implying trade-offs and others win-wins for climate mitigation and wider landscape health, including freshwater systems. Following the landscape approach will provide a pathway to assess these synergies and trade-offs within the system.
- **A model to adapt management to different contexts.** The delineation of what constitutes a landscape will differ depending on common problem entry point. The landscape approach can thus provide a model for adapting management to different scales and contexts.
- **A pathway for stakeholder interaction**. The landscape approach provides a pathway for dialogue and discussion among multiple stakeholders regarding trade-offs within a landscape to mobilize better land use and water resource outcomes, as well as maximizing climate mitigation potential.

Applying the landscape approach is considered particularly useful when integrated solutions are required to solve complex challenges related to sustainable development (Box 9.8). Reed et al. (2016) defined the landscape approach as a framework to integrate policy and practice for multiple land uses within a given area, to ensure equitable and sustainable use of land while strengthening measures to mitigate and adapt to climate change. Landscape approaches can be a mechanism for dialogue and discussion among multiple stakeholders regarding trade-offs to mobilize better land use and water resource outcomes. The 10 principles for a landscape approach adopted by the Convention on Biological Diversity to reconcile agriculture, conservation, and other competing land uses are: a) continual learning and adaptive management; b) common concern entry point; c) multiple scales; d) multifunctionality; e) multiple stakeholders; f) negotiated and transparent change logic; g) clarification of rights and responsibilities; h) participatory and user-friendly monitoring; i) resilience; and j) strengthened stakeholder capacity (Sayer et al. 2013).

Despite ambitious attempts to implement the landscape approach, many have failed to be truly holistic and cross-sectoral, and incorporate a multi-stakeholder perspective, and they have not been informed by local knowledge and livelihood priorities in the framing of sustainability and actions (Zanzanaini et al. 2017; Kusters et al. 2018). One of the challenges of the landscape approach is that it is based on the principle of a menu, and so does not present a framework for testing theories and relationships. Moreover, given the range of principles, most forms of environmental governance could be classified as a landscape approach (Erbaugh and Agrawal 2017), which gives rise to many interpretations and definitions. Long-term studies of forest Landscape Restoration (FLR) highlighted the importance of a conducive enabling environment, including tenure and ownership; clear rules and regulations; participation, education and capacity-building; integration of science and practice; and a dynamic private sector (Eriksson et al. 2018).

However, integration of water and understanding of hydrological processes in landscapes need to be further strengthened in FLR, because addressing water management is often a key entry point to the restoration of degraded lands, and mitigation actions in the land use, land-use change, and forestry(LULUCF) sector, while contributing to improved landscape resilience and livelihoods (Tengberg et al. 2021).

Box 9.8. The landscapes approach in practice: Strengthening water and landscape governance in Ethiopia

The SIWI-Swedish International Development Cooperation Agency project Strengthening Water and Landscape Governance in Ethiopia attempts to demonstrate how to integrate water resources in FLR by linking Ethiopia's new IWRM policy and implementation plan to the landscape approach. The key in this regard is to recognize and assess all relevant ecosystem services provided by river basins and their landscapes, and link participatory land-use planning that supports FLR to basin and sub-basin planning in maintaining the provision of critical ecosystem services, such as the provision of food, energy, and freshwater; the regulation of hydrological flows; the carbon and nutrient cycles; and cultural services, such as recreation and tourism (Tengberg et al. 2020). This approach is being demonstrated in the Ethiopia Central Rift Valley Lakes Basin and its four sub-basins of endorheic lakes.

Key lessons from Ethiopia include:

- The long-term changes in land use and land cover observed in the Ethiopian Central Rift Valley are the leading contributors to the decline and loss of ecosystem services (Mekuria et al. 2021a). This suggests that addressing the decline in forest cover and waterbodies, the major observed changes, plays a vital role in improving ecosystem services that can in turn contribute to climate change mitigation through carbon storage and sequestration.
- Identifying actions to address catchment and landscape degradation should be embedded in an understanding of the broader governance system (Mekuria et al. 2021b), and landscape stakeholders should be empowered first and foremost to organize themselves towards the planning and implementation of landscape restoration measures.

9.2.5 Integrated urban water management

Box 9.9. How can the IUWM approach contribute to implementing climate change mitigation measures?

