



Planning and Managing Water Resources at the River-Basin Level: Emergence and Evolution of a Concept

François Molle

The Comprehensive Assessment of Water Management in Agriculture takes stock of the costs, benefits and impacts of the past 50 years of water development for agriculture, the water management challenges communities are facing today, and solutions people have developed. The results of the Assessment will enable farming communities, governments and donors to make better-quality investment and management decisions to meet food and environmental security objectives in the near future and over the next 25 years.

The Research Report Series captures results of collaborative research conducted under the Assessment. It also includes reports contributed by individual scientists and organizations that significantly advance knowledge on key Assessment questions. Each report undergoes a rigorous peer-review process. The research presented in the series feeds into the Assessment's primary output—a "State of the World" report and set of options backed by hundreds of leading water and development professionals and water users.

Reports in this series may be copied freely and cited with due acknowledgement. Electronic copies of reports can be downloaded from the Assessment website (www.iwmi.org/assessment).

If you are interested in submitting a report for inclusion in the series, please see the submission guidelines available on the Assessment website or send a written request to: Sepali Goonaratne, P.O. Box 2075, Colombo, Sri Lanka.



Comprehensive Assessment outputs contribute to the Dialogue on Water, Food and Environment Knowledge Base.

Comprehensive Assessment Research Report 16

**Planning and Managing Water Resources at
the River-Basin Level: Emergence and
Evolution of a Concept**

François Molle

The Comprehensive Assessment (www.iwmi.cgiar.org/assessment) is organized through the CGIAR's Systemwide Initiative on Water Management (SWIM), which is convened by the International Water Management Institute. The Assessment is carried out with inputs from over 100 national and international development and research organizations—including CGIAR Centers and FAO. Financial support for the Assessment comes from a range of donors, including core support from the Governments of the Netherlands, Switzerland and the World Bank in support of Systemwide Programs. Project-specific support comes from the Governments of Austria, Japan, Sweden (through the Swedish Water House) and Taiwan; Challenge Program on Water and Food (CPWF); EU support to the ISIIMM Project; FAO; the OPEC Fund and the Rockefeller Foundation; Oxfam Novib and CGIAR Gender and Diversity Program. Cosponsors of the Assessment are the: Consultative Group on International Agricultural Research (CGIAR), Convention on Biological Diversity (CBD), Food and Agriculture Organization (FAO) and the Ramsar Convention.

The Author: François Molle is a Senior Researcher at the Institut de Recherche pour le Développement (IRD), France, currently having a joint appointment with the International Water Management Institute, Colombo, Sri Lanka.

Acknowledgements: This report greatly benefited from comments made by Mark Svendsen, Robert Hollaender and Hugh Turrall on an earlier version.

Molle, F. 2006. *Planning and managing water resources at the river-basin level: Emergence and evolution of a concept*. Colombo, Sri Lanka: International Water Management Institute. 38p. (IWMI Comprehensive Assessment Research Report 16)

/ Water resources development / river basin development /

ISSN 1391-9407
ISBN 92-9090-652-9
ISBN 978-92-9090-652-0

Copyright © 2006, by Comprehensive Assessment Secretariat. All rights reserved.

Cover photograph credit: <http://earthasart.gsfc.nasa.gov/jordan.html> (showing southern Jordan).

Please send inquiries and comments to: comp.assessment@cgiar.org

Contents

Summary	v
Introduction	1
Early Conceptions and Development of River Basins	2
River Basins as Boundaries of Utopia	4
Marshalling Water Resources	7
Remembering People and Nature	15
Complexity and Integrated Water Management	18
Conclusions and Perspectives	23
Literature Cited	25

Summary

The concept of a river basin as a management or planning unit has gone through several stages and is in a state of flux. From its early conceptualization in China and its western ‘discovery’ in the eighteenth century to its advent as the overriding concept behind European water policy, the river basin has been conjured up and mobilized in evolving contexts and with varying intentions. Associated with utopian ideas of the late nineteenth century, it supported ideas of full control of the hydrologic regime and multi-purpose dam construction in the 1930–1970 period, then partly faded and was revived to address water-quality problems, before reemerging in the 1990s as the cornerstone of Integrated Water Resources Management (IWRM), enriched and blended with watershed and ecosystem management approaches.

