CHAPTER II: DEFINITIONS, OBJECTIVES AND COMPONENTS OF TRANSBOUNDARY WATER ALLOCATION

SUMMARY:

This chapter details the definitions and objectives of water allocation in a transboundary context, and describes the key processes, approaches and mechanisms applicable in allocation arrangements and agreements. It also presents an overview of the core components of international water law, shared knowledge and data, and cooperation at different scales of governance for advancing sustainable and equitable water allocation.

1. Definitions and Objectives of Water Allocation in a Transboundary Context

Simply put, water allocation determines who can use shared water resources, for what purposes, in what quantity and of what quality, where and when. This Handbook takes as its starting point the following set of definitions for transboundary water allocation, building on previous practice and guidance.[19]

Transboundary water allocation is an iterative planning and decision-making process and/or an outcome that determines the quantity, quality and timing of water between two or more States and grants associated entitlements.

Water quantity is most commonly specified as an average volume of water (per year, month or other period) at a certain location. It may also be defined as an average, as a minimum volume, as a percentage of available supplies (a share of flow or of the volume in storage), or by a particular rule on access (e.g. legal right or entitlement to abstract a certain volume under particular circumstances).

Timing relates to daily, monthly, seasonal or inter-annual variabilities and exceptional circumstances, both natural and human induced, in water quantity or quality. In transboundary contexts, this occurs at the border. Velocity of water allocated is a combination of quantity and timing, which concerns the quantity of water passing through the border within a designated time period.

Water quality concerns certain water quality objectives and criteria with associated parameters, including standards and testing, that make water suitable for the intended use.

Transboundary waters means any surface or groundwaters that mark, cross or are located on boundaries between two or more States; wherever transboundary waters flow directly into the sea, these transboundary waters end at a straight line across their respective mouths between points on the low-water line of their banks. This definition comes from the Water Convention (Art. 1(1)) and the Convention incorporates a basin approach to the use and protection of transboundary waters. Another related definition under the Convention is "transboundary impact" (see Art. 1(2) of the Water Convention).

---

19 See Water Convention text at https://unece.org/DAM/env/water/publications/WAT_Text/ECE_MP.WAT_41.pdf; Speed and others (2013); OECD, *Water Resources Allocation: Sharing Risks and Opportunities* (2015).

Transboundary contexts, in this Handbook, covers a range of settings where surface waters and groundwaters (including rivers, lakes and aquifers) mark, cross or are located on boundaries between two or more States.

Allocable water is the share of water resources utilizable for abstraction for different uses in the given basin or aquifer area. Ideally, this occurs after flows needed to meet environmental objectives have been reserved.

Water entitlements give rights to different parties to abstract and use water for specific or general purposes. The entitlements may be further allocated to subbasins, regions and, ultimately, individual users who get water abstraction rights, permits, concessions or licences, depending on the jurisdiction.

Objectives of transboundary water allocation are context specific and often interconnected. They include, but are not limited to, those listed below (in no particular order):

- Equitable and reasonable use of shared water resources;
- Avoidance of significant harm to other States and parties;
- Environmental protection;
- Climate change adaptation;
- Management of exceptional circumstances, such as droughts and floods;
- Vital human needs;
- Benefit-sharing.

These different objectives are discussed in further detail in Chapter V.

2. Understanding Water Available for Allocation

Understanding water availability for different needs, uses and functions, in different seasons and climate and in development scenarios, is a key requirement for sustainable and equitable water allocation. In a transboundary context, estimation of allocable water consists of:

1. Delineating and agreeing on the basin and/or aquifer boundaries;
2. Assessing surface water and groundwater availability and quality, considering inter- and intraannual variability and overlap between the two water sources with hydrological and geohydrological analyses utilizing commensurate methods and data;[20]
3. Estimating allocable water in different seasons and in different scenarios.[21]

These different steps and associated methods are presented in more detail in Chapter VII.

The water available for allocation does not equate with the total water amount present in a basin or aquifer, primarily for three reasons. First, water availability may be constrained by hydrological variability, geology or infrastructure. Second, part of the flow is required for maintaining ecosystem and environmental functions. Third, the natural quality of water does not necessarily meet the requirements of different needs, uses and functions, and degraded water quality resulting from human impact such as pollution further limits the use

20 The overlap between river flow and groundwater recharge is largest where groundwater contributes significantly to river flow (i.e. a significant fraction of groundwater recharge is converted into river flow via base flow), which happens in humid areas. The other extreme is in arid areas, where river flow may contribute to groundwater recharge. Not accounting for this overlap may overestimate total renewable, and allocable, freshwater resources.

21 For general guidelines on assessment of transboundary water resources, see UNECE, *Second Assessment of Transboundary Rivers, Lakes and Groundwaters* (New York and Geneva, United Nations, 2011). For a detailed approach for estimating allocable water, see Speed and others (2013).

