1 Managing River Basins: an Institutional Perspective

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1.1 Introduction

Up until the beginning of the 19th century, human water use was largely confined to streamside uses for drinking, stock watering and water-powered mills, as well as in-stream use for navigation. There were exceptions in the ancient hydraulic civilizations in Mesopotamia, Egypt, China, India and a few other locations, which abstracted large volumes of water from major rivers to irrigate extensive tracts of riparian floodplain. However, whereas the local impacts of these abstractions were significant, on a global scale, river flow regimes were still largely dictated by natural features and forces, and water users were primarily natural biota.

As the world population grew, from less than 1 billion (10^9) in 1800, to 1.7 billion in 1900, to more than 6 billion today, human demands for water also expanded. Growing urban concentrations, often along rivers, led to significant abstractions of water from rivers for these settlements and to negative impacts on water quality. At the same time, the industrial revolution created new demands for water, and new technology and the growing demand for food gave rise to an expanding irrigated agriculture throughout the world.

The latter half of the 19th century saw great strides in the development of hydraulic technology for controlling major rivers and transporting water over long distances for irrigation and domestic purposes. Many of these developments took place in the Asian subcontinent, and engineers from the USA and other countries pilgrimaged to British India to learn this new technology (e.g. Wilson, 1891). The following century witnessed a great remaking of river systems across the world, as humans manipulated the natural hydrology to meet the domestic supply, sanitation, food, fibre and industrial needs of growing populations and rising standards of living. During much of the 20th century, expanding water supply was the easiest and least costly way of satisfying these demands, since water was relatively abundant and the harmful impacts on the environment were incremental, individually modest and at first little noticed.

From a situation of limited, low-impact and largely riparian uses of water, we have now reached a point where, in many parts of the world, cumulative uses of river resources have not just local but basin-wide and regional impacts. The result is that water resources in many river basins are fully or almost fully committed to a variety of purposes, both in-stream and remote; water quality is degraded; river-dependent ecosystems are threatened; and still-expanding demand is leading to intense competition and, at times, to strife. In response, there is growing interest in management systems that can bring together

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fragmented water uses, and water users, into an integrated planning, allocation and management framework. A common element of these approaches is that they do not just cover a single water use or an administrative jurisdiction, but deal with an entire river basin or sub-basin, such as the Colombia, the Indus or the Limpopo.

Integrated management frameworks promises a number of important benefits:

- Greater utility from a given amount of water through adjusted allocations;
- Reduced groundwater mining through conjunctive management of ground and surface water;
- More intensive reuse of water through planned sequencing of uses;
- Improved water quality through more comprehensive data collection, monitoring and enforcement;
- Incorporation of current social and environmental values into water allocation and management decision making;
- Inclusion of a wider range of basin stakeholders into decision making;
- Reduced conflict among users.

Despite this promise, and although highly fashionable of late in policy circles, integrated river basin management (RBM) is rather rare in practice. Reasons for this include the following:

- It requires genuine collaboration among administrative and sectoral units;
- It usually involves reductions in discretionary authority on the part of existing managing agencies;
- Managers who would gain influence over basin decision making may currently be bureaucratically and politically weaker than current managers;
- Its costs can be significant;
- It creates uncertainty for present resource users;
- It makes planning and decision making more complex.

Given these potentially inhibiting factors, it is not so surprising that there are not more practising examples of integrated management of water resources at the basin level. In order to hurdle these constraints, dissatisfaction with the current situation must be intense, and the prospective benefits of a new management regime significant. It is these conditions that we explore in this chapter.

This chapter defines the basic elements and concepts comprising integrated basin management and other key concepts and then focuses on the process of analysing institutional arrangements for RBM to further our understanding of institutional design. To do this, we first discuss institutions, organizations and policies in relation to water management. We then outline an essential functions and enabling conditions framework for analysing basin management regimes and discuss possible institutional arrangements for RBM that meet the needs of locally managed irrigation.

1.2 Terms and Concepts

1.2.1 River basin water resource management

There are a number of terms used to describe an integrated process of assessing and managing water resources at the basin level. Most are variations on the terms *integrated water resource management* or *river basin management (RBM)*.

Integrated water resource management (IWRM) is a newer term and is defined by the Global Water Partnership (TAC, 2000) in the following way:

> IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

IWRM tends to have a strong normative content, often referring to the Dublin Principles and emphasizing such values as economic benefit, equity, sustainability and public participation. It is implicitly suggested that all these values can be made commensurate and compatible, but in practice, there are often trade-offs between them, particularly between equity and economic efficiency, and between economic welfare and sustainability.

RBM is a more traditional term and has more recently broadened its meaning to encompass many of the same features and values which characterize IWRM. RBM is defined by Mostert *et al*. (2000) as follows:

> RBM is the management of water systems as part of the broader natural environment and in relation to their socio-economic environment.

This definition is simpler and less overtly value-laden than the previous one. Both definitions encompass both planning and management of water resources, even though the planning element is implicit. A key element of both concepts is that planning and management units almost always cut across other divisions more traditionally used to manage resources, such as sectors, provinces or even nations, and herein lies both their great strength and their challenge. Some divisions across which the approach we are discussing extends are shown in Box 1.1.