This report recounts the evolution of the concept of a river basin and how it has been associated with various strands of thinking and sometimes co-opted or mobilized by particular

groups to strengthen the legitimacy of their agenda. This illustrates the fact that beyond its relevance as a geographical unit for the study of hydrology or for water resources development purposes, the river basin is also a political and ideological construct. The concept draws its strength from its ‘naturalness’ and, as it becomes more embracing and consensual, is likely to—paradoxically—face increasing difficulties. Current conceptual or managerial approaches centered on the river basin reflect the growing complexity of the human-environment nexus and clearly distinguish themselves from earlier utilitarian and managerial approaches by putting humans at the heart of the ecosystem and citizens at the helm. How interconnected and nested waterscapes can be managed by discontinuous nested political/administrative and social levels remains a fundamental question fuelling an endless search for elusive governance systems that unite nature and society.

Planning and Managing Water Resources at the River-Basin Level: Emergence and Evolution of a Concept

François Molle

Introduction

Nothing, perhaps, is more 'natural' to mankind than water. The law of gravity, even if it is not mathematically conceptualized, is readily understandable to the observer: water flows downhill, joins larger streams and eventually discharges into the sea. Very early on, navigation from the estuary to the inland (or vice versa) also provided a tangible journey through the network of river systems. Yet, the conceptualization of a watershed and of a river basin appears to emerge quite late in western history. The quantification of hydrological flows within a basin is an even more recent achievement and is still imperfectly mastered.

The idea of a river basin, despite its physical or natural attributes, is more than an engineering concept encompassing the magnitude and dynamics of a resource that must be harnessed for the common good. The search for adequate administrative and political boundaries probably dates back to the first chiefdoms or kingdoms. With the development of scientific knowledge in disciplines such as hydrology, geology or geography, or political and managerial sciences, this search has frequently borrowed from the natural sciences in its justification of 'ideal' or 'natural' limits, political, managerial or otherwise, that would be rationally and non-controversially determined.

In parallel, the concept of the river basin has gradually emerged as an operational concept for the development and management of water resources. Despite some internal limitations, the

concept has been enthusiastically embraced by planners and engineers in their drive to master nature and 'optimize' the multiple tasks assigned to water and the benefits drawn thereof.

Hydropower generation, flood control, irrigation and water supply were, at first, the main expected economic benefits. With time, not only new benefits (e.g., recreation, aesthetic amenities, ecosystems services, etc.) but also, more crucially, the hidden cost of these developments, emerged. The river basin gradually became a wider political arena where contrasting interests and worldviews would be confronted and, sometimes, reconciled.

This report first reviews early conceptions of the river basin. It then focuses on the era of large-scale infrastructural development, when the river basin came to be seen as the logical unit to optimize, or "unify" the multiple uses of surface water, and then as a planning unit for regional development. The two subsequent sections address the further conceptualization of the river basin that has emerged during the last three decades or so in response to both the environmental degradation wrought by structural developments and by the increasing complexity of human-environment interactions. Ecosystem approaches restore a vision that incorporates humans and ecosystems as part and parcel of a basin, while various strands of thinking based on ideas of integrated management attempt to come to grips with the complexity of overexploited basins in the face of growing populations. Such

approaches, however, often remain largely over-technical and blind to history and therefore prompt

the need for a political ecology of river-basin development and management.