- **IUWM addresses cities as a key action field for climate mitigation.** Due to population growth and an increasing global share of emissions that can be attributed to urban areas, cities have become a key action field for climate mitigation. IUWM approaches are crucial to addressing arising challenges in the urban water sector while realizing its mitigation potential. Mitigation and adaptation potential need to be considered in all components of the urban water cycle, from water supply to wastewater treatment and reuse.
- **A model to make urban water more energy efficient.** The management of water and wastewater often requires energy-intensive processes. Depending on the energy source (e.g., fossil fuel) this leads to high GHG emissions. Reducing energy use of urban water and wastewater systems involves reducing energy requirements for water supply, purification, distribution, and drainage as well as wastewater collection, treatment, and disposal. Practical approaches to implementation include improving operational efficiency and adopting energy efficiency measures as well as updating pumping equipment.
- **An approach to make urban water sector emissions more tangible.** The United Nations Framework Convention on Climate Change requires all parties to submit national GHG inventories, which must include emissions, removals, and sinks. The urban water sector must measure and report its emissions as part of the national inventories in a comprehensive and transparent way.
- **A model to use circular approaches and reduce GHG emissions.** Urban wastewater management offers potential to reduce GHG emissions, e.g., through the production of biogas and its use for producing electricity. Sustainable sludge management can make an important contribution to national climate change mitigation efforts and GHG emissions resulting from biodegradation. It provides great potential to implement circular approaches that provide co-benefits in economic terms; for example, technology-based upcycling solutions like pelletizing or pyrolysis allow for the valorization of treated sludge as an alternative energy carrier/industrial fuel, industrial raw material, or compost additive.

Today, 55 per cent of the world's population lives in urban areas, a proportion that is expected to increase to 68 per cent by 2050 with 90 per cent of this increase primarily in Africa and Asia (UN-DESA 2018). Unsustainable urban growth often results in deteriorating livelihoods, increasing emissions, and environmental degradation. Urbanization also increases pressure on the urban water sector to cater for growing demands for drinking water with competing interests from the agricultural and industrial sectors (WWF 2019). At the same time, urban water and wastewater management hold large, untapped GHG mitigation potential as estimates suggest that cities are responsible for around 70 per cent of global carbon dioxide (CO_2) emissions, with transport and buildings being among the largest contributors (Rosenzweig et al. 2018). Urban water-related GHG emissions are predominantly associated with energy-intensive processes of water utilities for purifying, supplying, and treating water and wastewater as well as emissions from wastewater and faecal sludge management and discharge (GIZ et al. 2020). IUWM approaches are crucial to addressing arising challenges in the urban water sector while realizing its mitigation potential (Box 9.10). Mitigation and adaptation potential need to be considered in all components of the urban water cycle, from water supply to wastewater and reuse, as the following two examples on energy efficiency of water utilities and the sustainable management of faecal sludge show (Box 9.11).

Box 9.10. IUWM in practice: Reducing GHG emissions from urban water and wastewater management

To enable the management of water and wastewater, companies require processes with a high energy demand. Depending on the energy source used, this might lead to high GHG emissions. In addition, wastewater treatment can generate emissions of methane and nitrous oxide, which have a much stronger detrimental effect on the climate than CO_2. In many cases, energy and nutrients could be recovered from wastewater by using advanced treatment technology (GIZ et al. 2020).

The Water and Wastewater Companies for Climate Mitigation (WaCCliM) project is a joint initiative between GIZ and the International Water Association. It is part of the International Climate Initiative financed by the German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection. The project aims to understand water flowing into, within, and out of the world's cities to create a bridge between Nationally Determined Contribution (NDC) and Sustainable Development Goal commitments (GIZ et al. 2020). WaCCliM works with a variety of actors, including the international water and climate community, national governments, and water and wastewater utilities in Jordan, Mexico, and Peru. In addition to measuring, reporting, and reducing GHG emissions, the project's objective is to increase the utilities' climate resilience, while improving their services and reducing operational costs.

Taking a closer look at WaCCliM's partner countries, water and wastewater utilities are moving towards sustainable IUWM by improving operational efficiency and adopting energy efficiency measures. In the wastewater utility of San Francisco del Rincón, Mexico, more than 4,000 tons of CO_2 equivalent per year have been prevented from being released into the atmosphere by increasing wastewater treatment coverage and improving wastewater treatment processes. In the Jordanian city of Madaba, the Miyahuna water and wastewater utility has managed to reduce carbon emissions by around 52 per cent in a water supply system by replacing pumping equipment. The Peruvian water utility (SEDACUSCO) located in Cusco, the historical capital of the Inca empire, reduced emissions from wastewater management by about 8,200 tons of CO_2 equivalent per year, mainly by improving sludge management.

Lessons learned from project implementation:

- GHG emissions from water and wastewater emissions are relevant in climate mitigation.
- When possible, emphasize economic, environmental and social co-benefits.
- Climate mitigation may successfully be added to existing adaptation processes.
- Understanding of GHG reporting and cooperation with environment ministry are key.
- High level events and agreements can sustainably drive sector progress.

New pumping equipment at an urban wasterwater treatment plant can help reduce GHG emissions. Source: Shutterstock.