Typically, the boundaries of the management unit are defined hydrologically, as a basin or a sub-basin, defined by Mostert *et al*. (2000) as follows:

> A river basin is the geographical area determined by the watershed limits of a system of waters, both ground and surface, flowing to a common terminus.

In a few areas, concepts do diverge somewhat. Basin management can readily be extended to management of other related resources in a basin, especially land resources. IWRM focuses more tightly on the water resource. At times RBM also extends into the realm of river basin development, in which case project-based development of new basin infrastructure often acquires a dominant position in the paradigm. Millington (2000) notes that project design or evaluation, construction and operation is still a very strong role of many river basin organizations. Experience has shown that where project-based design and construction is a major activity, resource management functions tend to receive low priority. IWRM grows out of a 'post-construction' milieu, where basins are closing (Chapter 2) and new construction tends not to be the dominant activity.

Box 1.1. *Integrated* basin management.

Although the term *integrated* most commonly refers to integration across use sectors, such as agriculture and urban water supply, it can also encompass a number of other divisions, including the following:

- Administrative jurisdictions
- Ground and surface water
- Upstream and downstream reaches
- Environmental and human uses
- Supply and demand management
- Water quantity and quality
- Land and water use
- Trans-boundary uses

One important caveat to all this is that integrated basin management does not imply or require a single basin management organization. There is an unfortunate tendency in some quarters to equate basin management with a unitary basin management organization and to assume that in the absence of such an organization, effective integrated management is not possible. This is most certainly an incorrect assumption, as experience in the western USA demonstrates, and, in general, monolithic management organizations are the exception rather than the rule. The prototype for such thinking is probably the American Tennessee Valley Authority (TVA), which was, in its original form, an integrated basin development authority established during the economic depression of the 1930s to work in a very underdeveloped region of the country.[1] The TVA took on a wide range of development functions, including water resource development, in an area in which there was a dearth of effective organizational coverage by other public entities. The failure

[1] The TVA has since evolved into an energy production and management agency.

of most other attempts patterned on the TVA, such as the Damodar Valley Authority in India in the 1950s, suggests the uniqueness of this model. More common among effective basin management set-ups is a coordinated model in which the efforts of a number of different entities are articulated (see Section 1.3.4).

1.2.2 Institutional arrangements

How water is used in a river basin is determined by the interactions between water users, technology and water availability, and hence is a sociotechnical process (Mollinga, 1998). Water management organizations and institutions structure and mediate these interactions, and in turn are reshaped by water use in practice.

The terms 'institutions' and 'organizations' are often used interchangeably, but it is useful to distinguish between them. In mainstream institutional theory, *institutions* are understood to be 'the humanly devised constraints that shape human interaction' (North, 1990, p. 3), and consist of complexes of norms, values and behaviours that persist over time and inform action (Uphoff, 1986). In this view, institutions provide structure and regularity to everyday life by reducing uncertainty and providing a guide to human interaction. They are what Sir V.S. Naipaul calls 'the contract between man and man'. A central tenet of this view is that institutions work to reduce transaction costs by reducing the costs of monitoring and responding to the behaviour of others.

Organizations, on the other hand, are defined as 'groups of individuals bound by some common purpose to achieve objectives' (North, 1990, p. 5). Other definitions highlight the importance of seeing organizations as 'structures of recognized and accepted roles' instead of only groups of individuals, yielding a more realistic and accurate definition (Uphoff, 1986). Organizations are created intentionally within an existing web of institutions. Hence, what types of organizations exist and how they evolve are fundamentally influenced by the broader network of institutions in which they are embedded. Organizations, in turn, influence how institutions evolve over time. Organizations constitute a subset of institutions, which are distinguished by their purposive origin and maintenance and their hierarchically organized roles.

In this book, the combination of the institutions and organizations involved in water management is termed the *institutional arrangements* for water management. Institutional arrangements for water management thus include the following:

- The established policy and legal environment (policies, laws, rules, rights, regulations, conventions, and customs, both formal and informal);
- Water management organizations with responsibilities in water management;
- Processes, mechanisms and procedures for decision making, coordination, negotiation and planning.

At this point, a chasm opens, which must be carefully negotiated. Policies, rules and regulations, as specified by public authorities, may differ substantially from the application of those rules in practice. Moreover, local rules, such as those governing the allocation of water, for example, may be quite different from the formal set of rules promulgated by state authorities. The student of institutional arrangements must thus be aware of both the formal rules, and the set of *rules-in-use*, which operate on the ground. The importance of the differences that often exist between the two has led one prominent analyst to define institutions explicitly as rules-in-use, rather than simply as rules (Ostrom, 1992).

To this point, we have treated institutional arrangements as fixed and pre-existing. To animate this static view, it is necessary to consider how institutions emerge and how changes in them take place. Alternative approaches to the study of institutions, grounded in anthropology and sociology, argue that institutions are not only 'the rules of the game' or 'sets of working rules or rules-in-use' (cf. North, 1990; Ostrom, 1990) but are reproduced, transformed and subverted through interactions and negotiations between actors (Mosse, 1997; Cleaver, 1999; Mehta *et al.*, 1999). This approach suggests that institutions emerge historically from interactions, negotiations and contests between heterogeneous actors having diverse goals, and that they only continue to exist if they are invested in or practised. Thus, institutions cannot be seen apart from what people do, and are constantly made and remade through people's practices (Mehta *et al.*, 1999). Cleaver suggests that, '[t]he institutions for the management of water . . . are socially located and critically depend on the maintenance of a number of gray areas and ambiguity regarding rights of access, compliance and rules, [and] on a continuous process of negotiation between all users' (1999, p. 602). Such a notion of institutions opens avenues to analyse how power pervades institutional arrangements and gives rise to differentiated access to and control over water, and, more importantly, how to design processes to redress inequities.

