Chapter 7
Governance Options for Addressing Changing Forest-Water Relations

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7.1 The Problem of Governance – Knowledge, Scale, Institutional Structure and the Technology of Governance?

From a systems perspective, governance represents a key driver when it comes to the potential for addressing rapid environmental, climate, social and even technological change. As our knowledge of forest-water interactions and their potential to improve human welfare expands, new opportunities emerge to optimise the strategic use of natural resources in ways that may bring multiple spinoff benefits to those who depend on these resources for their livelihood and prosperity.

Even without considering the constraints of the 'new normal' and the challenges imposed by climate change, land use practices could be modified in ways that can potentially optimise natural resource availability across space and time. On the other hand, the increasing threat posed by both climate change and the rise of the 'new normal' further intensifies the need to better understand forest-water interactions, and to raise our proficiency at puttingthem to good use.

If the management of forests for water is genuinely to be considered, then a number of aspects need to be addressed before the principal set of priorities can be adequately and reasonably reordered:

1) First, there needs to be some relative agreement that the forest-water relationship should be prioritised over the more common forest-related goals of producing timber and/or sequestering carbon. Despite the comparatively uncontroversial notion that forested watersheds can help provide clean drinking water (see e.g., Box 7.1), such strategies are far less frequently employed than might be possible. Likewise, despite the uncontroversial notion that forests depend on water for their survival, this logical reordering of priorities appears to be less straightforward than it seems. The increasing number of forestation projects (defined as a generic term for projects aiming to increase tree cover regardless of baselines, species or methods used) that have failed to adequately consider the water demands of newly introduced foliage suggest there is a clear need to convince practitioners and communities that increasing forest cover is not necessarily good under all circumstances. Considerable care must be taken, for example, in the choice of species that are well-adapted to local circumstances (see for example the discussions of 'potential natural vegetation' (PNV) in (Maes et al., 2009, 2011; Wahren et al., 2012), as well as the PNV data collection project (Ramankutty et al., 2010; see also Little et al., 2009; Aranda et al., 2012).
2) Second, attention must be paid to the scale, scope and structure of the political institutions governing forest-water interactions. Many of the newer scientific insights regarding forest-water interactions are potentially observable from a much broader geographic and spatial perspective, leading to concern in particular about the spatial organisation of land use practices across hydrologic space (Ellison et al., 2017; Keys et al., 2017). As these authors demonstrate, this has implications for the related governance structure. The general mismatch between natural ecosystem scales and legal jurisdictions where both up- and downstream as well as up- and downwind forest-water relationships are concerned, ultimately requires a radical rethink of how to manage and govern forest-water interactions, and how to address some of the imbalances that can occur as a result of the failure to consider, in particular, up- and downwind forest-water relationships (see also e.g., Dirmeyer et al., 2009; Wang-Erlandsson et al., 2017). Forest-water relationships that do not fit neatly into existing political-institutional and decision-making frameworks are often ignored.
3) Third, social-ecological systems such as the forest-water-climate-people system suffer from multi-scalar challenges, including scale mismatches that affect the ability of the social system to address the challenges presented by the ecological system (Cash et al., 2006). The scalar mismatch between goals and means has plagued many aspects of natural resource governance (Holling, 1986). There are, however, many relevant and important exceptions to this rule, for example, South African forest taxation or the management of forested watersheds as water resources. The general trend has perhaps been toward increased awareness of, and attention to, the management of forests for water. But water governance institutions generally tend to focus on the local or catchment scales and are considered separately from forest governance. Moreover, forests are generally managed either at the scale of the forest stand, based on private forest ownership, or at the regional or national scale, generally speaking, irrespective of water governance concerns.

The relative primacy of concerns over water often means that forests and forest-water interactions are not adequately integrated into the water management concept.

On the Nam Ou river, Luang Prabang, Laos. Many local people depend on water – both for economic and social reasons
Photo © Peter Tarasiewicz

The reasons for this remain unclear. People often have a closer relationship with water than forests, and forests have often been defined on the basis of the exclusion of local people and restrictions on their land use. In lower watersheds and especially in delta regions where high concentrations of people live, water management has little explicit relationship with forests and trees. The conceptual relationship is perhaps strongest in middle/upper watersheds, with conflicts in accessible locations where logging and conversion to other land uses have historically been most attractive. Where attempts to tackle the forest-water system have occurred, a conventional focus on the partitioning of water resources across catchment scales has typically led to a focus on the up- and downstream management and uses of water.

To increase awareness of the importance of forests for water, the United Nations' Sustainable Development Goals (SDG) framework as well as the United Nations Forum on Forests' attempt to incorporate the SDGs into its own set of guidelines (the United Nations Forest Instrument (UNFI) and the UN Strategic Plan for Forests (UNSPF) for the period 2017-2030), have helped to frame the general debate about optimising environmental relationships and act as important agenda-setting tools. Moreover, the SDG agenda is well placed in the international arena, since all countries are encouraged to consider and potentially mobilise environmental resources in ways that can help improve human welfare. At the same time, the explicit links across the multiple forest-water interactions and their potential usefulness in the natural resource management context still need to be meted out and appropriately allocated. This requires both sufficient knowledge about the benefits of these forest-water interactions, as well as the potential restructuring and reform of the social governance institutions that must put these in place.

Livelihoods and the interests of individuals and communities are frequently intimately intertwined with forests and/or water, resulting in powerful and important interests and demands influencing decision-making on the use and management of these resources (Dewi et al., 2017; van Noordwijk, 2017; Watson et al., 2018). Thus, a wide range of socio-economic and political interests intersect with an increasingly complex set of forest-water interactions. For effective governance, these need to be optimised in suitable ways.

This chapter addresses the question of forest-water governance from the systems, willingness, ability and capacity to act perspective, as it applies both to natural resource governance in general, as well as to the project of forest-water governance in particular. Thus, we consider governance from a systems perspective (7.2), look for expressions of the political will to act on the forest-water agenda (7.3), consider the ability to act based on the nature and structure of existing governance institutions (7.4), and finally, consider the capacity to act based on whether the requisite knowledge exists, as well as the availability of appropriate models for action (7.5). Section 7.6 highlights persistent research gaps, while 7.7 concludes.

Box 7.1

'Forever wild' for water supply in the Adirondack Forest Preserve of 1894

Conservation of forests has been a central tenet of managing the drinking water supply of New York City for over 150 years. During the latter half of the 1800s forest multiple-use strategies in the headwaters of the Hudson River attempted to allow for timber harvest, while protecting the water supply, wildlife and recreation. An influential publication concerning this decision was 'Man and Nature' (Marsh, 1864) which propounded the value of forests in protecting water resources. Frustration with the 'balance' that allowed for too much cutting, exacerbated by forest fires and a drought, led to an unprecedented measure to protect forests when the state constitution of New York State was drafted in 1894. The state legislature required that all state-owned land (about half of the total area) in the 2.5 million-hectare Adirondack Forest Park was to be 'forever wild'. The decision is an excellent example of the power that ideas about forest-water relations can have for policy (Michaels et al., 1999). More recently, new measures to guide forest management with a primary focus on protecting drinking water supplies have been implemented in other forest areas of New York State. Particulate and pathogen concentrations were reaching levels where expensive water treatment plants would be required. Instead, forest management measures provided a more cost-effective way of controlling particulates and preserving the water supply (NRC, 2000).

7.2 The Challenge for Governance – A Systems Perspective

Political institutional features such as democracy, transparency, competitive party systems, open media, etc. all tend to be positively related with indicators of the quality of governance, so it is likely that frameworks generated from these contexts would be more effective (Weaver and Rockman, 1993; Persson et al., 2003; Buchholz et al., 2008; Mills et al., 2008; Rothstein, 2011).

The following factors have been identified with respect to the overall quality of governance and potentially, natural resource governance:

- **International agenda-setting/treaty building:** Placing new ideas and issues at the centre of international negotiations and agenda-setting represents one of the first important steps to devising meaningful solutions to important global problems. This not only requires a sufficient institutional framework, but requires the commitment of more internationally-minded actors. The current SDG framework within the United Nations is a prime example, as is the UNFF's parallel focus on integrating the SDG agenda.
- **The evolving need for new institutional frameworks:** Given that institutions typically represent the interests of those within them, if the institutional framework is not large enough to have complete purview over the relevant eco-hydrologic relationships, some relationships may well take precedence over

others. For example, while up- and downstream interests and concerns are more commonly represented, up- and downwind interests and concerns have not even begun to enter the political and institutional vocabulary.

- **Democracy, decentralisation and polycentric governance:** Institutions that can look both upward (to higher-level governance institutions) and downward (to more local-level governance institutions and interests), without ignoring political will and interests at all other levels of governance are more likely to be able to arrive at policy outcomes adapted to broader communities of interests. The necessity of considering a broader spectrum of interests and adapting these to relevant policy outcomes is one central motivation for re-thinking the institutional features underpinning the quality of natural resource governance. In this sense, democratically-driven, participatory and polycentric governance frameworks with multi-centred authority, are potentially better suited to addressing the problems of scalar mismatch and the spatial dislocations of (potentially) competing interests.
- **Strategies for overcoming entrenched interests:** The effort to provide meaningful solutions regarding natural resource governance, is frequently either slowed or completely stalled by the interference of powerful and entrenched special interests. Scenario analyses (see Chapter 5) may provide one potential strategy for finding new alternatives to old and largely unsolved problems. This approach has the advantage of creating buy-in to commonly devised policy options through the apparatus of participatory and strategic brainstorming.
- **Actors versus institutions and the necessity of leadership:** Though there does not seem to be any perfect strategy for finding good leadership, there is no replacement for those few individuals who are willing to champion important ideas and goals. Good leadership often seems accidental and is rarely planned. Institutional features such as good governance and the presence of good skill-building educational institutions may nonetheless support the likely emergence of such leadership. And these institutions may themselves be more likely under more polycentric systems.