Early Conceptions and Development of River Basins

Although humans have probably always pondered on the environment, it is likely that more careful consideration of water flows, their strength and their variability, arose concomitantly with the advent of large-scale irrigation in Mesopotamia, some 5,000 years ago. It can be hypothesized that notions of hydrology were gradually improved as diversion structures and, later, reservoirs¹ were washed away by floods. The most sophisticated early knowledge on rivers and on the hydrological cycle (with a clear description of how vapor generates clouds and clouds rivers) was probably gained by the Chinese, as early as the third century B.C. (Guowei 2001; Newson 1997). In that same period, the philosopher Guan Zhong classified water resources into several categories: the trunk, the tributary, the seasonal stream, the artificial canal and the lake (CHES and CNCID 1991). Although the Romans and, later, the Arabs developed sophisticated hydraulic infrastructures, it seems that their conceptual knowledge of hydrology remained limited (L'Hote 1990).

River-basin land and water resources were in general exploited by successive piecemeal projects sited in places deemed suitable, based on the characteristics of the land, of the hydrologic regime, and on available technology. Most projects, even large-scale ones, ranging from canalling, diking, river rectification, drainage, flow diversion, poldering, impounding, storage, to irrigation networks occupied adequate parts of the landscape (upper catchments, intermontane valleys, large plains, deltas, etc.), where risk was lowest and convenience highest. China's ancient history provides a full anthology of adaptations to, and crafting of, the environment (CHES and CNCID 1991). Infrastructures were often damaged, however, and as they grew in numbers

they became interdependent through the hydrological cycle.

One notable early development of river basins was observed in Sri Lanka, from the end of the first millennium B.C. to the thirteenth century. Several hypotheses have been made on the chronology of basin development, starting from small-scale tank "cascades" in smaller catchments to larger dams and then to their interconnection across catchments (Brohier 1934; Needham et al. 1971). Interestingly, it seems that diversion of rivers by canals and interbasin transfers predate the construction of large reservoirs. This prompted Mendis (1986, 1999) to observe that "river diversion represents water management in space, a much earlier achievement in humankind's agricultural history than storage, which represents water management in time." Although no document exists on the conception of a river basin in ancient Sri Lanka, one may hypothesize that space was defined by rivers (rather than basins), which could be diverted to irrigate land (sometimes located across contiguous basins) or interlinked (hence the technique to feed larger tanks through adding the diverted flow of neighboring rivers). River diversion is commonplace in all hilly or mountainous landscapes of the world, where catchments are rather small: run-of-the-river schemes are, in particular, found in the Himalayas, the Andes, and Southeast Asia. By nature, canals diverting river water diverge from the stream, cut across tributaries and, if furthered, straddle neighboring basins. Again, emphasis was on how to achieve diversions commensurate with the flow intensity and to take water away to convenient places, not on the river basin as a spatial unit.

¹The oldest dam on earth is believed to be the Sadd-el-Kafara Dam, built in Egypt sometime in 2600–2700 B.C. (Garbrecht 2001).

Conceptual progress in western countries remained limited for a considerable time, and was in particular hindered by the idea that some water was sourced from an ocean within the earth (Dooge 2001). During the Renaissance, Leonardo da Vinci drew a magnificent map of rivers in Northern Italy (1502–1503), with shadings showing details of mountains and slopes (Newson 1997), but he seems to have failed to fully articulate the notion of the basin and the hydrological cycle (Biswas 1970). Pierre Perrault, a French geographer, is believed to be the first author to have proved that rainfall alone is sufficient to supply springs and rivers. His 1674 treatise “*De l’origine des fontaines*” established a crude water balance of the Upper Seine River Basin, where he compared the river discharge with “the rainwater that falls around its bed.” His calculation of the catchment area was based on the observation that “the slope of [the river] bed extends to the right and left about two leagues on each side, where there are other brooks that flow elsewhere” (Biswas 1970). A similar calculation was to be made by Mariotte some years later, with regard to the flow of the Seine River in Paris. In 1799, John Dalton published the first water atlas of England and Wales (Dooge 2001).