Because water is essential to life and livelihood security and has multiple uses and users, water management readily gives rise to intractable or 'wicked' problems, especially where competition for water is acute. Wicked problems are clusters of interrelated problems characterized by high levels of uncertainty and a diversity of competing values and decision stakes (Ackoff, 1974; Rittel and Webber, 1973). The set of problems constituting a wicked problem cannot be solved in isolation from one another and are intractable since what constitutes a solution for one group of individuals entails the generation of a new problem for another. As wicked problems are characterized by competing perceptions and values, and often also involve power disparities, they enter the realm of politics, understood here broadly as the forum for choosing among values and the process through which relations of power are constituted, negotiated, reproduced or otherwise shaped (cf. Mollinga, 2001). Water is frequently a politically contested resource: a contest with unpredictable and unstable outcomes and diverging pathways to alternative futures (cf. Mosse, 1997; Mehta, 2000; Mollinga, 2001). Likewise, water management institutions and policies are frequently contested and the outcomes of political practices.

1.2.3 Institutional effectiveness

From the brief discussion of institutions and organizations above, it is apparent that studying effective institutional arrangements for water management is conceptually challenging. If institutions differ in principle and in practice, are contested, beset with ambiguities and the outcomes of political practices, it follows that what is defined as 'effective' by some will be deemed ineffective by others. Nonetheless, at an intuitive level, it is clear that the strong connection between institutions and how water is managed is indisputable. Heathcote (1998, p. 7) suggests that institutional arrangements for water management may be considered effective if they:

1. Allow an adequate supply of water that is sustainable over many years and provide equity in access to this water.
2. Maintain water quality at levels that meet government standards and other societal water quality objectives.
3. Allow sustained economic development over the short and long term.[2]

Thus, institutional arrangements for RBM are effective if they promote and achieve sustainable water management. Sustainability can broadly be defined as a condition in which natural and social systems survive and thrive together indefinitely (Euston and Gibson, 1995).

To be sustainable, water management must protect and restore natural systems, enhance the well-being of people and

[2] A fourth condition relating to maintaining ecological systems could be added here, but in our treatment is covered by an expanded definition of sustainability.

improve economic efficiency. These three objectives are often mutually exclusive, as the partial attainment of one has negative effects for attaining the others. This contested nature of water makes the institutional arrangements for water management of paramount importance, but also highly problematic. If institutions are viewed in managerial or interventionist terms, effective institutions are seen as those that contribute to attaining sustainable water management by reducing transaction costs, enhancing collective action and increasing certainty. If a more process-oriented and dynamic view of institutions is adopted, emphasis is placed on how institutions are embedded in power relations, and equity, and not economic efficiency, is a central concern.

1.2.4 Policy

Although established policies are included under our definition of *institutional arrangements*, they are often treated separately in discussions of 'policy and institutional arrangements'. One reason for this is that new policies not yet fully implemented do not necessarily rise to the level of 'institutions', as they have not demonstrated an ability to persist. Consequently, they are discussed separately here.

Policies provide a direction and suggest a course of action intended to influence decisions and actions in a particular realm of interest. Water resource policy thus gives overall guidance and direction to decisions and actions that determine the uses, protections and costs of water, and the subsidies and prohibitions related to its use. In the face of changing conditions, needs, priorities and values, policies and resulting actions must also change. Policies are important to water resource management because they can serve as important entry points into the established cycle of water management practices.

An instrumentalist view of government conceptualizes policy as a tool to regulate a population from the top down, through incentives and sanctions. Shore and Wright (1997, p. 5) summarize the conventional definition of policy as 'an intrinsically technical, rational, action-oriented instrument that decision makers use to solve problems and affect change'. Although many would agree that policies frequently fail to function as intended, there is a shared understanding that a good policy is one that adheres to the standard of rationality contained in the above definition.

However, conceiving of policy development and application as an unproblematic linear process that progresses from formulation to implementation to expected outcomes is dangerous, as it obscures how policies are produced through decidedly non-linear and non-rational means, through public and private negotiations, log-rolling,[3] political pressure, media manipulation, legal action and other processes involving a range of actors within and outside of government circles. Moreover, there is seldom a simple progression from policy formulation, to legislation, to framing regulations, to execution. The real process is much less tidy, with iterations, false starts and backtracking, where the lead role alternates between policy formulation and application.