Box 9.11. IUWM in practice: Upcycling sludge for climate change mitigation, water security, and economic opportunities in Jordan

Conventional faecal sludge disposal practices, which include unsanitary storage and dumping of sludge, often have overlooked negative socio-economic and ecological consequences since they contribute to deterioration of the quality of surface and groundwater with problematic implications for water security, and human and ecosystem health. Methane formation during biodegradation also accelerates climate change through high GHG emissions (GIZ et al. 2020). This issue is particularly pressing as methane alone accounts for more than 20 per cent of current climate warming (Euro-Mediterranean Centre on Climate Change 2020). In addition, unsustainable sludge management represents a lost economic opportunity; while conventional disposal practices often generate high costs, properly managed sludge has the potential to contribute to energy generation and can be used as a material resource.

In Jordan, the common way of disposing of sludge is conventional sludge-biosolids chains. After thickening and drying, most semi-dry and liquid sewage sludge is either stored and dumped onsite or transported to landfills. The Sustainable Sludge Management project implemented by GIZ on behalf of BMZ addresses the resulting ecological and socio-economic sustainability challenges in two ways:

- First, it promotes the deployment of technology-based upcycling solutions in close cooperation with its political partner the Ministry of Water and Irrigation and other local implementing partners. In the proposed innovative sludge-biosolids chain, the sludge is thickened and dried as usual but instead of dumping it, thermal processing (e.g., pyrolysis, pelletizing) is applied to create products like biochar or pellets, which can then be sold.
- Second, the project has an economic dimension as it fosters an enabling environment for the use of the new sludge products. This includes providing guidelines for product production and use, running positive awareness campaigns about sludge products and their uses to encouraging private sector participation, and developing and stabilizing distribution channels to access national and international markets. Ensuring the marketability of new sludge products and generating revenues helps to realize the economic potential sludge has to offer.

For now, this innovative approach to sludge management will be applied in three locations in Jordan where the highest economic and ecological feasibility is proven. In the chosen test facilities, information will be obtained on the optimum operational settings for useful product configuration to create opportunities for increasing the scale of the approach.

Two key lessons can be drawn from the project:

- **Sustainable sludge management can boost mitigation efforts and realize co-benefits.** Sustainable sludge management can make an important contribution to national climate change mitigation efforts and GHG emissions resulting from biodegradation. It also offers co-benefits for safeguarding aquatic ecosystems and human health and can even contribute to adaptation efforts in regions where water security is threatened by the impact of climate change.
- **Sludge is not just waste but holds untapped economic potential.** The technology-based upcycling solutions like pelletizing or pyrolysis allow for the valorization of treated sludge as an alternative energy carrier, industrial fuel, industrial raw material, or compost additive. These uses will decrease the costs resulting from common disposal practices and give wastewater utilities the opportunity to generate additional revenue while following the idea of a circular economy. In addition, they have co-benefits for the agricultural sector as farmers, including smallholders, can use organic biochar as fertilizer or for soil improvement to achieve a more permanent supply of moisture in the soil and higher yields. Furthermore, treated sewage sludge could be considered as an alternative fuel source in steel melting ovens and cement kilns, with the resulting ash used within the cement matrix.

9.3 Management under system complexities: Scalar, spatial, and temporal considerations

The delivery of integrated approaches is associated with certain complexities that need to be addressed, including acknowledgement of the complexities across different geographical regions and management levels, temporal scales, and contexts (Figure 9.2). Integrating these considerations into governance processes implies an unprecedented opportunity to address climate mitigation in a holistic water-smart manner.

While climate change is typically portrayed as a global issue, processes impacting climate mitigation are interlinked across all scales. Global climate change is not solely a product of events happening at the global level; changes are rooted in, and linked to, a complex mix of systemic interdependencies across multiple scales. Recognizing these scalar linkages is important to aid understanding of how issues interact and materialize across different levels, and to understand the potential trade-offs, synergies, opportunities, and solutions (see Chapter 8). As issues materialize in different ways across different scales, it is critical to take a holistic perspective and recognize that while an integrated approach can lead to synergistic effects at one level, it can result in trade-offs in another.

A useful starting point, as Granit et al. (2017) suggested, is to identify the appropriate scalar starting point from which to explore interconnections. The paper highlights the fact that interconnected scales can be identified and traced from a geographical perspective by, for example, examining a water body and tracing key flows, or identifying a single issue such as emissions from a particular source and tracing impacts. An example from the water mitigation context would be to trace emissions of GHGs from wastewater, which has a particular starting point, but flows through different geographical contexts. Integration also adds complexity around the issue of how to draw management boundaries, as boundaries are not fixed but socially constructed. Also, depending on how the boundaries are conceptualized, there is not necessarily a straightforward spatial fit between management boundaries and resource boundaries (Herrfahrdt-Pähle 2010). For example, conceptual demarcation can be achieved through river systems, catchments, source-to-sea systems, and landscapes. As these systems – as well as the cross-sectoral impacts – may traverse borders, the transboundary aspect also needs to be accounted for. No matter what the scalar starting point, and the manner in which it has been delineated, Granit et al. (2017) stressed that while it is useful to identify one scale as an analytical starting point, action will most likely be necessary across multiple scales.