Institutionally-driven solutions are clearly no panacea and cannot guarantee positive, natural resource governance solutions. In this regard, they may represent an important, but insufficient condition for success. Governments may, for any number of reasons, opt for less than optimal natural resource governance solutions. Economic interests and security concerns are among the many factors that can easily converge to derail an otherwise positively-minded executive or legislative branch of government (e.g., Altenburg and Lütkenhorst, 2015). Moreover, political systems are frequently weighted toward more powerful individuals and groups, or those for whom the costs of collective action are either lower, or the benefits more highly rewarded (Olson, 2003).

Even with firmly entrenched democratic institutions, there is no guarantee that environmental issues will be adequately addressed. Governments require the presence of actors with an interest in environmental protection and sound natural resource governance to engage in appropriate action (e.g., Olson, 1993). The development of an eco-centric foundation within the recently announced five-year plan in China (Ouyang et al., 2016) is a positive example of the progress made in accepting the importance of the environment for human well-being, despite the fundamental lack of more democratically-oriented or polycentric institutions. Democratic political systems can fail in their environmental responsibilities and are entirely capable of choosing leaders who have no interest in, or knowledge of, environmental issues and concerns. In contrast, even highly centralised and autocratic systems, when inhabited and motivated by well-meaning actors, can potentially arrive at optimal solutions far more rapidly than democratic systems that are typically based on lengthy decision-making processes.

Although the concept of a universal model of 'good governance' has been roundly criticised (e.g., Masson-Vincent, 2008), the principles of accountability, legitimacy and transparency (World Bank, 2009; PROFOR & FAO, 2011) have in the past been called upon to set the standard for ensuring sustainable forest management. Such principles tend to be more strongly defended in systems that are democratic and based, for the most part, on the principles of participatory governance.

The relative advantages of polycentric forms of governance – marked essentially by frameworks that are more open and responsive to signals from multiple levels and directions, and that recognise multiple centres of power – are gradually being recognised (Ostrom, 2010a). Generally speaking, there seems to be relatively broad support for the idea that the more governments are polycentric in character, the more likely they will be able to deliver quality governance (Ostrom, 2010a, 2010b; Gao and Bryan, 2017). This recognition builds upon experience from multi-level governance frameworks such as those in the European Union and in some more federal systems (e.g., Hooghe and Marks, 2003; Gillard et al., 2017). And the emphasis on polycentric forms of multi-level governance has also found support in the forest governance literature (see in particular Mwangi and Wardell, 2012, 2013). To cite Andersson and Ostrom (2008), "the complexity of many natural resources requires sophisticated governance systems capable of recognizing the multiscale aspects of natural resource governance and of seeking to determine optimal policy outcomes, despite the presence of countervailing incentives".

Presidential systems with strong veto powers provide significant authority and power to single individuals. Likewise, majoritarian party systems (based on single member electoral district systems) tend to thin out the ranks of political competition and reduce the potential for opposition. In contrast, institutions which support concepts of 'shared governance' may prove less susceptible to the whims of individual rulers. Parliamentary systems, in particular those that are governed by multi-party systems, tend to divide power and authority across a broader set of individuals, in part through the mechanism of coalition governments. Moreover, power and authority in multi-party parliamentary systems are continuously subject to review and potential recall through parliamentary procedures that allow for the interim removal of leaders who require parliamentary support for their survival in office. In contrast, presidential systems, tend to enjoy fixed terms and leave comparatively few options for the removal of standing presidents.

7.3 Political Will and the Forest-Water Agenda

Primarily as a result of climate change, forest-related policy objectives have significantly shifted toward the management of forests for carbon. To date, the traditional paradigm has been to manage forests for their ability to provide biomass, for their multi-functional uses, and/or for their ability to sequester carbon.

7.3.1 International Agreements and Programmes

The December 2015 Paris Agreement signed by the members of the 23rd Conference of the Parties (COP) under the United Nations Framework Convention on Climate Change (UNFCCC) led to a broad range of countries deciding to include forests into what are now called Nationally Determined Contributions (NDCs). To date, a total of 73% of the 189+ countries to submit intended NDCs have included Land Use, Land Use Change and Forestry (LULUCF) in their mitigation (and/or adaptation) plan, and forests are expected to contribute approximately 25% of the total emission reductions by 2030 (Grassi et al., 2017). The principal emphasis of the Paris Agreement remains on carbon; concerns about the availability of water and the potential impacts, both positive and negative, of forest-water interactions on the hydrologic cycle are absent from this agreement. The focus on the carbon sequestration potential of forests that resulted from previous UNFCCC discussions under the Kyoto Protocol led to a similar emphasis without, however, incorporating a similarly forceful declaration on the importance of water. Thus, the fact that so many countries are now beginning to pay more attention to the potential role of forests in the climate change mitigation framework presents both an opportunity and a challenge for water as it could potentially lead to unexpected and unintended outcomes.

Water concerns have typically been of secondary importance. At the same time, the increasing scarcity of, and rising demand for, water may be shifting the balance toward increasing concerns about water (Vörösmarty et al., 2010; Mekonnen and Hoekstra, 2016). Climate change has exacerbated, and will continue to further exacerbate, these concerns through rising temperatures, changes in precipitation patterns and amounts, the increasing likelihood of droughts and the increasing occurrence of less frequent but more intense rainfall events (Fischer and Knutti, 2015), as well as the potential flooding these imply.

Flooded neighbourhood in the US after Hurricane Harvey in 2017

Photo © iStock: Karl Spencer

7.3.2 Water and Forest Goals Side by Side

By and large, forest-water interactions have been almost entirely ignored in the management of global freshwater resources (Ellison, 2010; Ellison et al., 2012, 2017; Vörösmarty et al., 2015; Mekonnen and Hoekstra, 2016). On the other hand, there are many emerging fora in which these issues are increasingly being discussed and pushed onto the international and also national and local agendas (e.g., Ellison, 2010; Creed et al., 2016; Ellison et al., 2017).

Emphasis on increasing carbon capture as part of global climate policies, especially in dry areas (often avoiding direct competition for land with local populations in more hydro-climatically endowed areas), has resulted in a direct trade-off between blue water production and carbon sequestration in reforested areas (Jackson et al., 2005; Benyon et al., 2006; Trabucco et al. 2008; Filoso et al., 2017; Garcia-Chevesich et al., 2017). Numerous forestation projects have failed to consider adequately the water demands of newly introduced foliage, or to use species that are well-adapted to local conditions (Little et al., 2009). All too often, fast-growing species have been used without thinking about the relative impacts on the locally available water supply (e.g., Jackson et al., 2005; Benyon et al., 2006; Trabucco et al., 2008; Garcia-Chevesich et al 2017; Filoso et al., 2017). Lessons from these projects have helped to initiate and further promote concerns about the impacts of managing forests only for carbon (Jackson et al., 2005; Trabucco et al., 2008; Filoso et al., 2017). More often than not, knowledge of the forest-water relationship is inadequate, has not even been considered, or fails to be adequately contextualised, in favour of generalisations.

While such experiences have challenged the dominant forests-for-carbon paradigm, it is above all the improved understanding of positive and beneficial forest-water interactions that have led to a call for an explicit shift in the focus of the management of forests for water (Ellison et al., 2012, 2017; van Noordwijk et al., 2014; Ilstedt et al., 2016; Syktus and McAlpine, 2016). Many actors, public and private, support forestation strategies in order to restore the world's forests, but few have turned their focus towards an integrated view of the potential benefits of forest and water interactions. Recently, WeForest together with the Global Partnership on Forest Landscape Restoration (GPFLR), have attempted to shift the focus toward forests and water, and are currently involved in efforts to develop a Forest Landscape Restoration (FLR) set of principles that would help to encourage donors and recipient countries to place more of an emphasis on these important interactions.

Though mainstream approaches to forest-water interactions have over the past decades focused on the fact that trees and forests 'use' water (Bosch and Hewlett, 1982; Farley et al., 2005; Jackson et al., 2005; Vose et al., 2011; Filoso et al., 2017), this literature has never really attempted to determine what happens to the atmospheric moisture that is produced by trees and forests through the process of evapotranspiration. A major step in the evolution of thinking on forest-water interactions is to complete the logical and conceptual shift from an almost exclusive focus on demand-side, catchment focused thinking, to one that incorporates the supply-side, up- and downwind aspects of forest-water interactions (van der Ent et al., 2010; Ellison et al., 2012, 2017; Keys et al., 2016; van Noordwijk et al., 2014; Wang-Erlandsson et al., 2017).

The concept of ecosystem services and the underlying view that forests and the water they process and regulate provide invaluable returns to human civilisation, is ultimately a more recent phenomenon, arising primarily at the very end of the 20th century and becoming more prominent in the 21st century (see Chapter 5). International support for national and local actions has been at the 'motivational' (rather than the regulations or incentives) level. Milestones in the international recognition of the forest-water issues at stake include: the 2002 Shiga Declaration on Forests and Water (http://www.rinya.maff.go.jp/faw2002/shiga.html), the Millennium Ecosystems Assessment (MEA, 2005), various meetings of the Ministerial Conference on the Protection of Forest in Europe (renamed Forest Europe), in particular the 2007 'Warsaw Resolution 2 – Forests and Water' have begun to affect thinking on forest-water issues (Calder et al., 2007; Ellison, 2010; Creed et al., 2016). The FAO, for example, has initiated comparatively intensive discussions on forests and water with the creation of a 'Forest & Water Action Plan' announced at the 2015 FAO World Forestry Congress in Durban, South Africa (Ellison et al., 2017). The FAO's current efforts are focused on the development of a Forest and Water Monitoring Framework ('FAO Forest-Water Monitoring Framework, A Year Later'). Some NGOs are likewise working on similar agendas. The 'Gold Standard' certification body for forest/climate investments (https://www.goldstandard.org/) has also recently undertaken initial efforts towards integrating forest and water issues into their reforestation agenda, though it remains unclear what form this might take.