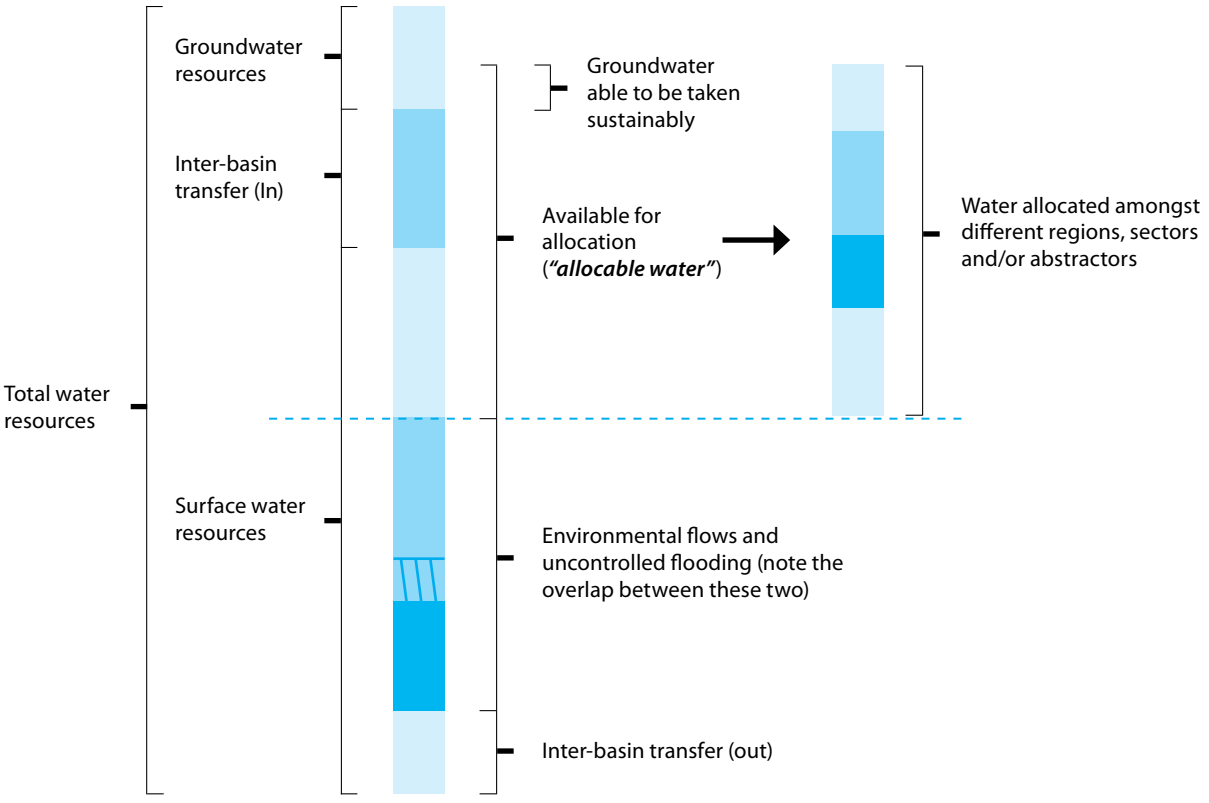
of water for human and environmental needs. On the other hand, alternative water resources may increase the overall water availability within a given area, also for transboundary purposes. Common alternatives, which have both advantages and disadvantages, include desalinated water, inter-basin transfers[22] and rainwater harvesting. Resource augmentation by, for example, managed aquifer recharge, may also improve availability.

The total water available for allocation is thus the share of water utilizable for abstraction for different uses in the given basin or aquifer area, after the flows needed to meet environmental objectives have been reserved (Figure 3). It should be approached as a dynamic concept and number, however, as both the availability of water resources and water requirements change depending on the season, development trajectory and climate.

The issues impacting on allocable water, and the issues water allocation may address, are discussed in more detail in Chapter III.

FIGURE 3

Total water resources and water available for allocation



Source: Robert Speed and others, *Basin Water Allocation Planning. Principles, Procedures and Approaches for Basin Allocation Planning* (Paris, UNESCO, 2013), p. 102.

22 It should be noted here that inter-basin transfers are "associated with both positive and negative impacts to water-exporting, water-transmitting, and water-importing regions", see Logan Purvis and Ariel Dinar, "Are intra- and inter-basin water transfers a sustainable policy intervention for addressing water scarcity?", *Water Security*, vol. 9 (April 2020), 100077. For further information, see, generally, J. Gupta and P. van der Zaag, "Inter-basin water transfers and integrated water resources management: where engineering, science and politics interlock", *Physics and Chemistry of the Earth, Part A: Solid Earth and Geodesy*, vol. 33, No. 1–2 (2008), p. 28–40.