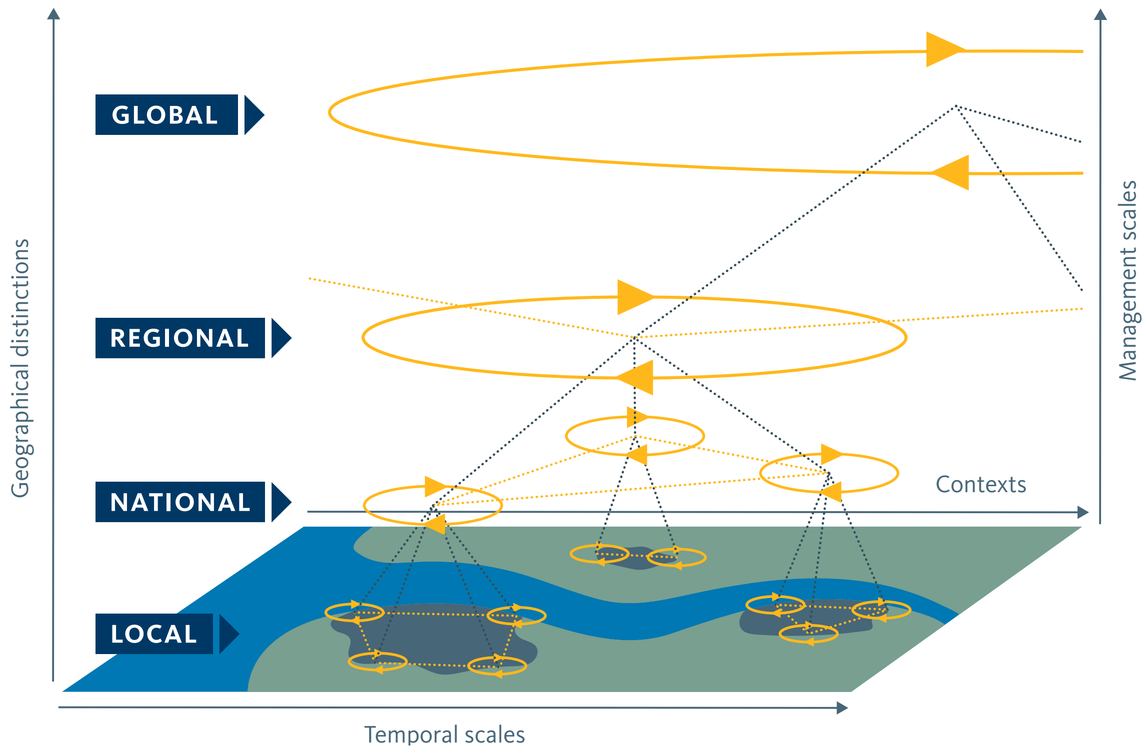

Figure 9.2. Management under system complexities. Source: SIWI.

Acting across scales creates opportunities as well as challenges. Traditionally, management approaches have been either top down or bottom up, with the former tending to be insensitive towards local realities, and the latter sometimes failing to adequately account for local contributions to global issues. Cash et al. (2006) suggest that "a middle path that addresses the complexities of multiple scales and multiple levels is much more difficult, but also what is required". Such a path needs to be nested across scales. This occurs when there are cross-level interactions between different stakeholder groups, including indigenous people, and jurisdictional bodies operating at different levels (Young 2006) (see Box 9.12.). Cross-sectoral collaboration creates challenges in terms of coordination across multiple sectors, which is inherently more complex than centralized action (Biswas 2008; Jeffrey and Gearey 2006). Moreover, it also blurs boundaries around management responsibilities. While traditional public sector approaches have clearly demarcated boundaries regarding management responsibilities, delineated through public sector responsibilities at different levels (e.g., local, regional, national), multi-stakeholder governance approaches blur these boundaries. While sectoral fragmentation and bureaucratic competition may pose a serious challenge to nesting scales (Koch et al. 2007; Lebel et al. 2011; Granit et al. 2017), it is necessary to strive towards inclusive governance approaches that can account for these different complexities and systemic interconnections through integrated approaches.

Box 9.12. Indigenous People in the NDCs: The importance of recognizing indigenous knowledge and values for climate change mitigation

Close to 38 million square kilometres of global land is located within the territories of Indigenous People, whether formally recognized or not. Many indigenous territories contain vast tracts of forested land, important water sources, and highly sustainable food systems. A recent report (FAO and FILAC 2021) noted that the forests of Latin America and the Caribbean's indigenous and tribal territories contain 30 per cent of the region's forests, equivalent to 14 per cent of carbon stored in global tropical forests worldwide. Multiple studies indicate that deforestation in indigenous territories is usually reduced compared with surrounding areas, including protected land. The report also noted that indigenous territories are under pressure from external interests. Indigenous People therefore have an outsized role in mitigating climate change, but this role is rarely recognized by national governments.