7.3.3 Sustainable Development Goals

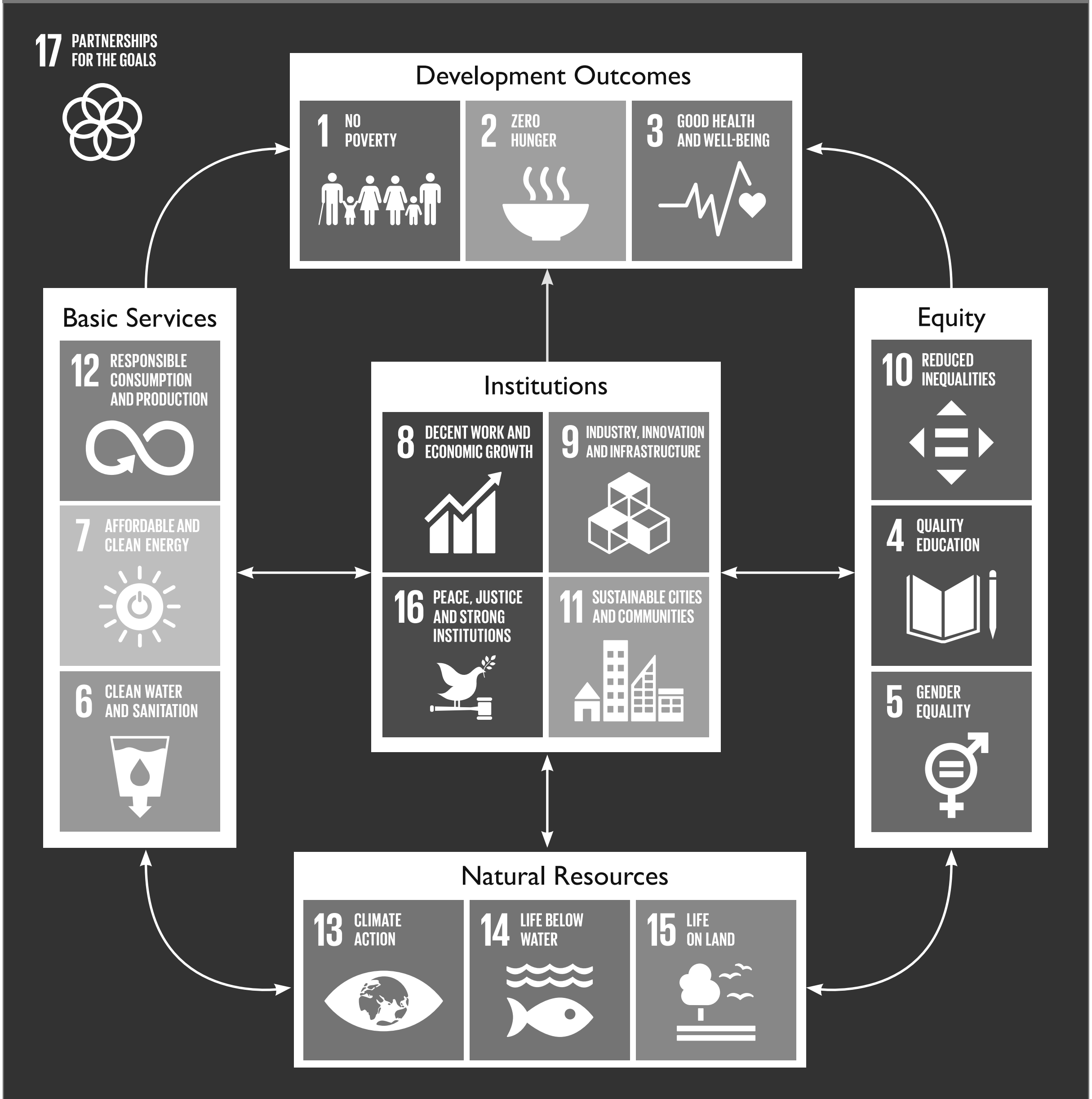
The SDGs express commitments from all UN Member States to tackle the various challenges of sustainable development in a coherent way. The 17 SDGs, adopted by the UN General Assembly in September 2015 (UN, 2015), with 169 associated targets, are aimed at balancing the three dimensions of sustainable development (economic, social and environmental) in an integrated and indivisible way.

Given the urgency of challenges that face us in the Anthropocene, the United Nations' SDGs offer an opportunity to revisit the case for cooperation across different sectors, development priorities and across the water-forest-climate nexus (Brondizio et al., 2016; Lima et al., 2017). A seven-point scale has been proposed to describe interactions between goals: cancelling, counteracting, constraining, consistent, enabling, reinforcing and indivisible (Nilsson et al., 2016). Where interactions among SDGs are primarily negative (cancelling to constraining), trade-offs need to be understood and managed; where interactions are primarily positive (enabling to indivisible), synergies can be achieved. The SDGs represent an important milestone towards a global social policy (Deacon, 2016), even though the SDG document as such was found to fail in improving the architecture of global social governance, thereby reverting back to an era of strengthening national sovereignty that reflects the current 'mood' in many countries.

The SDGs feature forests and water multiple times and indeed forests could be said to be linked to almost all of the SDGs in one way or another. However, the SDGs continue to treat forests and water separately, thus reflecting the strong sectoral pre-determination of policymaking on forests and water. Whereas the 17 goals are listed in the resolution, their interrelationships are not explicitly defined (other than acknowledging that they are indivisible). In exploring the role of policy and governance in promoting development outcomes, the SDGs can be organised into functional groups (Figure 7.1).

Dependencies between the functional groups indicate causality. For instance better basic services will promote development outcomes, whereas improved equity is supported by access to natural resources. And improved equity can also lead to improvements in natural resources. Referring to the resource perspective on forests and water, SDG 15 is to "*Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss*". Target 15.1 specifically addresses forests and water to "*… ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands …*", whereas Target 15.2 calls for "*… implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests and substantially increase afforestation and reforestation globally*". The other ten targets under SDG 15 address related aspects of life on land including mountain ecosystems, degradation, benefit sharing, poaching, invasive species, integrated planning and financial resources. Whereas the goals and

Sustainable Development Goals' functional groups and dependencies Figure 7.1



Source: Authors' own elaboration

associated targets may have independent merit, it is also useful to understand which other goals will aid in achieving SDG 15, but also, to what extent advances under SDG 15 will support other goals.

Improvements in equity (SDGs 4, 5 and 10) can create conditions for more equitable utilisation of forest and water resources, for instance through increased knowledge, resources and alternatives, thus having a positive impact on natural resources. Likewise, improvements in the provision of basic services (SDGs 6, 7, and 12) can reduce the impact of unsustainable consumption and waste products. The goals related to institutions (SDGs 8, 9, 11 and 16) can support the achievement of natural resource goals through effective policies, processes and practices.

Progress towards achieving the natural resource-related goals (SDGs 13, 14 and 15) can in turn support the provision of basic services, provide conditions for equitable development and provide a sustainable basis for institutions to translate resources to development outcomes (SDGs 1, 2 and 3). The partnerships defined in SDG 17 underpin all the goals.

To understand the role of the SDGs in the context of models of governance and policy objectives, we need to understand the dynamics of governance at the global, national and local levels. Weiss and Wilkinson (2014) state that many of the most intractable contemporary problems involve the overreach of trans-national non-state actors and that addressing them successfully requires actions that are not unilateral, bilateral, or even multilateral, but rather global, given that "everything is globalised – that is, everything except politics". The policy, authority, and resources necessary for tackling such problems remain vested in individual states rather than collectively in universal institutions. The SDGs tread this precarious line between national sovereignty and international intent. The means of implementation of the UN Resolution (UN, 2015) emphasise linkages to other international agreements and implementation through national policies and processes. Thus, whereas the intent and commitment are provided at a global scale, the emphasis on implementation is at the sovereign national level. Since forest and water systems span national boundaries, the SDGs (particularly SDGs 6, 12 and 15) provide a valuable means to support national action and cross-national cooperation for regional or global benefit.

In the framework of the water-forest-climate nexus, three SDGs are particularly relevant: SDG 6 on water, SDG 13 on climate and SDG 15 on terrestrial ecosystems. The SDGs, by their very nature, are framed in the context of human-wellbeing, which can directly be associated with the ecosystem services framework. For example, the role of coastal trees in protecting low-lying cities from storm surges is both part of the climate-forest-water nexus and corresponds to the regulating service of forests and coastal wetlands, whilst contributing to SDGs 13 and 15. Table 7.1 highlights the links between functions provided by the forest-water system and ecosystem services, whilst linking them to three of the SDGs. Relevance to other SDGs, particularly at the level of specific targets, can also be identified, however we consider the three most relevant SDGs here for illustrative purposes.

The United Nations Forum on Forests (UNFF) has likewise begun to integrate the SDG framework into its overall forest policy guidelines. In particular, the United Nations Forest Instrument (UNFI) and the UN Strategic Plan for Forests (UNSPF) for the period 2017-2030 and beyond, represent important steps along the path toward sustainable management of the world's trees and forests from a more water-driven perspective. In particular, Article V of the UNFI and Global Forest Goal 6 of the UNSPF open pathways for the integration of both currently and newly recognised forest-water interactions in the sustainable forest management framework. These frameworks, however, require further elaboration and concerted efforts in order to bring about the successful integration of the forest-water paradigm into the forest management framework.

Both the science and the science-policy interface still require considerable effort in order to be able to fully integrate forest-water interactions into the SDG, UNFF and other forest and water management frameworks. Without substantially improved knowledge and awareness of how forest and water interactions can be put to good use, more optimal outcomes are not very likely.