3. Key Processes, Approaches and Mechanisms of Transboundary Water Allocation

Transboundary water allocation processes, as defined, are a part of broader cooperation and management systems of shared water resources across, or at, a border. They typically consist of:

1. *Identification* of water issues at stake, water resources availability and distribution and resource use and demand assessments, and identification of current legal status and institutional frameworks in place;
2. *Negotiating* and *establishing* transboundary agreements or arrangements, defining the water allocation approach and mechanism applied;
3. *Implementation*, consisting of legal and policy instruments and mechanisms at different scales, including water laws, monitoring and compliance mechanisms, and entitlements, permits and licences granted to individual or collective water users.[23]

These different elements of allocation processes are elaborated in detail in the following chapters of this Handbook, notably in Chapter III and Chapters V–VIII. This section will look more closely at approaches and mechanisms that can be applied in transboundary water allocation.

BOX 4: TYPOLOGY OF TRANSBOUNDARY WATER ALLOCATION METHODOLOGY

Specific research results presented in this Handbook are part of an analysis done via the International Freshwater Treaties Database (IFTD) regarding global trends in transboundary water allocation mechanisms over time and status at present. This analysis is conducted using the Typology of Transboundary Water Allocation (TTWA) methodology to code agreements contained in the Transboundary Freshwater Dispute Database (TFDD).

Information about the TTWA methodology for analysing each agreement, the coding for all three steps and a summary of the allocation mechanisms using TTWA are contained in the Annex to this Handbook. Additional information can be found on the TFDD website: https://transboundarywaters.science.oregonstate.edu/content/transboundary-freshwater-dispute-database.

It is important to note that both the TTWA methodology and the data set used in conducting this discrete piece of research for the Handbook are one approach to conducting a broad analysis of the global practice of allocation in international freshwater agreements. Other approaches may be used and this research and the Handbook do not advocate for one approach over another. Please also note that the specific categories of allocation determined under the methodology in the text are signified via inverted commas, for example, "agriculture/irrigation".

Allocation mechanisms in international water agreements generally balance theoretical approaches with practical considerations. Approaches to transboundary water allocation shape how States negotiate, establish and develop methods and mechanisms to allocate water. According to research by McCracken and

23 See also Speed and others (2013); OECD, *Water Resources Allocation: Sharing Risks and Opportunities* (2015).

others,[24] these can be separated into six general categories, as outlined in Table 1 below. These categories are not strictly defined and can overlap, and multiple approaches might influence States during transboundary water allocation processes. Different types of considerations—such as the physical characteristics of the basin (e.g. population, hydrology and climate), goals of intended water use (e.g. navigation, environmental flows, agriculture and other water-intensive industries), economic criteria (e.g. benefit-sharing and balancing of supply and demand) and considerations for future use—may factor into which approaches influence the allocation process. For example, a country's hydrography can have an impact on the amount of water allocated and influence its approach to developing and shaping the allocation mechanism. Basins with high intraannual variability in rainfall might develop an allocation mechanism based on water availability during the wet and dry seasons. Together, theoretical approaches and associated practical considerations guide and shape transboundary water allocation processes and help States determine the specific allocation mechanism that outlines how water is physically allocated.

A number of studies list considerations or criteria that are taken into account in water allocation. One such categorization is provided by McCracken and others (Table 1):

TABLE 1

Approaches to transboundary water allocation and associated examples of considerations

Approaches to International Water Allocation	Examples of Considerations
Rights-based Approaches: Emphasizes the right to water based on hydrography or historical use; includes the concepts of absolute sovereignty and integrity.	Hydrography, historical use
Needs-based Approaches: Establishes allocation based on a riparian's needs rather than what they perceive to be their right. Needs can be based on various criteria, such as population or irrigable land area.	Population, irrigable land, future development, energy demand and consumption
Hierarchy-based Approaches: Allocates water based on priority. Most commonly, different sectors or uses are given priority (e.g. drinking water, agriculture), but this could also give hierarchy to historical, existing, or future uses.	Multiple types of hierarchies, for example: • Sectoral hierarchies: municipal, agricultural, industrial requirements • Temporally established hierarchies: previous, existing or future requirements
Proportionate Division Approaches: Allocation based on the physical division of water, either implicitly or explicitly.	Equal amounts of water per capita, absolute equality, or other proportion between riparians, based on temporal patterns, volume or percentage of water resources

24 M. McCracken and others, "Typology of Transboundary Water Allocation: a look at global trends in international freshwater agreements" (forthcoming). The TTWA methodology builds on previous work tracking transboundary water allocation mechanisms, see Jesse H. Hamner and Aaron T. Wolf, "Patterns in international water resource treaties: the Transboundary Freshwater Dispute Database", *Colorado Journal of International Environmental Law and Policy, 1997 Yearbook*, No. 157 (1997); Mark Giordano and others, "A review of the evolution and state of transboundary freshwater treaties", *International Environmental Agreements: Politics, Law and Economics*, vol. 14, No. 3 (2014), p. 245–264.). The typology is based on overarching theoretical approaches that have shaped the allocation of transboundary waters, as well as examples of considerations that can be used to interpret and apply these approaches when developing an allocation mechanism. Moreover, the allocation mechanisms in the TTWA also take into account theoretical approaches to allocation and their respective considerations, as described below. Furthermore, the methodology also enables the comparison of the type of mechanism, such as direct, indirect, principle based and groundwater specific. The results of this analysis of past and present international freshwater agreements—spanning from the 1860s to 2017—using the TTWA methodology has been highlighted in the text of the Handbook. This analysis accompanies a broader update, spanning the period 1820 to 2020 of the IFTD, which is in process and will be published in McCracken and others, "Typology of Transboundary Water Allocation" (forthcoming).