An alternative perspective on analysing how policies lead to changes in water management practices conceives of policy formulation and implementation as political processes in which many interests are at stake. Premised on the notion that water management is a politically contested terrain (Mosse, 1997; Mollinga, 1998, 2001; Mehta *et al.*, 1999), the 'policy as process' approach attempts to understand how water policies are 'produced' by the interactions between water users, dominant paradigms and the institutional arrangements that mediate water control. Through these interactions, the content and composition of policies are redefined and transformed, frequently leading to very different results

[3] A process in which legislators trade concessions and support for sometimes unrelated objectives.

from those envisioned. A politically informed analysis of policy processes helps to understand how policies work in practice to change control over water and water management, thereby giving insight into who gains and who loses.

1.2.5 Roles and actors

Individuals and organizations take action, and it is useful to define two other commonly used descriptive terms. *Roles* are sets of expectations and tasks associated with a particular function (Coward, 1980). As such, roles can be played by individuals or by organizations. *Actors* are those individuals or organizations who take actions in a particular context, and thus play roles. Actors can play a number of roles simultaneously, and roles can be split among different actors. Often actors, such as a government ministry, will play roles that relate to water resource management while playing other non-water-related roles at the same time. *Stakeholders* are individuals or groups which have a legitimate interest in the management of water resources in a basin but which may or may not play an active role in basin planning and management processes. Actors are thus included in the set of basin stakeholders, but do not comprise the entire set.

1.3. Basin Management

1.3.1 Context

1.3.1.1 Phases of basin closure

In Chapter 2, Molden *et al.* posit that river basins pass through three phases as more water is withdrawn by humans (development, utilization and reallocation), and argue the valid point that that institutions need to have the ability to adapt to changes. Keller *et al.* (1998) proposed a linear three-phase model of river basin maturation, with phases of exploitation, conservation and augmentation. In this model, the final phase is a search for new water sources – from distant basins, or by desalinating seawater, rather than reallocation.

Turton and Ohlsson (2000), expand this general argument positing that water scarcity *per se* is not the key issue, but rather whether a society has the adaptive capacity to cope with the challenges that water scarcity poses. They argue that institutional transitions need to occur in the water sector as water becomes scarcer, the first when water abundance turns to water shortage and the second when water shortage turns to water over-exploitation. In their argument, the ‘ability to cope’ with shortage is a critical societal attribute determining the ‘pain’ a society will feel as a basin closes.

These models are inductive, attempting to draw out an explanatory thread from a body of experience. As such, they are heuristic rather than predictive in particular cases. Keller *et al.* (1998) emphasize the economic logic of the sequence of development. In this framework, at any point in time the cheapest solutions are selected, from simple flow diversion on to desalinization. Molden *et al.* constrain the impulse to continuously develop new sources of supply and instead suggest that attention will shift to reallocating an ultimately fixed supply. In Turton and Ohlsson’s approach, the logic of the succession is based on a scale of complexity, with the solution of water scarcity problems demanding ever-increasing levels of social resources. This approach assumes that hydraulic development is the easiest response, and that its exhaustion leads to conservation efforts, later followed by adjustments in allocations. The latter are regarded as much more sensitive and likely to generate social conflicts. These three analytical grids are useful in making connections between the degree of water exploitation and types of human responses – responses that are clearly related to the degree of stress on the resource as well as other factors. At the same time, they cannot capture important nuances found in varied concrete situations. A number of interesting illustrations of this complexity are shown below (Molle, 2003).

- Sakthivadivel and Molden (2001) have compared five basins said to be at different stages of exploitation and have found that the problems faced by these basins were different. However, several of the problems encountered were not those that would be typical of the phase in which each basin was classified. For example, East Rapti basin in Nepal is an open basin, with only 5% of water resources being used by agriculture. In spite of this, water pollution from industries and 'intense competition' for river water during the dry season among wildlife sanctuaries, tourist requirements, ecological requirements and human use already appear as severe problems that 'need immediate action', although they are normally associated with later phases of development. In the Singkarak-Ombilin basin, Sumatra, considered to be at the beginning of the utilization/conservation phase, water allocated to non-agricultural activities and trans-basin diversion threatens to throw the basin directly into the last phase, where water rights need to be more formally specified and water reallocation becomes paramount.
- Problems of pollution are generally associated with late phases in which the scarcity of the resource does not allow adequate mitigation by dilution, but it may also happen very early if there are significant pollution point sources with little regulated water to ensure dilution as with gold mines in South Africa.
- The need to design more complex and integrated forms of organization at the basin level is associated with an ultimate phase of reallocation of very scarce water resources. However, in the case of France in the 1960s, it was the problem of water quality and not quantity that was the driving force, despite both aspects being interlinked.
- Trans-basin diversion is considered in trajectory models as a way to 'reopen' the basin after it has closed, but this option is sometimes observed at much earlier stages of development, especially in small and medium basins. In Sri Lanka, this was commonly achieved as early as the 5th century (Mendis, 1993) and has remained a basic feature of water resource development ever since. Such transfers are also typical of irrigation of mountainous interfluves, where irrigated areas straddle the boundary of two adjacent basins.
- In the later phases of basin closure, a wide range of measures are sometimes undertaken to relieve pressure, and not simply the reallocation strategy hypothesized. The case of California, as described by Turral (1998), clearly shows not only that both efficiency and reallocative measures are sought in parallel, but that the gains they provide are more limited than commonly believed and need to be accompanied with a substantial amount of supply augmentation. Closure does not conclude with reallocation but, rather, elicits continuous improvements on all three fronts (conservation, reallocation and supply).
- Not all trajectories are upward. Historical examples of civilizations that have not successfully maintained their resource base and have collapsed can easily be found. In Sri Lanka, for example, aerial photographs reveal a high density of abandoned, silted and destroyed small tanks in some basins. A classic case is that of ancient Mesopotamia in the 9th century (cf. Pointing, 1991).