The relative success of initiatives such as the UNFCCC's 2015 Paris Agreement, as well as the Convention on Long-Range Transboundary Air Pollution (Box 7.2), on the other hand, suggest the general will to act is present and can be mobilised on a grand scale, in particular in cases where humanity's well-being is threatened. At the same time, the relative slowness of the UNFCCC's response to the climate challenge further suggests that such action is not easy to bring about and can require considerable expenditure in terms of resources, time and effort.

7.4 Governance as Driver and the Ability to Act – Creating Systems Potential

While scientifically it may be clear why improved links between water and forests make good resource management sense (Nutley et al., 2007), there is little acceptance of this in political circles at any level of governance (Pielke, 2007).

Ecosystem services, forest-water system functions and SDGs — Table 7.1

SDG	Ecosystem Service	Ecosystem function of forest-water system (see Chapter 2)
SDG 6 – water	Provision of reliable and clean water	W1 - Water transmission W3 - Gradual release of stored water supporting dry-season flows W4 - Maintaining water quality (relative to that of rainfall) W9 - Ecological rainfall infrastructure and biological rainfall generation, including atmospheric moisture recycling
SDG 13 – climate	Climate change mitigation, and adaptation	W2 - Buffering peak flows W5 - Stability of slopes, absence of landslides W7 - Microclimate effects on air humidity, temperature and air quality W8 - Coastal protection from storm surges, tsunamis W9 - Ecological rainfall infrastructure, biological rainfall generation, including atmospheric moisture recycling
SDG 15 – terrestrial ecosystems	Ecosystem services associated with biodiversity from terrestrial ecosystems	W5 - Stability of slopes, absence of landslides W6 - Tolerable intensities of net soil loss from slopes by erosion W9 - Ecological rainfall infrastructure and biological rainfall generation, including atmospheric moisture recycling

Box 7.2

Convention on Long-Range Transboundary Air Pollution

When looking for models of international cooperation to protect ecosystem services, one of the signature successes is the Convention on Long-Range Transboundary Air Pollution. Signed in 1979 under the auspices of the United Nations Economic Commission for Europe, the treaty itself is straightforward in that the parties (now 51 countries), simply recognise air pollution as a threat that should be reduced, without any specific commitments. But the eight protocols that have been negotiated within the framework of the convention have not only set up specific goals but created a basis for remarkable reductions of air pollutants including heavy metals, volatile organic compounds and oxidising sulphur. Two lessons from this convention of relevance to governance of the forest-water system are:

1. the methods used, i.e. "*exchanges of information, consultation, research and monitoring*". Building a scientific basis for decisions, including the collection of key data, and a forum for discussing science to work out issues has been a key part of the convention's success.
2. the focus on long-distance "*air pollution whose physical origin is situated … under the national jurisdiction of one State and which has adverse effects in … another State at such a distance that it is not generally possible to distinguish the contribution of individual emission sources or groups of sources*". This has parallels to the issues vexing the discussion of forest and water where it is unclear where the water put back into the atmosphere by forests in one place will actually come down.

(N.B. Both of the quotes in the bullet points come from the Convention, which can be accessed at:

http://www.unece.org/fileadmin/DAM/env/lrtap/full%20text/1979.CLRTAP.e.pdf. See also Strahan and Douglass, 2018).

Men drawing water from Itare River – one of the 'water towers' in Kenya
Photo © Sande Murunga/CIFOR

In many countries, the governance and management of both water and forests in a practical sense are often seen as low priority among government officials (Wallace et al., 2003). Frequently this is a legacy of past governance arrangements even dating back to colonial times in many places, and until this (im)-balance of power within and between government agencies is addressed, it is unlikely that there will be significant change in resource allocation to support more effective governance within the water and forest sectors (Biermann et al., 2009; Devisscher et al., 2016). Even within the water sector itself, a majority of countries fail to integrate those responsible for water resources and provision with those staff engaged in waste water management. In both sectors, however, forest-water interactions could have an important role to play.

The lack of attention paid to forest and water issues is reflected, for example, in the way that data is collected on illegal logging and water withdrawals. While the problem of illegal logging is well documented (e.g., Kleinschmit et al., 2016), the widespread practice of illegal water withdrawals and connections to municipal water systems is less publicised. In the water sector, this means that official water resource plans may be ineffective from the outset, with practical difficulties resulting for water utilities and other agencies who are faced with the problem of 'unaccounted' water use. Regarding the problem of illegal logging and other unofficial access to forest resources, this again gives rise to inaccurate data resulting in an increased likelihood of policy failure when attempts are made to integrate the sectors.

At the local community and household scale, access to water is essential yet inequitably distributed around the world (Sullivan, 2002). In many areas, lack of access to water for domestic use and food production is the result of poor governance arrangements. The improvement of water provision has much potential to reduce poverty, as labour availability of household members will be increased (Sullivan et al., 2003). Similarly, access to healthy forest systems provide multiple benefits for households, including increased food security, especially in times of economic stress (Sullivan, 2003).

Although most forests are found on territorial land governed by a range of customary institutions and rights (Peluso, 1992), official ownership falls to governments in over 70% of the world's forests (RRI, 2014). Yet local institutions structure villagers' attitudes, social relationships and even technology in such a way as to ensure the sustainability of forest management and to secure collaboration in managing forest notably, for water. Forest decentralisation has therefore become a key indicator for 'quality of governance', which has promoted both local participation as well as forest recovery worldwide (Agrawal et al., 2008; Xu and Ribot, 2004; Rothstein 2011). For example, in China two-thirds of forestlands are collectively-owned by local communities. The Collective Forest Reform has triggered tree planting and increased forest cover, therefore contributing to ecosystem functioning (Hua et al., 2018). In Indonesia, the hopes of customary communities have recently been bolstered by Constitutional Court assurances that they have the right to control customary forest (Myers et al., 2017). In the payments for ecosystem services (PES) framework, community-based models have been among the most successful at promoting forest cover (Min-Venditti et al., 2017).

However, claims to customarily managed forests will likely provide little control over the rivers that are crucial for local livelihoods, with forest and mining concessions able to increase sediment loads and decrease water quality at will. Rural communities around the globe are highly dependent on forest resources, but do not always have secure access to the forestlands on which their knowledge, institutions and practices are based (Scherr et al., 2003). Responsibilities of stakeholders are not always clearly defined to ensure fair and locally controlled decision-making processes at ecoregional and watershed levels (Cohen and McCarthy, 2015).

As reviewed in Chapter 2, 'rights to water' and 'rights to forest' have evolved in various parts of the world in ways that reflect the local importance of collective action for water quality and flood protection. Subsequent state institutions claimed forests primarily as a source of income for private actors (often connected to elites) and the state, with water-related concerns forming an addendum. Locally-developed ways of managing the forest-water-agriculture interface have gained recognition as traditional ecological knowledge (see Chapter 2).

The real question raised by these observations is how best to bring the knowledge, interests and rights of local communities into a forest-water governance framework, without at the same time endangering the delicate balance that must be established across potentially competing scalar dimensions, whether these encompass up- and downwind, or up- and downstream interests, or both. Faced with the mismatch of scales across social and ecological systems, the concept of landscape governance was introduced in the early 2000s. Landscape governance emphasises the multi-scalar and multi-stakeholder nature of environmental decision-making (Görg, 2007; Beunen and Opdam, 2011; van Oosten, 2013; Ros-Tonen et al., 2014; Dawson et al., 2017). It reflects the recognition that forests and water are part of a social-ecological system (SES) (Ostrom, 2007; Ostrom, 2009), and acknowledges the dynamic and multi-scalar nature of both systems.

7.4.1 National Level Frameworks

Historically the primary rationale for government involvement in forests and water was national security. A shortage of masts for shipbuilding caused the British Navy to commission the first published English language study on forests (Evelyn, 1664), while keeping river deltas navigable was a primary concern in water management (van der Brugge et al., 2005; Grigg, 2005). Beyond that, the two policy domains diverged.

Forests and water have been historically developed as separate policy domains (Gibson et al., 2000; Saleth and Dinar, 2004; Arts and Buizer, 2009), with the possible exception of upper watersheds where slope stability is a common concern. Both policy domains have dealt with local as well as national policy challenges, including transport and security issues, but often in different ways and through institutions that have little incentive to work together (Ostrom et al., 2007).

Environmental issues were invisible to many, especially in policy-making institutions, until such institutions as environmental ministries were introduced, largely in the 1980s and later, although these were often under-resourced. In many countries there is little connection between the legislative framework for forests and that for water, though some countries such as the UK and other European countries, have nonetheless managed to develop forest and water guidelines. Moreover, each is most commonly addressed by different ministries and also managed at different institutional levels. Water governance has historically distinguished between waters used as transport infrastructure, measures for flood control, irrigation, provisioning of drinking water and wastewater recycling. Such diverse issues are rarely handled by any single ministry. Most water management is addressed at lower levels of administrative authority. The European Union's Water Framework Directive (WFD – Directive 2000/60/EC of the European Parliament and of the Council) has, for better or worse, shifted lower level administrative management in many countries from the local level to higher level subnational regional authorities. On the other hand, these regional authorities have no hydrologic or forest-related jurisdictional definition.

Forests, on the other hand, tend to fall far more frequently within the authority of an individual ministry, most typically the Ministry of Agriculture, though occasionally they fall within the authority of a Ministry of the Environment, or a combined Ministry of Agriculture and the Environment. In Ethiopia, for example, forests fall within the jurisdiction of the Ministry of the Environment, Forest and Climate Change but water is the responsibility of the Ministry of Water, Irrigation and Electricity. In Austria, on the other hand, responsibility for both forests and water have been incorporated, along with other natural resources, into the new Ministry for Sustainability and Tourism created in January 2018. Canada also exhibits a similar composition bringing together natural resource management into a single ministry (Natural Resources Canada).