Approaches to International Water Allocation	Examples of Considerations
Strategic Development Approaches: Allocates water by balancing competing needs. For example, this could include balancing economic development and environmental needs through the use of alternative scenarios, risk assessments and addressing uncertainty.	Future needs, considering multiple goals or needs, including but not limited to population growth, environmental, economic, development and risk-mitigation interests in a broader context; this can include plans for water use in an explicitly future-focused context and can include benefit-sharing outside of water resources to balance multiple needs and goals for a region
Market-based Approaches: Allocates water by market, based on the economic value it generates in different economic activities.	Supply vs. demand balance, efficiency, equity

Source: M. McCracken and others, "Typology of Transboundary Water Allocation: a look at global trends in international freshwater agreements" (forthcoming).

Specific allocation mechanisms in negotiated transboundary agreements can take various forms. This determines how water is physically allocated, divided or distributed between States. Allocation mechanisms take into consideration several criteria and the same research by McCracken and others (forthcoming) highlights examples of explanatory components, including fixed quantity, prior utilization and water loans. Examples of context components include agriculture/irrigation, hydropower and environmental flows. It must be noted that these are not exclusive categories and an allocation mechanism can satisfy multiple explanatory and context components.

TABLE 2

General approaches, associated explanatory mechanisms and example allocation agreements

Approaches	Explanatory Mechanism	Example
Rights-based Approach	Fixed quantity; allocation of entire/partial rivers; historical or existing use	Agreement between Iran and Iraq concerning the use of frontier watercourses, and protocol
Needs-based Approach	Fixed quantity; percentage of flow; prioritization of use	Tripartite Interim Agreement between the Republic of Mozambique and the Republic of South Africa and the Kingdom of Swaziland for co-operation on the protection and sustainable utilisation of the water resources of the Incomati and Maputo watercourses
Hierarchy Approach	Prioritization of use; historical or existing use	Treaty between Great Britain and the United States relating to Boundary Waters and Boundary Questions, signed at Washington
Proportionate Division	Fixed quantity; percentage of flow; equal division	An agreement between the Syrian Arab Republic and the Lebanese Republic for the sharing of the Great Southern River Basin water and building of joint dam on the main course of the river
Strategic Development	Variable by water availability; water loans; prioritization of use; benefits-sharing; sustainable use	Treaty between the Government of the Republic of Moldova and the Cabinet of Ministers of Ukraine on cooperation in the field of protection and sustainable development of the Dniester River Basin
Market-based	Market-based mechanism	Issue of new water entitlements through an auction/tender process in Queensland, Australia.

Source: McCracken and others, "Typology of Transboundary Water Allocation: a look at global trends in international freshwater agreements" (forthcoming).

Note: An example agreement is provided for each theoretical approach that contains an explanatory mechanism that could be associated with that approach.