In Europe, the first theorization of the landscape as a set of contiguous catchments may have been postulated by Philippe Buache, a French cartographer attached to King Louis XV. In 1752, Buache published his *Essai de géographie physique, où l’on propose des vues générales sur l’espèce de charpente du globe*, which had an enormous impact. In this essay, Buache inaugurated the theory of drainage systems to try to explain the structure of continents based on the study of mountain ranges, streams and rivers (Ghiotti 2001). He defined a river basin as “the set of all the slopes on which fall the waters that converge to a same river or creek” (Lacoste 2003).² The theory was rapidly taken up by Gatterer in Germany who improved it and made it the basis of a theory of the division of the world into lands and regions (Hartshorne 1939).

Notwithstanding these theoretical advances, awareness of river-basin interconnectedness had long been nourished by various types of natural events or human-made conflicts. Upstream-downstream interactions have probably always been recognized. Diverting water or storing it to stifle rice production in downstream enemy states or releasing it on cities to destroy enemies were employed in China as early as the fourth to the third centuries B.C. (CHES and CNCID 1991), and by Xerxes in Mesopotamia (Teclaff 1967). Parker (1976) presents an almost continuous record of “river offences” in England from 1318 until 1698, and conflicts between mills and farmers diverting water for irrigation can be found in Japan in the seventeenth and eighteenth century (Kelly 1980), and in France (and southern Europe) in the eighteenth and nineteenth century, for example. Floods also led to questions about their causes. Wengert (1985) reports that the great floods of the 1870s in the US exposed the irrelevance of local works and led the US Congress to create the Mississippi Commission in 1879. Similarly, in France, the belief in a link between the floods of the Rhone River and deforestation in the upper basin was established by the end of the eighteenth century (Ghiotti 2001). The impact of local flood control works on shifting risk and destruction onto other parts of the basin had also led to conflicts (e.g., in Japan, Kelly 1980). Pollution, brought about by the Industrial Revolution, also later generated upstream-downstream conflicts, and the British Rivers Pollution Prevention Act was passed in 1876, although implemented under the administration of the county councils and not at the basin level (Newson 1997). Fluvial navigation had also long provided people with a sense of the river system. In most cases, heavy use of rivers for the transportation of goods welded a basin into a commercial entity, regardless of whether it was politically unified or not (Teclaff 1967).

² “L’ensemble de toutes les pentes des eaux qui se réunissent dans un fleuve ou une rivière.”

In sum, although hydrological interactions had been experienced (and sometimes manipulated) very early on, the focus was on the river itself and on the various types of use allowed by available technology at one point in time. The main issues were adaptation to the strength of the river, the interactions between upstream and downstream reaches, or the exploitation of the connectivity of river systems. Headwaters were

rarely visited and, in the case of long rivers, interconnectedness of tributaries or reaches was not always well recognized. The western conceptualization of a river basin as a natural spatial unit only developed in the second half of the eighteenth century. Industrialization paralleled by scientific and technological development would subsequently project the river basin as the locus of human conquest of nature.

River Basins as Boundaries of Utopia

Around the beginning and middle of the nineteenth century, water science developed considerably. Expanding knowledge in chemistry, sanitation, hydraulics, topography, geology and hydrology provided the basis for an improved description of the water cycle, the marshalling of the hydraulic power of rivers for industrial development, the advance of the hygienist movement, and the development of irrigation in Europe. With the progress of natural sciences, positivist thinking toyed with the idea of determining 'natural truths' that could be dragged out of, and insulated from, the misery of human affairs, though this pretension at defining 'natural' territories necessarily came into conflict with prevailing political structures.