Perhaps the most important reason for a lack of integration between forest and water is that the dominant view of the impact of forests on water resources has remained focused primarily on the catchment and the demand-side functions that most water resource management agencies are required to fulfil. Thus, the predominant view has tended to be that forests use water and remove it from the hydrologic cycle. In this sense, forests are typically managed either for their economic benefits (harvested wood products and fuel supply), for their benefits as a watershed purification system (see e.g., Box 7.1 on the Adirondack Forest Reserve), or, as has been more and more common across different countries from the first to the second half of the 20th century, for their benefits as recreational and symbolic natural resources.

Box 7.3

Challenges of managing water and forest interactions at the mega-catchment scale: an example from the Nile Basin

The Nile River is the longest river in the world with a basin area of 318 million hectares covering about 10% of Africa. A fast-growing population of almost 300 million people depend on the Nile waters for their livelihoods and sustenance. Yet it is one of the most water scarce river basins in the world, and high pressures from rapid population growth and related expansion in agricultural demand risk sharpening transboundary conflicts over water. Climate and land use change impacts exacerbate these deep-seated tensions (Swain, 2011). The high spatial and temporal variability of rainfall across the basin results in highly variable water availability within the different sub-catchments and, as a result, complex institutional arrangements are needed if water is to be shared equitably between the riparian states. To support the institutional development needed to manage surface and groundwater in such a complex situation, the Nile Basin Initiative (NBI) was established with significant support from the World Bank, donor organisations, and from the riparian countries themselves.

Under the auspices of the NBI, efforts have been made to quantify some of the ways benefits have been shared between the riparian states. This has mostly been achieved through cooperative efforts in agriculture, energy generation, water management, irrigation schemes, and efforts in climate adaptation. In terms of energy generation, only 20% of the total basin hydropower generation potential of 33,024 MW has been developed, with 6,833 MW mainly generated in Egypt, Kenya and Sudan (NBI, 2012). Estimates suggest, however, that the combined GDP of the basin countries would increase by USD 15.59 billion if this potential could be realised (NBI, 2014; World Energy Council, 2013).

Cooperative efforts in watershed management across the basin could also result in increases in the value of benefits from agriculture. The introduction of trees in shelterbelts could protect valuable cropland, and in the villages of Argi, Abkar and Afaad, a 40 km strip of tree-planting could generate a net benefit of USD 2.2 million (NBI, 2007). On a broader scale, soil and water conservation could translate to an increase in crop value of USD 5.49 billion per annum (World Bank, 2009; NELSAP, 2012), and increased regional trade in agricultural produce could potentially generate an increase of USD 9.78 billion to the basin as a whole (NBI, 2014).

Agriculture is by far the most significant user of water in almost every country (see e.g., Hoekstra and Mekonnen, 2012), and access to agricultural water is often influenced by distorted power relations or corruption. Countries across the world have built large dams to support agricultural water use (as well as hydropower production), frequently causing massive population displacement and creating serious damage to forest ecosystems both during and after the construction phase. Furthermore, these dams may be financially supported by capital loans from international institutions. While the major beneficiaries of these dams are often large scale commercial farmers, the repayments of this capital may often have to be generated by the nation's taxpayers (Sullivan, 2006). A further problem arising from dam construction in forest areas is the increased incidence of vector borne diseases associated with land clearing, and pooling of water in rutted surfaces where heavy equipment is used for forest operations (Alves et al., 2002).

In order to be able to better address many forest-water interactions – for example the management of forested watersheds for clean drinking water, or flood moderation by better managing the extent of forest cover – it may be enough to improve governance structures at the national and sub-national levels. Increasing the relative degree of institutional and policy convergence across forest-water interactions by, for example, creating hybrid ministries to address integrated natural resource governance represents perhaps one of the more compelling models to emerge in recent years. However, when catchment-level forest-water interactions begin to merge into landscape level forest-water interactions, national-level institutional innovations may not be sufficient.

7.4.2 International Level Frameworks

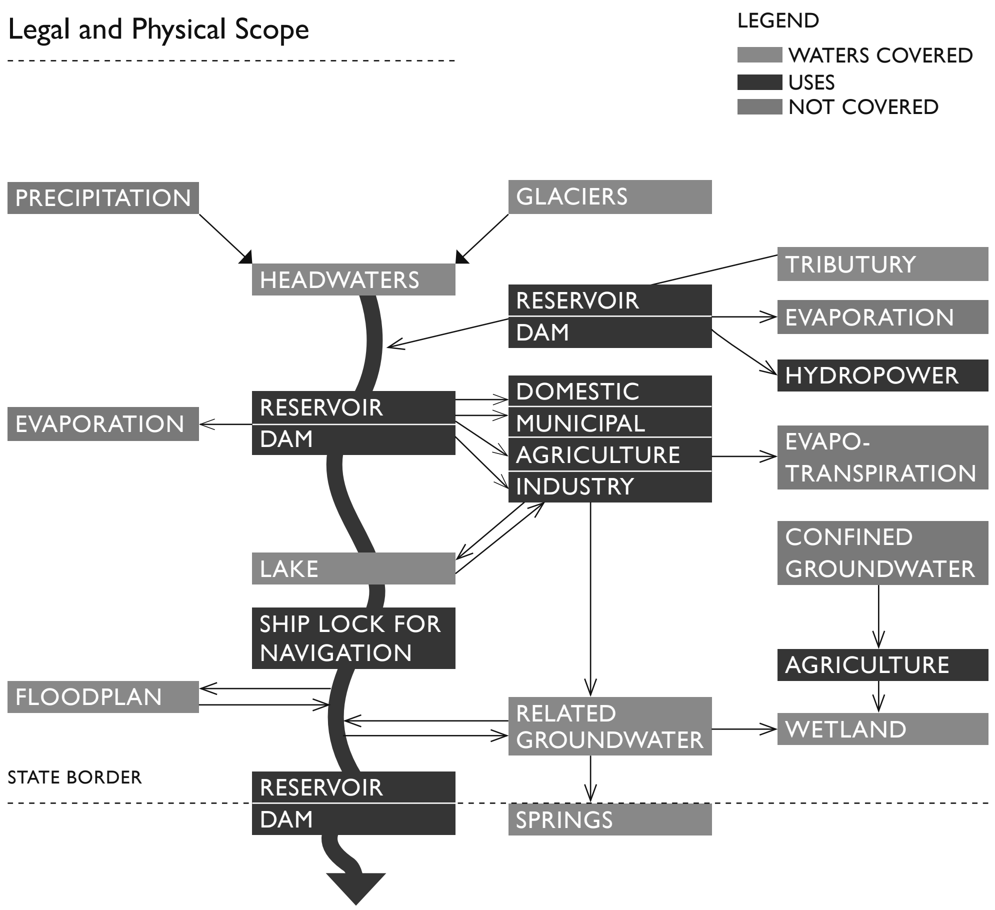
Most river basin agreements, along with institutional and state-level actors other than those representing local and regional basin-defined surface water flows, ignore the full water cycle. Likewise, the international legal framework that attempts to establish appropriate boundaries for what is covered under international water basin sharing arrangements is insufficient. As illustrated in Figure 7.2, the UN Water Convention, which intends to provide such an international legal framework, ignores the role and importance of evapotranspiration, regardless of whether evapotranspiration derives from intra- or extra-basin flows of atmospheric moisture. More generally, recognition of these types of forest water interactions has been slow to materialise (Dirmeyer et al 2009; van der Ent et al., 2010; Keys et al., 2012, 2017; Ellison et al., 2012, 2017).

Some of the water balance components in Figure 7.2 could be major limiting factors to future livelihoods and societal development, in particular the failure to measure and assess the impact of evapotranspiration, both at the local and the cross-catchment level.

A more recent dynamic view of the spatial dimension of the hydrologic landscape that moves beyond the framework of the catchment, raises the complexity of governance of the system to another level. When it comes to up- and downwind governance arrangements, there does not seem to be a single international integrated water management framework that has thus far managed to go beyond the inclusion of the riparian countries bordering the catchment in question, or that has managed to include countries that are the principal sources of the evapotranspiration that falls in a given basin as precipitation. Improved understanding of the consequences of the spatial organisation of land use

Waters covered (and not covered) under the UN Water Convention Framework

Figure 7.2



Source: Rieu-Clarke et al., 2012

practices and the role these play in the production and total available amounts of atmospheric moisture is crucial to our ability to make better use of this option.

We are only aware of one international agreement that recognises and attempts to constrain the potential for countries to interfere in the atmospheric hydrologic cycles of other countries and that is the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (the Environmental Modification Convention, or ENMOD for short). Signed in 1977, it was primarily designed to prohibit countries from interfering in the weather of other countries under conditions of war (the initial complaint involved the US' use of cloud seeding to increase rainfall in specific target areas during the Vietnam war). The actual convention is not limited to acts of war and incorporates all relevant environmental modifications that can have a 'hostile' impact on environmental outcomes in other countries. The Convention on Biological Diversity, developed in 1992 and which came into force in 1993, also bans some forms of weather modification, or geoengineering. Finally, the focus on the 'long-distance effects' of pollutants in the Convention on Long-Range Transboundary Air Pollution (see Box 7.2), likewise provides a potential framework for future discussion.

7.4.3 From Catchment to Landscape – On the Configuration of Regional and Transboundary Institutions

Recent publications (Dirmeyer et al., 2009; Keys et al., 2017; Ellison et al., 2017) highlight the failure to consider up- and downwind sources of atmospheric moisture, in particular in arrangements that attempt – sometimes very explicitly – to regulate the amounts of water used by individual countries along a river basin, as a cause for concern. As demonstrated, in particular, by the case of the West African Rainforest and Ethiopian Highland atmospheric teleconnection (see Box 7.4), the availability of waters in the Nile River basin are potentially influenced by changes in land use practice in the Tropic forest belt across the West African Rainforest and the Congo Basin. This is all the truer in situations where high rates of deforestation threaten to alter important land-atmosphere interactions and the supply of atmospheric moisture (Nobre, 2014; Lawrence and Vandecar, 2015).