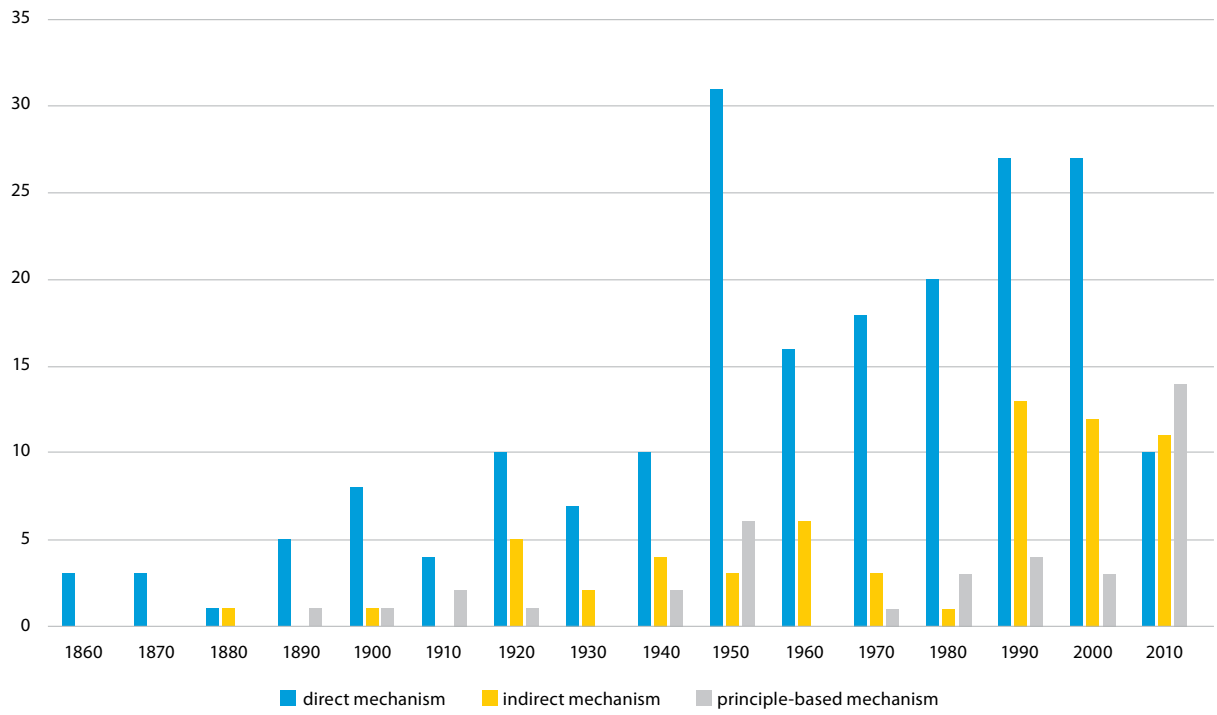
Table 2 lists the theoretical approaches to transboundary water allocation processes, examples of how water might be allocated, and an example treaty that could have been informed by that approach based on the type of allocation mechanism included in the agreement. Explanatory components can be used within more than one approach, such as fixed quantity. For example, a State can identify a specific volume of water it requires based on its rights, needs or hierarchy of uses. The theoretical approach, therefore, influences how the volume of water allocated is arrived at, as well as how the State might present an argument for requiring this volume in a negotiation.

While a detailed discussion of the global trends in the types of allocation mechanisms—how and why water is allocated, as categorized by the method applied—is included in Chapter VI, section 1, there are some general trends worth noting here. Within the method, the explanatory mechanism can be separated into three broad groups: direct mechanisms, indirect mechanisms and principle-based mechanisms.[25]

Direct mechanisms explicitly define a means for physically dividing water, such as a fixed volume or percentage of flow. Indirect mechanisms establish a procedure for determining the allocations, for example, prioritization of uses or through a joint body. Treaties can also establish mechanisms based on principles that guide States in developing allocation mechanisms, for example, historical use or equitable use. Historically, States tend to establish agreements that directly allocate water through a measurable means

FIGURE 4

Global trends in the type of allocation mechanism over time



Source: M. McCracken and others, "Typology of Transboundary Water Allocation: a look at global trends in international freshwater agreements" (forthcoming).

Note: The number of agreements with a direct, indirect or principle-based allocation mechanism is separated by decade spanning the 1860s to the 2010s. Also note that the 2010 decade is partial and only summarizes the period from 2010–2017, not the entire 2010–2019 decade, due to data availability and update timing.

25 Alena Drieschova, Mark Giordano and Itay Fischhendler, "Governance mechanisms to address flow variability in water treaties", *Global Environmental Change*, vol. 18, No. 2 (May 2018), p. 285–295; Giordano and others (2014).

(direct mechanisms), as shown in Figure 4. While still evident in older agreements, indirect mechanisms and principle-based mechanisms have become more common in recent decades, with both indirect and principle-based mechanisms exceeding direct mechanisms in the 2010s. This trend illustrates a shift towards approaches that manage water allocation rather than directly allocating water itself. Furthermore, it shows how treaties have shifted from defining specific regulations towards establishing management procedures and principles.

4. Basis of Water Allocation in International Water Law

International law concerning transboundary rivers, lakes and aquifers (international water law) constitutes the overall framework and foundation for transboundary water management and cooperation. Transboundary water allocation arrangements therefore fall within, and are shaped by, international water law, including general international law (treaty and custom) relevant to transboundary waters, and more specific treaty practice between and among States sharing transboundary rivers, lakes and aquifers. In general, several key principles of international water law are today regarded as having developed into customary law rules, including the principle of cooperation that is the foundation for effective water allocation in a transboundary context.[26]

The key international legal principles and rules governing transboundary rivers, lakes and aquifers can be found in customary international law, treaties (bilateral, subbasin, basin) and regional agreements—such as the Revised Protocol on Shared Watercourses in the Southern African Development Community (SADC Revised Protocol) of 2000—applicable to transboundary waters, and in the two global international water law frameworks: the Water Convention and the 1997 Convention on the Law of the Non-navigational Uses of International Watercourses (Watercourses Convention), collectively referred to as "the United Nations (or UN) global water conventions". The 2008 Draft Articles on the Law of Transboundary Aquifers provides further guidance on transboundary groundwater resources.[27]

The United Nations global water conventions reflect the main principles of international customary law on transboundary freshwater resources. As with the Watercourses Convention, the Water Convention's three-pillar normative structure includes: i) the obligation to prevent, control and reduce significant transboundary impact (the so-called "no-harm rule"); ii) the equitable and reasonable utilization principle; and iii) the principle of cooperation—all of which are part of customary international law. While transboundary water allocation is not directly and explicitly addressed in the United Nations global water conventions, both provide guiding legal frameworks (and certain obligations as per international customary law) relevant for the establishment and maintenance of transboundary water allocation arrangements, as discussed and illustrated in Chapters V, VI and VIII of this Handbook.