Recent analysis of the enhanced NDCs from non-Annex 1 countries revealed that close to 27 per cent included measures and activities in relation to Indigenous People or indigenous knowledge. Most references were within a context of acknowledging the marginalization or vulnerability of Indigenous People and the need for increased engagement. Very few enhanced NDCs acknowledged the potential for partnership with Indigenous People or their role in governance for mitigation or adaptation, even when forest land use plays an important role in mitigating climate change emissions within the national NDC. There were some exceptions, most notably in Belize and Costa Rica, which acknowledged a stronger role for Indigenous People in governance, but this was rare. Partnering with Indigenous People on mitigation activities and recognizing their role in governance is critical for climate mitigation, especially given the external pressures that could lead to increased deforestation or land degradation in indigenous territories. Such partnerships will need to acknowledge differences in worldviews held by partners, including differences in values and valuation approaches (IPBES 2022), as these will affect decision-making and governance.


Source: Shutterstock.

Just as spatial scale can be considered at different levels, Cash et al. (2006) showed that temporal scale can also be thought of as divided into different segments related to frequencies, durations, or rates. Both environmental and social processes occur in different timeframes, manifesting themselves as slow-moving processes as well as sudden events. When designing integrated approaches, it is therefore critical to consider alignment across timeframes; in other words, how different processes interlink and interact over time. This is important because while some actions may lead to short-term benefits, others can have long-term trade-offs or vice-versa (Folke et al. 1998; 2007; Young and Gasser 2002). It is not only important to consider the implications for natural systems, but also to recognize the standpoint of inter-generational equity.

When designing and implementing integrated approaches, consideration should also be given to contextual circumstances. Each place is different, characterized by various natural conditions, jurisdictional systems, and affected stakeholder groups, among other things (Ostrom et al. 1999). This creates a unique set of opportunities and challenges as different places experience different vulnerabilities and have various institutional structures to address these vulnerabilities. This reinforces the point that no one (integrated) approach fits all places. It also means that approaches need to be adapted depending on local circumstances and objectives as trade-offs and synergies may differ depending on the place.

9.4 Building better governance systems: Enabling conditions for strengthening integrated and cross-sectoral approaches

Climate mitigation and water are inextricably linked. Having outlined how and why different types of integrated approaches contribute to strengthening alignment between climate mitigation and water, and having discussed the complexities that need to be accounted for in these processes, this section now suggests a pathway to action. Drawing on the findings from earlier chapters, it identifies four focus areas that need to be strengthened to promote the acceleration of water-wise climate mitigation efforts: a) strengthening data-based decision-making through data generation, harmonization, and transparency; b) building capacity through inclusive knowledge systems; c) mobilizing innovative finance; and d) enhancing governance across sectors and levels.

While discussed separately, it should be emphasized that these areas are all interlinked**.** For instance, innovating finance is not an objective in its own right; it is a mechanism to deliver other objectives including building transparency and strengthening capacity. Similarly, capacity is built with a purpose, including enhancing governance and improving the nature of data. Each area is discussed below, and key recommendations for policy action within each area are outlined.

9.4.1 Strengthening data-based decision-making through data generation, harmonization, and transparency

Access to robust data that in many cases underpin management is still a challenge. Part II demonstrates that there is significant room for improvement when it comes to improving data, harmonizing accounting methodologies, and building transparency.

Several chapters demonstrate a critical need to improve the quality and coverage of scientific knowledge and data to enable mainstreaming of water into climate mitigation. For instance, Chapter 4 concludes that critical information and reporting gaps lead to probable underestimation and under-prioritization of GHG emissions from water supply and sanitation. Similarly, Chapter 5 notes that improvements in data collection and coverage have a key role to play in ensuring that inland water bodies, wetlands, and coastal systems are included more often within GHG inventories. Moreover, Chapter 6 flags that the lack of data on the relationship between forest change and water cycle dynamics at the scale of a river basin and higher reduces the capacity of managers and policy-makers to make informed, evidence-based decisions. These examples all point towards the need to improve data quality and coverage to enable scientifically robust decision-making.