Regional and transboundary commissions (Box 7.5) have been established to deal with water governance in some of the more important transboundary basins. However, even at the catchment scale, these integrated water basin management frameworks face challenges. For example, in the case of the Nile Basin Initiative (NBI) most of the more important agreements are currently signed separately, either between the major downstream countries (Egypt and Sudan), or between the principal upstream countries (Burundi, DR Congo, Ethiopia, Kenya, Rwanda, Tanzania and Uganda). Though negotiations continue, attempts to bring these two sets of countries together have thus far failed to yield more encompassing agreements that would permit an adequate reconciliation of potentially competing demands over water rights and access (e.g., Salman, 2017; Yihdego, 2017 and also Boxes 7.3 and 7.4 on the transboundary Nile Basin arrangement).

Despite the fact that catchment-level transboundary governance institutions still require significant effort to successfully govern the entire precipitationshed, significant reform of the existing Nile Basin Initiative would be necessary to encompass both the catchment countries and the precipitationshed countries, which include the West African Rainforest and the Congo basin areas. Such a broader governance perspective may well be necessary to successfully manage up- and downwind flows of atmospheric moisture, in particular in the context of persistent and progressive climate change, but also, more generally, in the context of rapid population growth, rising food demand, increasing agricultural production and progressive deforestation.

Box **7.4**

West African Rainforest teleconnections to an African water tower

About 85% of the surface water reaching Egypt originates from less than 10% of the Nile River Basin's total area: the Ethiopian Highlands. Much of the precipitation falling on these highlands originates as atmospheric moisture transported from the Indian and Atlantic Oceans as well as from the West African Rainforest (WARF; Viste and Sorteberg, 2013). Though concerns remain about how accurately these sources can be apportioned, evapotranspiration from the WARF provides an important contribution to rainfall in the Ethiopian Highlands and Blue Nile Basin areas. The WARF also influences the weather patterns bringing atmospheric moisture to the highlands. Changing land use in the WARF, especially deforestation, and associated changes in atmospheric transport patterns and regional climate will influence future rainfall patterns over the Ethiopian Highlands. This has major ramifications for subsistence farming in the highlands and regional food security, as well as for livelihoods further downstream along the Nile. Transboundary negotiations over water resources in this international basin ignore the importance of the WARF. Negotiations about water and food security in the Nile Basin should ideally move beyond transboundary discussions to include transregional governance, with an eye to the sources of the precipitation that provide the lion's share of the Nile waters beyond the basin. Ellison et al. (2017) and Keys et al. (2017) are two of the first papers to think through the implications, and enormous challenges, of managing such teleconnections. *Source: Gebrehiwot et al., 2018*

Box **7.5**

Transboundary river basin management

At all geospatial scales, transboundary rivers and forests provide challenges for management.
Progress on transboundary water governance at the global scale has been slow. Even though the 1997 UN Convention on the Law of the Non-Navigational Uses of International Watercourses entered into force in 2014, there is no guarantee that the majority of the world's transboundary riparian states will adhere to it. More recently, the UN Water Convention has been seen as being more effective (UNECE, 2013), but there is still no global agreement on how transboundary rivers can effectively be managed for the equitable sharing of benefits from the river system (including groundwater). The Greater Mekong catchment, for example, contains six countries, all with very different governance approaches to both forest and water management. In spite of the fact that a Mekong River Basin Commission was set up three decades ago, full integration of how water is managed across the basin has yet to be achieved. As a result, land degradation and deforestation rates have been dramatic, with far-reaching consequences for the whole region. Between 1990 and 2015, some 5% of forest cover has been lost across the basin, with a corresponding loss of ecosystem services.
In response to this, initiatives are now being undertaken to address this governance challenge through the formation of 'Voices for Mekong Forests', a multinational collaborative effort by non-state actors. In this EU-funded project, the interests of 85 million forest dependent people, (including some 30 million indigenous people), are being addressed, in specific transboundary forests in Lao PDR, Myanmar, Thailand and Vietnam (Dahal et al., 2011; RECOFTC, 2017). This is to be achieved through the establishment of a regional 'Forest Governance Monitoring System', and capacity development for regional non-state actors to enable them to play a more meaningful role in forest governance in the Greater Mekong Basin.

International and transboundary aquifers likewise pose very similar problems of international management and coordination (see e.g., Gleeson et al., 2012). Moreover, the explicit role of forests in promoting recharge, or the role of deforestation in explaining aquifer retreat and loss, have, at best, been inadequately explored. The work of Ilstedt et al. (2016), however, suggests these issues deserve more attention.

Blue Nile falls in Tis Abay, Ethiopia
Photo © iStock: Joel Carillet

7.4.4 Actors versus Institutions and the Problem of Agency

It is opportune to consider which factors are most likely to support and strengthen the likelihood that actors will act in the interest of the general public and broad communities of interest, as well as to support and promote more innovative knowledge generation systems. Such factors are perhaps best explained by the existence of strong civil society organisations and effective educational systems but are also potentially the result of more polycentric institutions that favour 'shared governance' over reliance on single individuals and/or political parties.

Similar sets of questions can be directed at the behaviour of the private sector. The private sector has no immediate public mandate and has the explicit goal of defending economic interest, the profit-motive and the ideal of personal gain. Thus, since the goals of corporate entities are primarily profit-driven, they do not have any strong inclination to serve either the public interest, or the interests of sustainable natural resource governance except insofar as they rely on natural resources for their business. The role of the private sector , however, is increasingly central in the governance of natural resources.

Exploring the factors that drive corporations to internalise the externality costs of ecosystem damage and destruction may provide important insights into potential opportunities for mobilizing the corporate sector into positive action on natural resource governance. In many cases, this can happen because corporate actors may

Box **7.6**

The responsible corporation

Corporations that are directly or indirectly dependent on forest-based commodities have a significant role to play in climate security through responsible action in their operations and supply chains. If not addressed, businesses face significant social, environmental and economic risks that will impact the reputation, the operations and ultimately the expenditure of their business (FAO, 2017). These risks unfold due to deforestation impacting on ecosystem infrastructure and services, causing biodiversity and habitat loss, greenhouse gas emissions, disruption to water cycles, soil erosion and social conflict (CDP, 2016, 2017). The Carbon Disclosure Project provides a platform for businesses to publicly disclose their efforts to reduce their impacts relating to carbon issues. Another mechanism is corporate social responsibility (CSR) strategies, which include clean development in support of the United Nations Framework Convention on Climate Change (Aggarwal, 2014).

Initiatives such as the New York Declaration on Forests, the Consumer Goods Forum and the Banking and Environmental Initiative, are drivers for zero-net deforestation through reforestation. Such initiatives – and those of certification and procurement standards such as the Forest Stewardship Council (FSC), the Roundtable on Sustainable Palm Oil (RSPO), Naturland, and the Rainforest Alliance Certified Coffee Farms – attempt to eliminate deforestation from supply chains.

The Paris Agreement on Climate Change and the Sustainable Development Goals (SDGs) are fairly new international mechanisms that are further driving businesses to commit to zero deforestation. While such mechanisms are driving governments to regulate unsustainable practices, it is the investors that are uniquely positioned to influence change by shifting financial commitment away from high-risk unsustainable business practices (CDP, 2017; FAO, 2017). Investors are increasingly favouring companies with policies and supply chains that decouple commodity production from forest impacts, which also affects supply chains and producers.

Companies as diverse as Dell and IKEA have planted millions of trees as part of their corporate social responsibility programme. While the notion of planting trees is extremely appealing, it may not always be as valuable as it appears. Tree planting is one of the most contested issues in the climate policy debate (Carton and Andersson, 2017). Offset projects have been linked to land grabbing; the displacement of rural communities; the unequal distribution of, and access to resources; a particular propensity for corruption; and a range of deleterious environmental side effects (Böhm and Dabhi, 2009; Leach and Scoones, 2015). In some instances carbon offsetting projects have been criticised for displacing the burden of mitigation to some of the world's poorest communities while giving the richest countries – and those most responsible for climate change – the opportunity to avoid taking action themselves (Bumpus and Liverman, 2008).

actually depend to varying degrees on the provision of specific ecosystem services, or because they may have an interest in presenting a positive public profile (see Box 7.6). Moreover, at a global scale, private sector entities are increasingly held accountable for actions along the total value chain (Mithöfer et al., 2017). For many tropical commodities 'zero deforestation' pledges have become popular, but how these are defined and implemented remains to be seen (Pasiecznik and Savenije, 2017).

7.4.5 Multi-Level Governance, Polycentricity and Multi-Scalar Governance

In the last couple of decades, the central authority of environmental governance has migrated from its focus central governments to multiple geographical scales (from international to local) and now also encompasses a broader diversity of actors (from local communities to large multinational companies; Box 7.6). Four recent trends in environmental governance have been highlighted: decentralisation, globalisation, the increasing role of market and agent-focused instruments and cross-scale environmental governance (Lemos and Agrawal, 2006). We might add to this the phenomenon of cross-sectoral environmental governance in institutional frameworks that begin to create the potential for building upon interactions across important natural resource frameworks, in particular forests and water.

The most appropriate level for addressing environmental resource governance issues remains somewhat obscured in controversy (e.g., Ostrom, 2009). Many point to the relative advantages of the international level of governance as a framework for sending appropriate signals (e.g., through the setting of 'norms' or the establishing of treaties) to regional and national level governments (Frieden et al., 2016). The fact that related issues – such as the up- and downstream management of forest-water interactions – have, to some degree, already been addressed in international conventions may suggest the international governance pathway represents one possible strategy for incorporating up- and downwind land-atmosphere interactions into some kind of international agreement.