5. Cooperative Frameworks and Scales of Governance for Water Allocation

Usually, transboundary water allocations are first made based on area, for example, States, subcatchments or administrative areas, and thereafter further divided based on purpose of water use, for example, of sectoral user groups, or for irrigation or other water supply schemes. In international water bodies, the management scales are often nested: while transboundary allocation is agreed between the countries, each country then implements the arrangement and agreements by applying its own allocation schemes based on

26 See, for example, Owen McIntyre, "Substantive rules of international water law", in *Routledge Handbook of Water Law and Policy*, Alistair Rieu-Clarke, Andrew Allan and Sarah Hendry, eds. (London, United Kingdom, Routledge, 2017), p. 234–246.

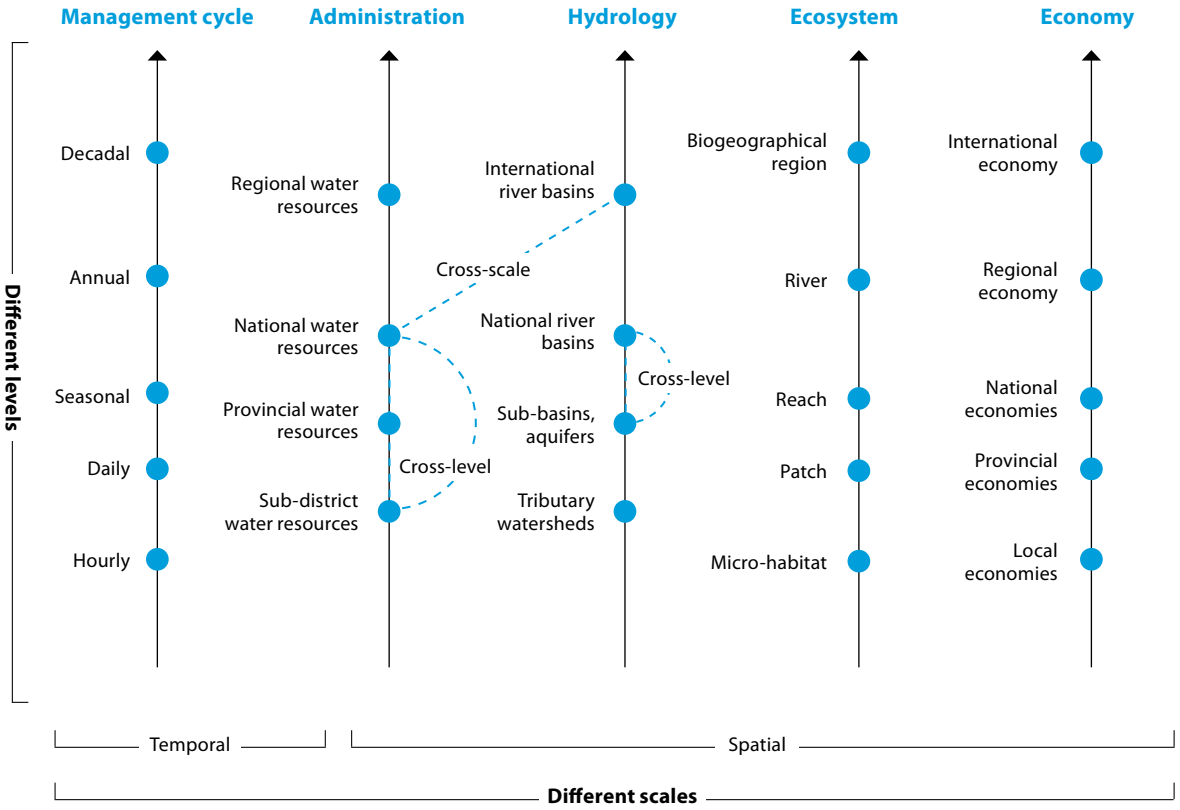
27 See, for example, Francesco Sindico, *International Law and Transboundary Aquifers* (Cheltenham, United Kingdom, Edward Elgar, 2020).

its own national policies and legislation. As has been described, "[w]ater-related decision-making is often complex and necessarily should take into account many different scale and level perspectives; deliberation is a way of coping with this complexity and contributing to ensuring that negotiations and policy making is better informed than might otherwise be the case. Rarely does a single scale or level have the sole claim to legitimacy. A key strength of deliberation is that it can ensure that different scale and level perspectives are heard and competing logics are examined."[28] (See Figure 5 for a visual representation of interaction between levels and scales in transboundary water allocation).