It seems clear that decisions must be understood also in terms of their political economy. That is, decisions must be understood not only on the basis of their actual costs and social 'pain', but also in terms of the identity of the beneficiaries and the increased power or financial gain that accrues to different actors as a result of the decision taken. Costly solutions, such as desalination, are sometimes justified and implemented in lieu of less expensive demand-management solutions because they involve less political pain and can be accommodated under the existing logic of pork-barrel politics.

The difficulty of reforming management varies, depending on many cultural, social and political factors, but it is recognized that 'regional politicians have a powerful intuition that economic principles and the allocative measures which follow logically from them must be avoided at all costs' (Allan, 1999). This largely explains the persistent gap between consultant's rationality and the actual shape that policy measures take in the real world. It also suggests why strict economic analysis is not always the best framework to use to understand the succession of state investments and responses. Resource capture can occur at any time, depending on the power balance within the society, and is perhaps more frequent than rational allocation.

The basin closure models are useful in outlining hydrologic changes which tend to take place in a generalized basin as its water resources are utilized ever more intensively and the response strategies which tend to occupy the minds of basin managers as this unfolds. In practice, institutional responses are highly varied and functions of a diverse range of forces and influences.

1.3.1.2 The governance context

One of the most important, and least studied, aspects of the environment controlling institutional change is the context of governance in which water resource organizations operate. Governance is defined as the exercise of authority through formal and informal traditions and institutions for the common good. Governance includes: (i) the process by which those in authority are selected, monitored and replaced; (ii) the capacity of the government to effectively manage its resources and implement sound policies; and (iii) the respect of citizens and the State for the institutions that govern economic and social interactions among them (Kaufmann, 2000). In Kaufmann's framework, good governance consists of six interlinked components:

- Voice and accountability;
- Political stability;
- Government effectiveness;
- Lack of regulatory burden;
- Rule of law;
- Control of corruption.

Problems stemming from poor governance are numerous, well known and routinely given a blind eye. Examples include favouritism in granting water use permits, kickbacks on construction and procurement contracts, biased and inaccessible court systems, withholding of data and sale of public data for personal profit, promotion of risk-averse bureaucrats and firing of innovators, flaunting of water-quality regulations by well-connected industries, and bureaucratic red tape which strangles local initiative. Quality of governance pervades public decision making relating to policy formulation, resource allocation, legislation, rule enforcement and adjudication, making it the most important single influence on the shape and pace of institutional change in the water sector. While difficult to change, improving the quality of governance is not impossible, and a variety of tools have recently been developed to support such change, many involving voice, transparency, information and participation. Several specific elements, which can support improved governance and promote institutional change, are discussed in a subsequent section.

1.3.2 Functions and actors

To analyse the institutional arrangements for water management in a river basin we propose a framework of essential functions and enabling conditions. The groundwork for this framework is provided by drawing up a water account of a basin as well as a basin profile that provides an analytically rich description of the basin as a sociotechnical system. The next step is to identify the water management actors in a river basin and the essential functions they execute.

1.3.2.1 Actors

To portray the multitude of water management stakeholders in a river basin, it is useful to distinguish between the various water use sectors and the types of organizations involved in water resource management. Combining sectors with actors yields a matrix of key organizations and stakeholders involved in water management in a basin (Table 1.1). This matrix, after individual actors are identified under each category, provides a basis for identifying key actors in a particular basin.

1.3.2.2 Essential functions

To analyse basin governance, it is necessary to focus on the roles and functions of the various actors engaged in water management in the basin, asking who does what, where, to what end and how well. To guide the analysis, a set of essential functions for RBM has been identified (Burton, 1999; Svendsen *et al.*, 2001). These are defined in Table 1.2. How well functions are carried out, from whose perspective and for whose benefit are empirical questions.

It is possible to construct alternative lists of basin functions. This one was empirically and inductively developed from experience in a number of basins. Its functions subsume supporting functions such as data collection and resource mobilization, which are not ends in themselves, but rather facilitate the higher-level functions listed.

Table 1.1. Illustrative matrix of key water management stakeholders.

	Sector					
Stakeholders	Agriculture	Domestic	Industry	Hydropower	Environment	Other
Multinational agencies						
Government agencies						
Private firms						
Associations/NGOs						
Informal groups						

Note that *government agencies* may include national, sub-national and local entities, while *private firms* can include both multinationals and local firms as well as regulated for-profit utilities. The list of sectors is far from exhaustive and could also include fisheries, navigation, recreation, amenity value and others, depending on local importance.

Table 1.2. Essential functions for river basin management.