On the other hand, there are frequent calls for decentralisation, and for returning to more local levels of governance as a way of generating closer attachments to local needs, interests and expertise (see e.g., Colfer and Capistrano, 2005). The downside of larger scale governance at the regional, national, transboundary and transregional levels, is that local interests, needs and knowledge are frequently overlooked and usurped by power seeking interests at these larger and often more distant spatial scales. Participatory governance and increasing decentralisation represent two strategies that have been invoked in an attempt to encompass and incorporate greater involvement from the local level, ensure the recognition of local interest and rights, as well as to engender greater legitimacy for policy-making.

The downside of increasing expectations regarding decentralisation and even local autonomy are that the management of multi-scalar needs for both up- and downstream, as well as up- and downwind interests and concerns with respect to forests and water require institutional frameworks that are capable of coordinating across disparate groups that are spatially and geographically separated, sometimes by long distances (see e.g., the discussion of long-distance teleconnections in van der Ent et al., 2010 and van Noordwijk et al., 2014).

Tensions between more centralised and more localised governance frameworks are not new. They have long troubled the smooth functioning of social, economic and political systems. And they have only been exacerbated with the increasingly rapid emergence of globalisation and the diverse set of international governance frameworks to emerge alongside national level governance. In this regard, developing strategies that can successfully reach across these domains seems more important than delegating exclusive authority to one level of governance over the other.

Increasing and/or achieving reciprocity across different levels of governance, from the local to the national level (and ideally all the way up to the international level) is one of the principal goals of polycentric governance, which is based on greater degrees of power-sharing and participatory decision-making across multiple levels of governance (Ostrom, 2010a, 2010b). Political and institutional decision-making frameworks that makes it possible for groups to interact and coordinate their interests, without at the same time imposing excessive power either from the top-down or the bottom-up is likely to be better suited to managing both the desire for decentralisation, on the one hand, and the necessity of coordinating multi-scalar forest and water interests across spatially and geographically distinct regions.

The ideals of 'participatory governance' rest upon a similar set of principles. General guidelines for participatory governance models are widely available (see e.g., Fischer, 2010, or the work of the International Observatory on Participatory Democracy, https://oidp.net/en/about.php). These models emphasise and promote the advantages of inclusiveness in decision-making processes. The concept of polycentricity may however go one step further, since it opens up more questions about the locus of final decision-making authority and may extend more flexibility and reciprocity across the individual components of the polycentric system. But the concepts of reciprocity and general inclusiveness in the discussion and coordination of the issues of the day, in this case natural resource governance, are common to both.

Polycentric institutions of shared governance are also likely to reinforce the selection of other institutional and civil society features based on the ideals of polycentrism. Ostrom makes this argument herself when she writes; *"Polycentric systems tend to enhance innovation, learning, adaptation, trustworthiness, levels of cooperation of participants, and the achievement of more effective, equitable, and sustainable outcomes at multiple scales, even though no institutional arrangement can totally eliminate opportunism with respect to the provision and production of collective goods"* (Ostrom, 2010a).

These models provide a strong foundation for thinking about how to improve interactive reciprocity across different levels of government and society. States and national governments, however, lie in-between the local and international levels of governance and are typically vested with the right to act. Moreover, states possess all the appropriate trappings of modern governance (executive, legislature, judiciary) (Scheffer et al., 2009). Thus, whether or not such strategies are chosen will depend, not on idealised models of governance, but rather on the balance of interests and the evolution of political coalitions at the national level. Clearly not all states or national governments can or are willing to move in the direction of more polycentric forms of governance – witness for example the many calls for subsidiarity, even in the context of European governance. But to the extent this is possible, and is supported by broad political coalitions, it may provide the foundations for more balanced natural resource governance outcomes.

7.5 Governance and the Capacity to Act – Reforming Governance Systems

7.5.1 Knowledge of Environmental Systems

As illustrated through this assessment, our knowledge of the ways in which environmental systems, including forest-water interactions, function, is reasonably well advanced, despite the fact that not all aspects of these interactions are all that well accepted. However, the extent to which we have progressed with the integration of forest-water interactions in the general policy framework is far more limited. And continued disagreement regarding some aspects of forest-water interactions has not simplified this process.

It is more important , therefore, to turn our attention to relevant policy frameworks that can potentially be used for setting some of these goals into action.

7.5.2 Models for Action

Many measures can be undertaken without a significant amount of institutional reform. Thus, for example, the promotion of forested watersheds for the provision of clean drinking water, or the reforestation of flood prone landscapes. Text boxes 7.7 and 7.8 provide other meaningful examples of measures that individual countries have undertaken without the need for significant institutional reform.

On the other hand, for other concerns, more significant institutional reform may be required. Thus, for example, the merger of ministries that integrate natural resources into a single institution (or ministry) represents a far more significant reform that requires significant legislative and/or executive effort and preparation. On the other hand, the advantages that may arise out of such mergers may well be worth that time and effort. It will thus be interesting to follow the experience of those countries that have undertaken such such strategic shifts in behaviour.

At the same time, it is important to recognise that not every country is prepared, nor has the political will to undertake such transitions. Certainly, the transition to more polycentric forms of governance, or to democracy, represent even more considerable evolutions that not all countries can adequately manage. And, as the eco-compensation model in China illustrates (see e.g., Ouyang et al., 2016; Leshan et al., 2018), the transition to democracy, let alone to more polycentric forms of governance, may not necessarily hold the only key to successful environmental and natural resource governance. In this regard, first environmental principles and adequate knowledge of environmental systems can potentiatlly trump the adequacy of governance institutions. But, on the other hand, arbitrary rule, dependence on the will and whim of the rulers, may leave such systems prone to future failure.

7.5.2.1 Instruments and Incentives for Forest-Water Governance

One of the suggested models for integrating the interests of different and potentially competing groups is represented by the market-based instruments (MBIs) and PES models discussed in more detail in Chapters 5 and 6. These strategies generally illustrate a set of principles concerning the potential governance of forests (and water) that may be useful in beginning to define a pathway for achieving reciprocity across multiple governance layers, as well as regions and differentiated spatial locations. What is uniquely interesting about these arrangements is that they allow for some degree of local self-governance and management, within a larger, multi-scalar and geographically dispersed cooperative and coordinated framework.

At the same time, however, these models are also being contested for their potential risk of inducing nature commodification (Gómez-Baggethun, 2014; see also the discussion in Box 7.6) and contributing to changes in values or mind-sets relating to environmental protection, changing conservation logic "*from moral obligation or community norms towards conservation for profit*" (Rode et al., 2015). Whether or not this is a bad thing, remains to be seen. On the one hand, without valuation, it is much simpler to usurp the provisioning power of ecosystem services for singular interests and purposes. On the other, with valuation, it may be easier to guide this provisioning power of ecosystems more in the direction of services in the interest of public and human welfare. Without such supporting framework, the transition away from defending purely economic interests may not always be possible.

As noted in Chapter 6, the typical market-based instrument and PES models involve performance-based payments that generally tend to be 'conditional' on the delivery of ecosystem services or on the actions that are supposed to deliver those services. These payments are also expected to provide 'additionality', i.e. go beyond what would be delivered in the absence of the scheme. Governments generally agree to organise the provision of these services because they would not otherwise occur in market systems. These strategies remain market-based, however, in the sense that stakeholders are paid for the contractual fulfilment they agree to provide (see e.g., Martin-Ortega et al., 2013; Porras and Asquith, 2018).

Box 7.7

Working for Water (WfW) in South Africa - An example of an innovative multiple benefits approach

South Africa and, indeed, the African continent more broadly, has a long history of attempts to deal with problems directly and indirectly related to invasive alien species (see, for example, IPBES 2018). The case of the Working for Water (WfW) programme in South Africa provides us with a useful example of a management approach that has tried (with acknowledged limitations) to focus not simply on one objective, but to take a positive synergies approach and yield benefits in a range of areas. Established in 1995, and currently managed by the Department of Environmental Affairs, WfW has worked on clearing alien invasive species with the intention of improving ecosystem services, including water provision, while also focusing on job creation and the broader objectives of land management.

A 'WfW' team at work in Limpopo Province, South Africa. Photo © Jane Furse

Van Wilgen et al. (2013) found that the programme had reduced invasion with regard to some species, but not all, finding that invasions had become more of a problem in many biomes. By 2013, WfW had spent approximately USD 457 million on the control of alien invasive plant species (interestingly, two invasive species combined account for just over a third of the expenditure). Given the mixed success, a more focused approach was recommended, with more funding redirected to support biological control, where success rates have been higher. In this way, WfW provides an imperfect, but useful example of a management approach that attempts to yield results across a range of sectors, focusing on alignment where possible. For more information, see also Marais and Mlilo (2018)..

Box 7.8

'Thanks to the Forest, We have Water' youth perspectives on community-forest-water linkages

The Future of Forest Work and Communities project engages forest youth from around the world to share insights and ideas about community, territory, rural versus urban life, forest values, and forest work and governance. Multi-day 'visioning' workshops have been held, or will soon be held, in Bolivia, Canada, Ecuador, Guatemala, Indonesia, Mexico, Mozambique, Nepal, Peru, the Philippines, Tanzania and Uganda.