Bilateral, subbasin and basin treaties relevant to transboundary waters are a primary means to establish specific inter-State provisions for water allocation in a transboundary context. Such treaties and agreements may include, for example, provisions on water allocation methods and data and information exchange, which may incorporate criteria, procedures and exceptions, for example. While it is also possible that a particular transboundary water agreement does not specifically and/or explicitly address the issue of allocation, it may provide the foundations to develop allocation mechanisms, by more generally providing a basis for cooperation and facilitating joint water management between/among the States sharing a particular river, lake or aquifer.

FIGURE 5

Example of interaction between levels and scales in transboundary water allocation



Source: John Dore and Louis Lebel, "Deliberation and scale in Mekong water governance", *Environmental Management*, vol. 46, No. 1 (July 2010), p. 62.

28 John Dore and Louis Lebel, "Deliberation and scale in Mekong water governance", *Environmental Management*, vol. 46, No. 1 (July 2010), p. 62.

The actual operationalization and implementation of water allocation takes place within defined jurisdictions, such as at the national and subnational levels. National-level water allocation or State-level water allocation typically sets the context for, and informs the needs for, transboundary water allocation. Depending on the State system, national-level water allocation is further divided into basin-level and regional water allocation. It usually allocates the transboundary shares to subnational jurisdictions, administrative regions and management entities that decide and grant water entitlements, permits and licences to individual water users and abstractors. While each national context is different, having some general guidelines and principles on water allocation at both national and subnational levels facilitates fluent cooperation on water allocation. Many of the international water law principles are transferable also at the national and subnational levels in federal States with transboundary waters and applicable via incorporation into domestic legislation.[29] The general steps/elements for operationalizing transboundary water allocation are presented in Chapter VIII.

CASE STUDY 1: **United States of America and Mexico transboundary water allocation on the Colorado River and Rio Grande: the 1944 Water Distribution Treaty**[30]

The United States and Mexico established the International Boundary Commission (IBC) on 1 March 1889 as another temporary body to apply the rules that were adopted by the Convention between the United States of America and the United States of Mexico Touching the International Boundary Line Where it Follows the Bed of the Rio Colorado, 1884. The IBC was extended indefinitely in 1900 and is considered the direct predecessor to the modern-day International Boundary and Water Commission.

The United States and Mexico used studies developed by the IBC as the basis for the first water distribution treaty between the two countries, the Convention between the United States and Mexico: Equitable Distribution of the Waters of the Rio Grande, 1906, which allocated the waters of the Rio Grande from El Paso to Fort Quitman, an 89-mile (143 km) international boundary reach of the Rio Grande through the El Paso-Juárez Valley. This Convention allotted to Mexico 60,000 acre-feet annually of the waters of the Rio Grande to be delivered in accordance with a monthly schedule at the headgate to Mexico's Acequia Madre just above Juárez, Chihuahua. To facilitate such deliveries, the United States constructed, at its expense, the Elephant Butte Dam in its territory. The Convention includes the provision that in the event of extraordinary drought or serious accident to the irrigation system in the United States, the amount of water delivered to the Mexican Canal shall be diminished in the same proportion as the water delivered to lands under the irrigation system in the United States downstream of Elephant Butte Dam.

The IBC was also instrumental in developing the second water distribution treaty between the United States and Mexico in 1944, which addressed utilization of the waters of the Colorado River and Rio Grande from Fort Quitman, Texas to the Gulf of Mexico. The Water Treaty of 3 February 1944 expanded the duties and responsibilities of the IBC and renamed it the International Boundary and Water Commission (IBWC). The 1944 Treaty charged the IBWC with the application of the Treaty and the exercise of the rights and obligations which the United States and Mexican Governments assumed thereunder and with the settlement of all disputes that were to arise under the Treaty.

Of the waters of the Rio Grande, the Treaty allocates to Mexico:

a) The totality of the waters that reach the main current of the Rio Grande (Rio Bravo), the rivers San Juan and Álamo; including the returns from the lands that irrigate these last two rivers.

29 See, generally, for example, Dante A. Caponera and Marcella Nanni, *Principles of Water Law and Administration: National and International*, 3rd ed. (London, United Kingdom, Routledge, 2019).

30 Source: International Boundary and Water Commission (www.ibwc.gov/About_Us/history.html). United States and Mexican Government officials were given the opportunity to update the text.

b) Half of the runoff from the main channel of the Rio Grande (Rio Bravo) below the main lower international storage dam, provided that such runoff is not expressly assigned in this Agreement to either of the two countries.

c) Two-thirds of the flow that reaches the main current of the Rio Bravo (Rio Grande) from the Conchos, San Diego, San Rodrigo, Escondido and Salado and Arroyo de Las Vacas rivers, in accordance with the provisions of subsection c) of what is allocated to the United States.

d) Half of any other runoff in the main channel of the Rio Grande (Rio Bravo), not specifically assigned in this article, and half of the contributions of all non-gauged tributaries - which are those not named in this article- between Fort Quitman and the International Main Lower Dam.