Findings from Part I and II also illustrate that even when data sources are available, they are often fragmented and incomparable; there is a strong need for harmonization across accounting methodologies to ensure consistency. Specifically, different approaches to water and mitigation accounting can lead to different conclusions regarding water use or mitigation potential. Chapters 3 and 4, for example, show that there is no clear system for accounting for emissions emerging from water bodies, leading to vastly divergent estimates of both emissions and the mitigation potential of actions to reduce or prevent those emissions. Overall, the report concludes that the mitigation potential of water is likely to be significantly underestimated as a result of the ways in which emissions accounting and reporting are performed, and the lack of coherent accounting methodologies. If emissions of GHGs resulting from nutrient pollution in water bodies are not currently accounted for in a given region (Chapter 5), the mitigation benefits of removing or preventing this pollution and resulting emissions will also be difficult to track or claim.

Even when data are available, there is often a lack of transparency and sharing. Sharing is needed both between sectors and government entities, as well as across national boundaries. Access to information is an important precondition for targeted interventions. It is also a key element to stimulate functioning institutional arrangements. However, the institutional and technical structures to enable sharing across sectors, departments, and borders are still insufficient. All these aspects need to be addressed.

Strengthening data-based decision-making: Policy implications for more successful implementation of climate change mitigation measures

- **Strengthen disclosure, as well as the scientific knowledge underpinning the generation of robust data.** Knowledge gaps exist that need to be closed. Develop incentives to foster collaboration with universities and other research institutes, as well as the private sector, to drive disclosure as well as cost-efficient data collection.

- **Build institutional and citizen capacity to strengthen data collection, management, and sharing capacities.** This includes improving frameworks and knowledge to better utilize digital solutions and data management systems, and support transparency. It also includes building capacity towards developing integrated and cross-sectoral data collection and monitoring systems.

- **Invest in institutions that can collect, manage, and share data.** Invest in the development of technologies that can be used to acquire standardized data sets worldwide, targeting long-term, continuous, large-scale, and aggregated data that can be measured simply and at low cost.

- **Ensure that what is measured is also comparable.** To ensure that data can underpin decision-making, accounting frameworks need to be standardized across sectors and countries.

- **Ensure that what is measured can also be shared.** Target the development of cross-sectoral and international reporting systems to ensure access to available information. Ensure that national efforts are aligned with global systems to avoid unnecessary work.

9.4.2 Building capacity through inclusive knowledge systems

While access to robust data is critical to strengthen integration and enable cross-sectoral approaches, building capacity to gather, understand, analyse, and utilize the data is equally important. The chapters in Part II point to two critical gaps in capacity: a) gaps in knowledge to fully comprehend cross-sectoral linkages; and b) insufficient capacity to address the challenges or utilize the opportunities such interlinkages present.

Building capacity to better understand the increasingly complex interdependencies across scales and actors is fundamental. This report concludes that in climate mitigation, the role of freshwater is stronger and more diversified than has been acknowledged. A great majority of mitigation measures worldwide – including in forests and grasslands, food systems and energy systems – have a link to water management and water availability in ways that must be understood and planned for. Moreover, the report shows why and how the mitigation potential of water is likely to be significantly underestimated depending on the ways in which emissions accounting and reporting are performed. Building capacity to strengthen and integrate knowledge is therefore critical. At the widest level, capacity can be strengthened by learning across governance systems. Chapter 3 concludes that to galvanize action for water-wise climate mitigation, existing governance regimes should be leveraged. More specifically, the chapter shows that strong global frameworks exist for climate action, and robust national plans often exist for water management. Building on existing institutional structures can strengthen capacity and ensure more rapid implementation of water-smart mitigation measures. To build capacity across governance systems, it is critical to recognize the need for reflexivity. To foster polycentricity and create governance systems that are adaptive, there is a need to embrace governance as an iterative process rather than a static end goal. The notion of reflexive governance encapsulates this notion, and points to the value of systems where learning is an embedded component, thus creating a system with the capability to evolve and adapt depending on context (Feindt and Weiland 2018).

Learning can also be strengthened by sharing knowledge across sectors. Chapter 4, for instance, argues that through training, considerable water-sector know-how can be scaled up to help water utilities lower emissions. At the individual level, it is fundamental that measures to build capacity are inclusive, paying special attention to youth, women, and vulnerable groups. It is also critical to recognize that the knowledge generated is inclusive, and that different knowledge is valued, to build inclusive knowledge systems. In this context, it is important to recognize that knowledge is not neutral and that actors are driven by particular interests. Thus, to ensure inclusivity, it is fundamental to ensure that a multitude of voices are heard, and to pay special attention to those that are typically excluded.

Part II not only points to a lack of knowledge on interlinkages but also to insufficient capacity to address the challenges or utilize the opportunities such interlinkages present. To strengthen capacity to act, both Chapter 3 and Chapter 6 conclude that underlying governance systems need to be strengthened. Chapter 3 argues that water has not been adequately integrated into the current climate governance regime, particularly climate mitigation efforts, which means that opportunities to invest in and accelerate climate change mitigation through water-wise actions have not yet been capitalized on. Further, Chapter 6 notes that forest management built on functional governance, monitoring, and enforcement mechanisms can mitigate climate change and generate co-benefits, such as maintenance of watershed functions and biodiversity protection. Simultaneously, policy-making and investment planning processes need to be strengthened. In particular, such processes need to budget for capacity-building activities to ensure the sufficient technical and legal knowledge is institutionalized in order to plan, design, and implement mitigation projects.