In the middle of the nineteenth century, the river basin gradually became a tenet of productivism. With its growing contribution to the industrial revolution, water became a pivotal resource and its management gradually shifted from the local to the regional or national scale, with regulation structures and decision making becoming increasingly distant from the points where water was used. Subduing nature and marshalling water became part of the mission of western countries, inebriated both by their colonial adventures and by the scientism of the time. Industrial and mechanical arts were thought to herald the civilizing blessing of European culture. Although his masterpiece *Man and Nature* would, two decades later, show a more qualified

judgment, the founding father of American geography, George Perkins Marsh, considered in 1847 that "America offers the first example of the struggle between civilized man and barbarous uncultivated nature... In North America,..., the full energies of advanced European civilization, stimulated by its artificial wants and guided by its accumulated intelligence, were brought to bear at once on a desert continent, and it has been but the work of a day to win empires from the wilderness, and to establish relations of government and commerce between points as distant as the rising and setting sun."

In France, the concept of a river basin was popularized, after Buache, by cartographers and atlases, and appeared in the debate around the definition of the *départements* (the spatial basis of the post-revolutionary administrative system) as a contender of the idea that natural territorial divisions should help produce an ideal social organization (Reynard 2003; Ozouf-Marignier 2002). It remained the object of scientific debate and was vehemently opposed by geologists, who proposed other natural units based on geological features (Ozouf-Marignier 2003). Scientific considerations were captured by political interests and the river basin served as a weapon against centralization, as inherited from the Revolution, and was supported by the landowning aristocracy and by monarchists/conservatives who sought to reestablish the preeminence of the "local" (Ghiotti 2004). In 1851, a plan to regroup the *departments*

in 22 regions, which further combined into main river basins, was proposed. The plan was presented as a pertinent regional division for administration and public services, with the clear intent to counterbalance Paris-centered political power (Ozouf-Marignier 2003). The concept was also taken up by economic interests concerned by the use of rivers for transportation. In parallel, it was also endorsed by agronomists who emphasized the rationalization of hydraulic management and called for the establishment of a *Hydraulic Service*, as a way to challenge the supremacy of the corps of state engineers (*Ponts et Chaussées*), gatekeepers of technical expertise (Ghiotti and Haghe 2004).

The concept also came to nourish some early utopian dreams of mastering nature. In 1871, in France, Thomé de Gamond, an engineer and long-time friend of Napoleon III, proposed the “transformation of the wild stream into the civilized river” and to subject rivers to “the absolute discipline of a totally stable regime.” His plan consisted in transforming rivers into a succession of reaches in which the water level would be maintained constant, allowing navigation, easy diversion to irrigated land, and the creation of 40,000 waterfalls that would provide hydropower in place of the costly steam machines.³ Thomé de Gamond (1871) also recommended delegating the exploitation of France’s “nine natural and distinct hydrographic basins” to semi-private regional companies, foreshadowing the advent of the *Compagnie Nationale du Rhône* in the 1920s. Since the 1840s, each basin became the subject of comprehensive studies on topography, geology, hydrology and agriculture (Ghiotti 2004). The dramatic floods of 1850 provided a further impulse for improving knowledge of basin hydrology. In 1856, a letter from Napoleon III demanded that “each basin be provided with a permanent engineer in charge of protection systems,” these engineers being responsible for providing hydrographic data to be centralized by the administration (*Corps des Ponts et*

Chaussées) (Haghe 1998).

In Spain, the ideology of national development, revival and progress (*regeneracionism*), which emerged in the late nineteenth century along with internal disintegration and loss of colonial power, also embraced the river basin as a “natural unit” (Swyngedouw 1999). At the confluence of a scientific-positivist comprehension of the world and of traditional rural culture, the river basin signaled a natural and harmonious order that was contrasted with the traditional political and administrative divisions inherited from the past. Naturalization was part and parcel of the project of modernization called for by *regeneracionists*, most notably Joaquin Costa (Fernández 1998). Just like in France in the nineteenth century, the concept became a social construct and a political weapon in the hands of the revivalists, who spearheaded an alliance between a new bourgeoisie and smallholders against the traditional landowning elite associated with the state apparatus (Swyngedouw 1999). The first partition of the country in ten hydrological divisions (later reduced to seven) was established by royal decree as early as 1865. Although functionalist views lost out to administrative thinking, they reappeared in 1899 when Minister Grasset created seven Divisions for Hydraulic Works (Blasco n.d.) that were later enshrined in the 1902 Hydraulic Plan. Despite Costa’s call for a “hydraulic policy,” large-scale river basin development would take off only in the 1920s, to later peak during Franco’s regime.