The Treaty allots to the United States:

a) All the waters that reach the main current of the Rio Grande (Rio Bravo) from the Pecos, Devils, Goodenough spring and Alamito, Terlingua, San Felipe and Pinto streams.

b) Half of the runoff from the main channel of the Rio Grande (Rio Bravo) below the main lower international storage dam, provided that such runoff is not expressly assigned in this Agreement to either of the two countries.

c) One third of the water that reaches the main current of the Rio Bravo (Rio Grande) from the Conchos, San Diego, San Rodrigo, Escondido, Salado and Arroyo de Las Vacas rivers; third part that will not be less altogether, on average and in cycles of five consecutive years, of 431,721,000 cubic meters (350,000 acre feet) per year. The United States shall not acquire any rights for the use of the waters of the tributaries mentioned in this subsection in excess of the aforementioned 431,721,000 cubic meters (350,000 acre feet), except the right to use the third part of the runoff that arrives to the Rio Grande (Grande) of said tributaries, although it exceeds the aforementioned volume.

d) Half of any other runoff in the main channel of the Rio Grande (Rio Bravo), not specifically assigned in this article, and half of the contributions of all non-gauged tributaries - which are those not named in this article - between Fort Quitman and the International Main Lower Dam.

In cases of extraordinary drought or serious accident in the hydraulic systems of the gauged Mexican tributaries that make it difficult for Mexico to deliver the 431,721,000 m^3 (350,000 acre-feet) per year that are allocated to the United States as the minimum contribution of the aforementioned Mexican tributaries, in subsection c) of paragraph B of this article, the shortages that exist at the end of the aforementioned five-year cycle will be replenished in the following cycle with water from the same tributaries.

As long as the useful capacity allocated to the United States of at least two of the major international dams, including the one located further upstream, is filled with waters belonging to the United States, it will be considered ending a five-year cycle and all debts fully paid, beginning, from that moment, a new cycle.

The 1944 Treaty further provided for the two Governments to jointly construct, operate and maintain on the main channel of the Rio Grande the dams required for the conservation, storage and regulation of the greatest quantity of the annual flow of the river to enable each country to make optimum use of its allotted waters.

The 1944 Treaty provides that of the waters of the Colorado River there are allotted to Mexico:

a) A guaranteed volume of 1,850,234,000 cubic meters (1,500,000 acre feet) each year, to be delivered in accordance with the provisions of Article 15 of this Agreement;

b) Any other volumes that reach the Mexican derivation points; on the understanding that, in the opinion of the United States Section, in any year there is water in the Colorado River in excess of that necessary to supply consumption in the United States and the volume guaranteed annually to Mexico of 1,850,234,000 cubic meters (1,500,000 acre feet), the United States undertakes to deliver to Mexico, as established in Article 15 of this Agreement, additional quantities of water from the Colorado River system up to a total volume not exceeding 2,096,931,000 cubic meters (1,700,000 acre feet) annually.

Mexico will not acquire any right, other than that conferred by this subsection, for the use of the waters of the Colorado River system for any purpose, in excess of 1,850,234,000 cubic meters (1,500,000 acre feet) per year.

In cases of extraordinary drought or serious accident to the irrigation system of the United States, which makes it difficult for it to deliver the guaranteed amount of 1,850,234,000 cubic meters (1,500,000 acre feet), per year, the water assigned to Mexico, according to Subparagraph a) of this article, will be reduced in the same proportion in which consumption is reduced in the United States.

To enable diversion of Mexico's allotted waters, the Treaty provided for the construction by Mexico of a main diversion structure in the Colorado River, below the point where the California–Baja California land boundary line intersects the river. It also provided for the construction at Mexico's expense of such works as may be needed in the United States to protect its lands from such floods and seepage as might result from the construction and operation of the diversion structure.

6. Shared Knowledge and Data for Water Allocation

Sustainable and equitable transboundary water allocation planning and agreements are best supported by a shared knowledge base, commensurate data and well-functioning monitoring and information-sharing systems. Ideally, harmonized and comparable assessment and monitoring methods, data management systems and uniform reporting procedures can provide a common ground for deliberation, planning, negotiating, decision-making and operational water management.[31] They are built on the regular and systematic collection of sufficient quality-controlled data and represent a necessary basis for reliably assessing and monitoring shared water resources and understanding different needs, uses and functions, which can in turn inform water allocation arrangements.

More specifically, shared knowledge and data may relate to: assessment of available surface water and groundwater resources; potential for augmentation of resources (water reuse, desalinization, rainwater harvesting, managed aquifer recharge, etc.); determining needs of the environment, sectors and States in different development scenarios, and supply and demand management options, and the development of technical and management tools for water allocation, monitoring and compliance. This component is dealt with in greater detail in Chapter VII.

31 UNECE, *Strategies for Monitoring and Assessment of Transboundary Rivers, Lakes and Groundwaters* (New York and Geneva, United Nations, 2006).