Sharing knowledge during a capacity building workshop for water and saniation in Somalia. Source: Antoine Delepiere, SIWI.

Building capacity: Policy implications for more successful implementation of climate change mitigation measures

- **Build inclusive capacity to better understand the increasingly complex interdependencies across scales and actors.** Such knowledge is critical to leverage integrated approaches that can realize water-smart climate mitigation. Pay special attention to the voices that are typically excluded, such as youth, women, and vulnerable groups.

- **Build processes to account for the increasingly complex interdependencies across scales and actors.** Such processes could include frameworks for increased collaboration and transparency, and safeguarding the integration of the acquired capacity.

- **Foster learning through collaboration.** Knowledge exchange should be pursued across governance systems, sectors, and individuals.

- **Design governance systems that are adaptive.** The notion of reflexive governance encapsulates this notion, and points to the value of systems where learning is an embedded component, thus creating a system with the capability to evolve and adapt depending on context.

- **Strengthen governance systems and planning processes** by embedding knowledge and budgeting for capacity-building activities.

9.4.3 Mobilizing innovative finance

Additional funding will be required to support water mitigation measures and protection. The International Energy Agency estimates that many trillions of dollars will need to be invested annually to reach climate agreements and limit global warming to 1.5°C (IEA 2021). Part II shows that much of the required investment in energy, agriculture, and ecosystems to achieve mitigation must consider potential risks from or impacts on water systems and, as such, these considerations need to be integrated into the financing instruments used to deliver investments.

Several chapters in Part II highlight areas where the current level of investment is not adequate to meet current or future funding needs. Chapter 4 points to the additional investment needed for wastewater treatment, noting that most global wastewater is currently not treated adequately, and that wastewater could be a significant source of GHG emissions. The chapter also highlights the underfunded nature of sanitation services. Further, Chapter 5 flags the critical need to scale up investments in restoring and rewetting degraded peatlands, as healthy and well-managed peatlands may contribute to a reduction of at least 5 per cent in global anthropogenic CO_2 emissions. Chapter 6 notes how additional funding is required to incentivise transition into water wise and climate smart land system management, that ensures the capacity of soil and vegetation to sequester carbon, while safeguarding livelihoods for smallholder farmers.

To meet funding demands, new pathways need to be explored that can facilitate investments in and direct funding to areas that can support water mitigation measures. Current and future investment needs cannot be met solely by public financing, official development assistance, and financing channelled through funds such as the Global Environment Facility and Green Climate Fund. In addition, financing requires new approaches that can mobilize more funding from the private sector.

To achieve the desired impact and ensure that funding is channelled in a manner that supports overarching national and global climate targets, institutional structures need to be strengthened. In particular, there will be a need for public actors to strengthen collaboration, especially to ensure that the water sector does not carry the sole fiscal responsibility for delivering projects upstream with substantial climate mitigation potential. Conditions that would more easily enable public authorities to pool finance to pay for different benefits also have to be explored. However, Part II demonstrates that the current institutional structures that exist to mobilize funding are ill-equipped to mobilize funding for the cross-sectoral and integrated efforts needed to deliver climate mitigation, with water mainstreamed into climate mitigation. For instance, viewing water as an additional or core component of climate mitigation will have different implications when attracting financing. This is due to different funding bodies often having specific mandates, which dictate specific end goals into which money can flow. While this is a challenge when seeking to mobilize funding for integrated projects that may contribute to a range of different goals rather than one specific component, it can also be seen as an opportunity to leverage additional financing.

Chapter 3 argues that existing climate governance regimes should be used to leverage financing for water management actions that contribute to climate change mitigation. Water has yet to be adequately integrated into current climate mitigation plans, which means that opportunities to invest in and accelerate climate change mitigation through water-wise actions have not yet been capitalized on. However, such efforts will require additional capacity-building. For example, Chapter 4 demonstrated how considerable water-sector know-how can be scaled up for water utilities to lower GHG emissions as available guidance and technologies for energy-efficient and low-climate-impact wastewater processes can be scaled up via investment and training. Further, Chapter 5 suggests that capacity-building will be a critical component to materialize implementation of bolder emission reduction targets as part of broader water resources management strategies. This strengthens the argument that each of the enabling conditions should be viewed as interconnected rather than separate.