Function	Definition
1. Plan	The formulation of medium to long-term plans for the management and development of water resources in the basin, by which the water demands of different sectors are brought in line with water supply.
2. Allocate water	The mechanisms and criteria by which bulk water is apportioned among the different use sectors.
3. Distribute water	The activities executed to ensure that allocated water reaches its point of use.
4. Monitor water quality	The activities executed to monitor water pollution and salinity levels.
5. Enforce water quality	The activities executed to ensure that water pollution and salinity levels remain below accepted standards.
6. Protect against water disasters	Activities executed concerning flood and drought warning, prevention of floods, emergency works and drought preparedness.
7. Protect ecology	Actions undertaken to protect associated ecosystems.
8. Construct facilities	Activities executed for the design and construction of hydraulic infrastructure.
9. Maintain facilities	Activities executed to maintain the serviceability of the hydraulic infrastructure in the basin.

1.3.2.3 Interactional analysis

Functions that should be performed in a closing water basin for effective management may or may not be performed, in fact. Moreover, some may be performed incompletely and some may even receive more attention than they require. Since many organizations and stakeholders are involved with water management in a river basin, a number that generally grows with closure, more than one organization will frequently be involved in performing a particular function. To structure and clarify the resulting patterns of activity, the essential functions of basin management can be crossed with key water management actors as illustrated in Table 1.3. The essential functions are replicated, as appropriate, across three broad categories – surface water, groundwater and derivative water. Because the perspective is basin-wide, functions are not separated by sector, e.g. irrigation or environment. Thus, the category *derivative water* includes irrigation return flows as well as municipal wastewater and industrial discharges. Cells in the resulting matrix are coded to show whether the actor is judged to play a major or a minor role. One of the case studies in this volume (Chapter 9) adds another dimension to the table and endeavours to indicate the type of activity performed by an actor in addressing a particular function.

It is important to note that the matrix depicts actual activity in practice and not nominal responsibilities according to legal frameworks or normative prescriptions defining what should be done. The matrix, together with description of the key actors, gives an indication of which essential functions are being addressed and who is involved in their execution. The matrix exercise can shed light on a number of important questions:

- The functions covered and a rough indication of the adequacy of coverage;
- The functions not covered;
- The number of actors involved in each function and the need for coordination;
- The stakeholders represented in performing particular functions, which leads to conclusions about the representativeness of the basin governance.

Perhaps more importantly, the process is heuristic in that it produces insights and questions that can be used to probe more deeply into issues of functional performance, relationships among actors, and the political dynamics of basin governance and management.

The actors/functions matrix can also be used comparatively within a basin to examine changes over time, the nature of a transition to a desired future state, or nominal versus actual functional performance. Furthermore, it can be applied comparatively to look for patterns among different basins and national contexts. This is done in Chapter 13 of this volume for several of the case studies presented.

The matrix can be generated in different ways. It can be filled in by expert observers after study of a basin, as in the Turkey case study. It can be created on the basis of questionnaire survey results combined with expert observation as was done in the Mexico case, or it can result from focus group interactions of knowledgeable persons, as happened for the South African case. Although used here as a research tool, matrix generation can also be a useful understanding and consensus building tool among the involved parties when used in focus groups made up of key basin stakeholders.

1.3.3 Enabling conditions

Describing who executes the essential functions in a river basin and how effectively, while useful, does not constitute a sufficient methodology for understanding and diagnosing problems affecting basin governance. The essential functions and actors' roles depicted in Table 1.3 provide a static view of responsibilities. Additional attributes of well-functioning basin governance systems relate to its dynamics.

In order for societies to reach decisions consistent with the public interest, several

Table 1.3. Illustrative hypothetical matrix crossing essential basin management functions and key actors.

	Surface water								Groundwater								Derivative water					
Key actors	Plan (basin-level)	Allocate water	Distribute water	Construct facilities	Maintain facilities	Monitor quality	Ensure quality	Protect against disasters	Protect ecology	Plan (basin-level)	Allocate water	Withdraw/distribute water	Construct facilities	Maintain facilities	Monitor quality	Ensure quality	Plan (basin-level)	Allocate/distribute	Construct facilities	Operate/maintain facilities	Monitor quality	Enforce quality
Ministry of Environment	•	•					•	•	●						•	•					●	
Ministry of Water Resources	●	●		●	•	•		●									●	●				
Ministry of Health	•																				●	•
River Basin Commission	●					●	•		•	•					•		●				•	
Electrical Authority	•	•		●	●			•														
Municipal Water Supply Company		•	●	●	●	●						●	●	●	●				●	●	●	
Irrigation System Office	•		●		●																	
WUA			●	•	●							●	●	●								
Groundwater Department, Ministry of Water Resources										•	•				●							
Friends of the Environment (NGO)	•					●	•		•												●	
Leather tanning factory				•	•														•	•		
Association of Manufacturers (trade association)	●	●									●											
Federation of Irrigators (WUA umbrella group)	•	•									•											

●, Major role; •, minor role.
WUA, water user association; NGO, non-governmental organization.

conditions need to be satisfied. We term these attributes *enabling conditions* (Box 1.2). Enabling conditions are features of the institutional environment at the basin level that must be present, in some measure, to achieve good governance and management of the basin. These attributes are not specific to any one actor, but apply to all actors and their interactions and comprise necessary (but not sufficient) normative conditions for good basin management. Most of them contribute to good governance, as discussed in an earlier section. Some basic enabling conditions are shown in Box 1.2. A thorough analysis of these factors is well beyond the scope of this chapter, but a number of them are described briefly.