Water was not a theme that explicitly informed workshop activities, yet water has repeatedly been raised by participants as a key issue. In four of eight workshops, clean drinking water was among the most important benefits of village life, with 'access to clean water' a major reason why youth may choose to stay in their communities. While access to clean water was a major pull factor for communities, water scarcity and water contamination were among the key drawbacks associated with city life. Youth also perceived a clear connection between water availability and forest stewardship. When asked why forests were important, youth at every workshop talked about the role forests play in 'providing' or 'purifying' water. In Poplar River First Nation, Canada, a youth stated it was *"important for everyone in the world to have forests … for water, oxygen… we want to support them [the forests] for our kids, for the future"*. In Intag, Ecuador, water was the main reason for restoring its cloud forest – *"Why plant trees? Because they give us WATER!"* When youth discussed forest work opportunities, water remained centre stage. In five workshops, youth developed project ideas based on locally-sourced water, including community water bottling plants (Bolivia, Mexico and Nepal), irrigation infrastructure (Bolivia) and water purification systems (Canada).

While many consider life outside of their communities, this work is showing just how connected these young people are to territory and the forests they still call home. Water plays a fundamental and increasingly important role in these place-based relationships. As actors work to improve community-based forest management, community-based applications of REDD+, and other PES projects, it is vital that they understand such perspectives. After all, it is these young people who will shape local community capacities to lead future forest strategies.

(See: http://pilot-projects.org/projects/project/the-future-or-forest-work-and-communities)

In this basic model, several features appear to be key:

1) Some role for the higher-level assessment and recognition of ecosystem gaps is necessary. Without government intervention, these gaps are presumably less likely to be recognised and action less likely to be undertaken.
2) These strategies typically involve more or less formal contracts between governments and various stakeholders for services rendered.
3) As long as the ecosystem or related services are provided (performance-based strategy), payments are typically made to the providers of these services.
4) In many cases the provision of ES depends on the maintenance or adoption of certain land use/management frameworks can potentially deliver nature-based services important for general human welfare. This is common in the case of water-related services, as the performance (output in terms of the actual service:

water yield or improving quality is not monitored, but land use/management changes are).

Though most PES models are based on some degree of knowledge about forest-water interactions, this knowledge is at best imperfect and often competing views about the viability of forests for promoting water availability are prevalent. The vast majority of PES for water services provided by forest are established to address up- and downstream dynamics at the catchment level (Martin-Ortega et al., 2013). Inadequate attention is paid to the up- and downwind framing of forest-water interactions (where most supply-side, precipitation-recycling is likely to have its principal impact).

Many of the initial signals for the establishment of agenda-setting principles and potential projects designed to mobilise and promote ecosystem services often have an initial spark as government plans. International agenda-setting on the goals of integrating forest and water interactions into the general climate change adaptation framework is important because of the signal it sends to national governments, as well as the many stakeholder organisations. At the same time, it is becoming increasingly important to recognise the value of monitoring and assessing the outcomes and viability of these ecosystem-based strategies (see e.g., Taffarello et al., 2017). The Forest and Water Programme at the FAO is also currently working on the development of such a Forest and Water Monitoring Framework.

Real, performance-based systems are hard to achieve (van Noordwijk et al., 2012) as they require high quality and fine-grained data on carefully selected metrics (van Noordwijk et al., 2016; Lusiana et al., 2017). While progress is being made to disentangle the combined effects of climate variability and change, and land use change on streamflow in specific landscapes (Ma et al., 2014), most ‘performance-based’ schemes will for the foreseeable future rely on ‘land use proxies’ for the desired ‘ecosystem services’.

At the same time, many of these performance-based schemes exhibit positive outcomes. Min-Venditti et al. (2017) highlight the fact that both PES (88% of cases) and community-based management strategies (81% of cases) have had strong positive impacts on increasing forest cover, in particular in Mexico and Costa Rica. Whether PES systems have proven capable of addressing questions of scalar mismatch, however, has generally not been assessed. The Min-Venditti et al. (2017) study, for example, does not consider the impacts of such strategies on forest-water relationships – though clearly such a research programme could provide new terrain for the analysis of PES and reforestation programmes more generally.

7.6 Research Gaps and Future Priorities

The transition to a forest and water management framework that manages to successfully integrate forest and water interactions and, in addition to up- and downstream relationships, is able to encompass up- and downwind forest-water relationships, is necessary, but is likely to be the cause of some conflict and controversy. The challenges of increasing water scarcity and progressive and persistent climate change, not to mention additional contextual factors related to rapid population growth, etc., require us to identify strategies that can help facilitate adaptation to, and ultimately mitigation of, climate change through mechanisms that will help to preserve existing forest cover and perhaps even go beyond.

Institutionally-driven decision-making frameworks that are large enough in their membership and representation to physically encompass the geographic spread of such ecological relationships are far more likely to be able to address up- and downwind relationships. A focus on the catchment is inadequate, since this framework has typically led institutions and countries to ignore both the downwind impacts of local action, as well as the potential upwind contributions to the local water regime. In order to bring these relationships into the general discussion of forest-water and hydrologic relationships, there is a need to extend the geographic coverage of such institutional negotiation and decision-making frameworks.

The relative importance of finding ways to further encourage integration of the larger scale hydrospace perspective into the general framework of policy output and decision-making on forest and water issues can no longer be ignored. The livelihoods of millions of people may well depend on how well individual countries and larger regions are able to manage these larger scale relationships. However, there is still much to be learned. In particular, it would be helpful to greatly improve our knowledge of when and where additional forest cover can help intensify the hydrologic cycle. Though we think of this general relationship as a universal principle, there are likely to be important differences across biomes that have not been adequately considered.

A shift toward policy objectives that increasingly incorporate the knowledge-base provided by the current literature on forest-water interactions can significantly impact human welfare. Thus, benefit sharing and uneven distributional impacts, both in the water and forestry sectors, as well as across geographic landscapes, have to be carefully examined if new strategies are to be developed towards greater cross-sectoral and multi-scalar, cross-regional harmonisation.

The ability of governments and more international decision-making frameworks to adapt to these emerging concerns may well depend on their ability to devise appropriate discussion and decision-making structures and/or institutions. This may involve the elaboration of institutions capable of addressing forest and water issues simultaneously and in concert (as opposed to in separate institutional ‘silos’), or it may involve the elaboration of negotiation frameworks that are capable of spanning not only the catchment, but also the precipitationshed.

To the best of our knowledge, no existing PES schemes or governance frameworks reflect the emerging broader understanding of forest-water dynamics. A next step in the MBI and PES discussion would be to try and classify existing forest-water strategies into different categories and to assess their effectiveness based on where they fit within this general framework, i.e. whether they are designed to address only the catchment or attempt to mobilise larger-scale (beyond-the-basin) visions of the hydrologic landscape, similarly to what has been achieved with international/global carbon-credit and REDD+ schemes. Another potential next step may be to begin proposing PES and MBI schemes based on the supply-side model.

7.7 Conclusions

A mismatch exists across ecological and administrative scales, generating challenges for the management of transboundary forest and water resource systems. A further mismatch occurs within national scale governance contexts, especially in federal governance systems where responsibilities for forests and water are typically shared between central ministries and administrative bodies as well as provincial and municipal level counterparts nested within an administrative hierarchy.

Not all countries are in a position to optimise their existing institutional and political frameworks. In this regard, the failure to arrive at more optimal solutions may be dictated by the inadequacies of the existing political and institutional frameworks. In such systems, the only recourse may be strong social and civil action in order to overcome persistent barriers to successful natural resource governance. As Andersson and Ostrom (2008) note:

> *"there is no guarantee that such [polycentric] systems will find the combination of rules at diverse levels that are optimal for any particular environment. In fact, one should expect that all governance systems will be operating at less-than-optimal levels given the immense difficulty of fine-tuning any complex, multi-tiered system"* (p.78).

The governance of, and co-investment in, water and forests as resources can be improved to reduce the identified hydro-vulnerability in the context of all SDGs, and the persistent and growing threats arising from climate change. Failure to place water at the centre of discussions on forest – climate interactions and diverse forestation strategies, will have important negative impacts on policy effectiveness and ultimately on the provision of water.

Governance frameworks play a key role in the potential optimisation of natural resource management. Moving from an emphasis on decentralisation to one that addresses flexibility and balanced interaction across multiple levels of governance (polycentrism) is more likely to ensure outcomes that are able to address concerns central to the management of larger scale landscapes (as opposed to catchments). People must be respected as integral components of the forest-water interface, and policies to strengthen that interface must engage with them at all levels to ensure success. The challenge for polycentric governance is to balance top-down and bottom-up forces.

Models that increase the degree of shared governance and move away from dependence on single individuals or majorities may be more successful at providing positive natural resource governance. Likewise, such models may provide opportunities for reconciling interests in decentralisation and relative local autonomy (subsidiarity) with the simultaneous need for more regional and cross-national coordination of policy goals.

Cloud forests in Rincón de la Vieja National Park in Costa Rica
Photo © iStock: PobladuraFCG

Market-based instruments in environmental management are part of new public-private partnerships involving non-state actors taking responsibility for resource governance. Moreover, this type of institutional structure presents opportunities for the coordination of up- and downwind, as well as up- and downstream interests and concerns. The framing of rights and obligations, however, remains a sensitive issue.

Institutional frameworks that have been set up to address transboundary concerns need to be re-constituted and reformed to be able to address both up- and downwind, as well as up- and downstream forest-water relationships. This is further likely to extend the geographic purview of such institutional frameworks due to the requirement of bringing together locations that are the providers of atmospheric moisture, with basins where that atmospheric moisture contributes to potential rainfall.

International governance plays a highly important, symbolic and substantive role by creating norms (such as the SDGs), and providing fora in which these norms can be discussed, negotiated and agreed upon. National level governance can also be radically improved, in particular, by beginning to bring together competing sectors of the economy into national level institutional frameworks that encourage cooperation and negotiation across the broader scope of forest and water interactions.

Strategies that can assist governments and NGO actors to move beyond the dominance of entrenched interests are important for shifting policy goals away from more profit-oriented and toward more sustainability-oriented strategies, policy building and policy learning. Market-based instruments and PES schemes may provide one, though certainly not the only, model for moving forward.

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