Mobilizing innovative finance: Policy implications for more successful implementation of climate change mitigation measures

- **Foster and incentivize innovative financing models** that can attract commercial and non-commercial sources of funding.
- **Pay special attention to ensure that funds are distributed in an inclusive manner, and that investments benefit the most vulnerable.** It is critical to not exclude vulnerable communities and groups.
- **Improve the enabling conditions for fostering investments.** These include improved transparency and policy coherence to strengthen the bankability of projects.
- **Build capacity to improve know-how of the value of integrated approaches** and how to use this knowledge to leverage water and increase the scale of climate financing. Consider especially the interdependencies and mutual (financial) benefits between water and other sectors in investment planning.
- **Build institutional capacity that is equipped to fund integrated approaches,** moving beyond siloed projects by aligning frameworks across sectors.

9.4.4 Enhancing governance across sectors and levels

Governance is the primary vehicle through which to solve complex global environmental challenges. The delivery of water-smart climate mitigation requires strengthening of existing governance frameworks and instruments. The findings from Part II highlight two particular areas that need to be considered: a) one size does not fit all, implying there is a strong need to adapt governance frameworks and instruments to different scales; and b) there is a need for integrated and multi-actor governance approaches.

The need to enhance governance across different levels is a recurring theme across many of the chapters in Part II. Chapter 4 stresses the critical need to adapt to local contexts and develop locally grounded solutions. It concludes that decentralized sanitation solutions resting on local governance should be lifted as win-wins for development and climate mitigation. At the other end of the spectrum, Chapters 5 and 6 stress the need for watershed-level governance, with Chapter 5 proposing that watershed-scale policies should be adopted for an effective and sustainable emission reduction strategy, and Chapter 6 arguing that climate mitigation associated with forests and forestry needs to account for the whole water cycle, including upstream and downstream users, as well as between upwind and downwind rainfall receivers. The findings clearly demonstrate that no one approach fits all cases, but rather that governance frameworks and instruments need to be adapted to fit local circumstances.

The chapters in Part II also point to the need to enhance governance across sectors. In particular, the chapters stress the need for additional coordination and collaboration. Chapter 6 points to the need for coordinated planning, and stresses that effective emission reduction strategies will entail coordinated approaches for land and water management, while also considering factors such as disaster risk reduction, biodiversity recovery, and sustainable community livelihoods. To improve coordination in terms of goal setting, Chapter 5 calls for cross-referencing, assessing, and aligning policies, such as National Adaptation Plans (NAPs), National Biodiversity Strategies and Action Plans (NBSAPs), integrated coastal zone management, marine spatial planning, and hydrological management, to utilize synergies. Stressing the need for further collaboration, Chapter 6 argues that regional and cross-border collaboration may help address water trade-offs as well as undesirable transboundary deforestation leakages. As noted in Chapter 3, collaboration across sectors is also critical to adapt to the growing number of non-state actors involved in governance. While governments undoubtedly remain the drivers of regulation, more actors are taking a larger role in policy design and implementation, broadly characterizing the shift from government to governance as a system of governing. Chapter 3 further notes that this shift towards such polycentric governance systems is necessary because to perform well under conditions of rapid climate change, governance systems must be integrated (coordinated across levels and sectors to enhance synergies and reduce trade-offs) and adaptive (able to respond to new knowledge gained during policy implementation) (Pahl-Wostl 2015).

Enhancing governance: Policy implications for more successful implementation of climate change mitigation measures

- **Capitalize on on-going water and climate governance processes across different levels** to further integrate the water and climate agendas.
- **Pay special attention to ensure that governance frameworks and instruments are adaptive** to suit the needs of different contexts and different scales.
- **Design governance frameworks that enable and support integrated approaches**. In particular, align planning and goal setting to leverage synergies across sectors where relevant.
- **Foster collaboration across scales, sectors,** and borders and recognize the need for collaboration and coordination among different actors to leverage synergies and better support context-specific and cross-sectoral challenges; for example, by supporting cross-sectoral and multi-stakeholder dialogues.
- **Build capacity within governance systems** to support data collection, management, and sharing.

9.5 Conclusion

Water must be mainstreamed into climate mitigation processes to achieve climate mitigation targets. This chapter argues that integrated approaches can help achieve water-smart climate mitigation. To make this case, Section 9.1 provides an overview of some of these approaches, including IWRM, the WEF nexus approach, the S2S approach, the landscape approach, and IUWM. Exemplifying each approach through case studies, it is demonstrated how different approaches can be utilized depending on the context. Section 9.2 further outlines the complexities that need to be accounted for in these integrated processes. Section 9.3 turns to outline the pathway for action. Drawing on the findings from Part I and II, it identifies four focus areas, including building transparency and data-based decision-making, strengthening capacity through inclusive knowledge systems, innovating finance, and enhancing governance across sectors and levels. Combined, these sections make a strong case for a pathway in which climate and water is managed in an integrated manner to achieve water-smart climate mitigation.

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