1.3.3.1 Political attributes

An important political attribute is the representation of interests. In most river basins, some water users will be well represented, while others will not, and in the arena of political give-and-take, those without representation become losers. Industrialists and commercial farmers, for example, typically have ample financial resources, are well organized and have ready access to political decision makers. Poorer irrigators, on the other hand, are likely to be less well organized and consequently will be weakly represented. Their interests are often rather fragile. Water users associations (WUAs) are likely to be intermediate, particularly if they are connected to the local political establishment and collaborate informally, sharing information and coordinating activities. Many times WUAs would benefit by establishing more formal linkages among themselves to allow a single spokesperson to represent them collectively in discussions over basin water allocation, water quality standards, potential irrigation return flow restrictions, and so on.

A serious failure of representation will frequently exist for the environment. Experience has shown that strong non-governmental organizations (NGOs) rooted in civil society are essential components of a political system making socially responsible choices about environmental issues. NGOs can serve as advocates for environmental values and for unrepresented future generations. At the same time, fund raising requirements may lead such mass-based organizations to take extreme and uncompromising positions on issues that must then be moderated in the give-and-take of political debate and decision making.

Hence, fully as important as the existence of representational bodies is the need for a rough balance of political power and influence among various interests. When power is one-sided, issues are not aired adequately and decisions are also one-sided. A key to the evolution of a suitable and balanced governance regime is maturation of non-government organizations and associations based in civil society, which can advocate for particular interests, coupled with the informational attributes described below.

Box 1.2. Enabling conditions.

- Political attributes
  - Representation of interests
  - Balanced power
- Informational attributes
  - Process transparency
  - Information availability
  - Information accessibility
- Legal authority
  - Appropriate institutions
  - Adequate powers
- Resources
  - Human
  - Financial
  - Institutional
  - Infrastructural

1.3.3.2 Informational attributes

An essential enabling condition is the presence in the public domain of accurate and up-to-date descriptive information on water-related issues in the basin. Another is open public transactions, related to policies, plans, regulations, violations and sanctions. The first of these stipulations require that information on basin water allocations, reservoir positions, groundwater elevations, water-quality conditions, available resources, and so on be a part of the public record. Information collected with public funds should be available to the general public at little or no charge in the interest of sound and democratic public decision making. This disclosure condition applies to intra- and inter-departmental information relationships, as well as to those with the general public. The second stipulation, transparency of public proceedings, is similarly essential to fair democratic processes. Rent-seeking behaviour requires darkness and privacy to thrive, and conducting regulatory processes in full view of the public and the press is an effective antidote to such practices.

1.3.3.3 Legal authority

Establishing appropriate organizations requires suitable legal authority. This authority includes the right to exist, the right to a legal personality and suitable electoral procedures to ensure representative leadership of the organization. A legal personality usually includes the right to handle money and keep a bank account, enter into contracts, access the legal system and represent the membership in dealings with governmental agencies.

In some cases, existing legislation has been adapted to allow new water-related organizations to be established. The formation of Irrigation Associations in Turkey took this route. In other cases such as Mexico, new legislation has been written at the outset to facilitate establishment of new organizations and relationships.

1.3.3.4 Resources

Clearly, all four types of resources listed in Box 1.2 are needed for effective implementation of basin management activities. A potential problem is scattering of human and financial resources among a number of organizations, where each lacks a critical mass to be effective. In a context of cooperation, it is not necessary that resources be consolidated under a single administrative structure for effective implementation. However, cooperation and coordination must be effective if a decentralized strategy is to work.

1.3.4 Organizational configurations

The choice of a river basin as a unit of management is based on a certain hydrologic imperative, controlled by gravity and topography. However, establishing basin boundaries is by no means automatic. There are choices involved in subdividing large basins into management units, in grouping small basins, and in deciding which natural basins and sub-basins are to receive priority attention. Moreover, there are often differences between surface water and groundwater divides and basins, where choices have to be made, and where water is imported from neighbouring basins, controversies have arisen over whether to include the watershed of the transferred water in the basin definition. Making such choices has an important bearing on basin management, as different boundaries imply different decision makers and possibly different decision outcomes. However, whether defining boundaries is straightforward or contentious, the defined basin becomes a political unit as well as a hydrologic one and questions immediately arise as to who will make decisions, and how (cf. Wester and Warner, 2002).

Mostert *et al.* (2000) posit three different types of organizational configurations for basin management. One is an *authoritarian model*, in which management is organized on hydrologic boundaries and a single organization makes basin decisions. The second is a *coordinative model*, in which the basin as a hydrologic unit is recognized, but many functions remain in the hands of traditional governmental units, and work is coordinated among these units. The third is management by existing organizations without coordination. The third model is, in reality, not a model of basin management at all but rather the business-as-usual backdrop against which the two other models can be contrasted.

We distinguish two basic organizational patterns for basin governance.[4] The first is the centralized (unicentric) model, in which a single unified public organization is empowered to make decisions regarding management of the basin. This centralized organization is not necessarily 'authoritarian', but does centralize authority under a governance process that may be more or less democratic. The second is the decentralized (polycentric, coordinative) model, in which the actions of existing organizations, layers of government and initiatives are coordinated to cover an entire river basin or sub-basin. While new structures may be created, the bulk of routine work is done by existing organizations that are not specific to the basin. Although both models are characterized by separations among the three basic roles of management, regulation and service provision, the firewalls between them are typically stronger in the coordinative model where separate organizations are involved.

In the real world, RBM structures are usually hybrids, relying to some extent on existing government structures to provide policy and direction, and perhaps execute particular management functions, and basin-specific organizations to collect data, and make certain circumscribed decisions. We describe the two hypothetical models briefly to illustrate the two poles of the continuum.

1.3.4.1 Centralized (unicentric) RBMs

A strength of the centralized model is that its operational span of control coincides with the boundaries of the basin. This internalizes upstream/downstream and other conflicts, making them easier to deal with, and it concentrates the decision-making authority needed to resolve disagreements. Disadvantages of the centralized model include the following: (i) as the organization will generally deal only with water, water will be isolated from other relevant policy sectors such as agriculture, environment and the economy; (ii) establishing a strong unified central authority presents a more challenging political problem than securing agreement for a coordinative body. The challenge here will be even greater for international river basins; and (iii) governance of a centralized organization raises challenging questions of broad stakeholder representation and accountability.

The most prominent examples of authorities are those having the development of a river basin as a primary mandate. The classic example is the TVA, which was created during the economic depression of the 1930s to address problems of poverty and unemployment in a particular region of the USA. Other examples are the Rio São Francisco Development Agency in Brazil and the Mahaweli Development Authority in Sri Lanka. When their primary development tasks are finished, these authorities often try, with varying degrees of success, to assume a broader resource management role.

1.3.4.2 Decentralized (polycentric) RBMs

The decentralized model addresses some of the weaknesses of the centralized model but contains others. On the plus side, it provides for a strong political base for action, since coordination involves voluntary agreement among participating jurisdictions. The coordinative process also leads to a more responsive governance process. Intersectoral linkages remain intact, as coordination is among individual states, nations or other jurisdictions responsible for a range of policy sectors, and such a set-up provides a natural base for decentralization of responsibilities. On the other hand, decision making can be cumbersome, coordinating costs may be high and political changes in participating jurisdictions can upset agreements.

These two models represent polar extremes, and actual arrangements are often blends of the two. In the Murray–Darling

[4] We focus here on organizations and governance and not on the way in which particular functions are executed. There are a range of options within each governance structure for providing services and executing other functions.

basin, for example, a cooperative Ministerial Council, made up of representatives of the four involved states and the federal government, sets policy while under it an authority-like Commission supports the Council and executes its decisions. A similar set-up exists in France, where a River Commission made up of local and national government representatives and users sets water policy, which is implemented by an associated Water Agency. Publicly held companies manage the distribution infrastructure and make bulk water deliveries to user associations. In the USA, formal bodies for managing river basins are rare, allowing some exceptions such as the TVA and the Delaware Basin Commission. Policy-making authority is distributed among a variety of federal and state agencies and departments. Coordination is achieved through a plethora of committees and working groups linking stakeholders into discussion and decision-making forums. Legislation and negotiated legally binding agreements are important instruments for establishing policy and practices, and the court system is routinely invoked to resolve disagreements and disputes. In California, a state water plan, updated every 5 years, provides a rolling framework for managing the state's water resources.

1.4. Basin Management and Irrigation

As basins close, irrigation systems within the basin are confronted with both internal and external challenges. Internal challenges require them to do more with less water, whereas the external ones require them to organize and act effectively to protect their interests. Dealing with both at the same time is difficult, and systems which address the internal challenges successfully before having to tackle the external ones will generally be better off.

Closing basins, by definition, are becoming water scarce, and newer rapidly growing sectors, typically urban and industrial users and the environment, will usually demand that irrigated agriculture, as the largest traditional user, use less water to free more of it for their growing needs. This puts pressure on irrigators to use water more efficiently, and may lead to retirement of less productive irrigated lands and transfer of their water rights to other users, as is presently happening in California's Central Valley. The cost of water will generally increase to reflect its growing scarcity, leading to pressure to grow higher-value crops to cover these costs. More efficient use of water requires that irrigation systems acquire new measurement and control technology, and more professional management.

These same pressures may emerge as challenges to agriculture's right to use basin water resources at all in legislative and legal arenas. Often agriculture began using water at a time when rights were not formally specified, which can make them less secure than the formalized rights allocated to industries and larger corporate irrigators which came later. Where water rights are merely implicit in the allocation priorities of a large public irrigation agency, risks also arise. Regulation, service provision and other functions of unitary public water agencies tend to be split up among several new agencies or departments as basins mature, giving basin managers a broader constituency and weakening their ability to defend their former clients. Basin-level decision-making forums will tend to include more actors and cover a broader range of issues, requiring that irrigators mobilize to represent their own interests vigorously and become conversant with a broader range of water-related considerations.

Irrigators located downstream of major population centres and industries will also need to seek protection for the quality of the water they receive. Urban concentrations with inland locations, such as Cairo or New Delhi, degrade significantly the quality of water reaching downstream irrigators, with impacts on human health and contamination of produce and soil. Individually, irrigators and small systems will have little or no ability to apply pressure for reduced pollutant loadings in their water supplies. Organized into a larger network, they can have influence.

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