In the US, the rationalization challenge was taken up by John Wesley Powell, Head of the Geological Survey Department between 1881 and 1894. Moved by an eagerness to “redeem” the arid West by capturing, taming and diverting its rivers, Powell nevertheless opposed enthusiastic supporters of massive federal involvement in the financing of irrigation on the ground of the prior need for a full scientific examination of topographical and hydrological conditions. Powell’s plan was to divide the arid

³Factories would be established near these streams and expropriated land around these factories would be resold to families of laborers to cultivate half a hectare each for their subsistence, to the benefit of 4 million landless and homeless families.

region of the western US into two or three hundred hydrographic basins and to design settlements based on natural resources rather than on the prevailing township and county system (Worster 1985). Society, its institutions, its productive activities and even the definition of land and water rights, would be organized based on these natural units and on a sound survey of their natural resources.⁴ His stance, typical of the time, that civilization, science and technology were meant to dominate nature was paralleled by a Jeffersonian fondness for locally organized autonomous corporations of small farmers, who would constitute “commonwealths,” self-determined and independent of both capitalists and bureaucrats (Worster 1985). The Reclamation Service, founded in 1902, failed to follow such lines and ushered in an era of federally funded projects (Hundley 2001). It was only in 1923, with the transformation of the Service into the Bureau of Reclamation, that the realization of the ‘hydraulic mission’ would be up and running.

The British experience with Commissioners of Sewers dates back to the Middle Ages. In addition to problems of navigation and mills, England was faced with pollution problems throughout the nineteenth century: the Public Health Act and the Rivers Prevention Act were passed in 1875 and 1876, respectively (Newson 1997). In 1857, a Thames conservancy board was formed, perhaps because Parliament on its riverside site could no longer ignore the stench (Kinnersley 1988). In 1879, F. Toplis, an eminent geologist, proposed the creation of 12 agencies for England and Wales largely related to river basins and to be managed by engineers (Kinnersley 1988). This farsighted proposal was disregarded, since it entailed centralized power and responsibility at a time when municipal bodies were financially in charge of water supply and sanitation.

In addition to the US and to European countries like Spain, France or Italy, other dry countries were captivated by the “desert bloom” syndrome and moved towards large-scale river engineering. In South Africa, scientists called for rivers to be “tamed and domesticated” like they were said to be in China, so that “deserts [could be] turned into gardens” (Turton et al. 2004). In Brazil, especially after the great drought of 1877-1879, engineers and politicians referred to irrigation development in the US and, later, drew inspiration from the Bureau of Reclamation, launching massive construction of reservoirs in the northeastern region of the country under the banner of the “*solução hidráulica*” (Guerra and Guerra 1980; Molle 1991). In Mexico, despite the drive to “win over nature” (*vencer a la naturaleza*) and the inspiration provided by the development of irrigation in the US, large-scale river basin development remained hindered by a lack of hydrological knowledge and would only materialize after WWII (Aboites 1998).

Developing river basins and irrigation was widely discussed in the nineteenth century and early twentieth century. Success stories here and there (US, Italy, Spain, India, Egypt, etc.) were widely commented upon across the world, with California becoming an icon of the “desert bloom” (Ertsen 2006). Colonial feats in large-scale land reclamation (Mekong and Irrawaddy deltas), irrigation (India, Java, Sudan), flood control (Tonkin) and dam construction (Egypt) stirred the imagination. The French thought “the El Dorado would be at reach once irrigation is developed” in the inner delta of the Niger Basin (Schreyger 1984), “Rome granary” would flourish again in Morocco, and the Guezira scheme in Sudan would remain in history as a “great romance of creative achievement” (Ertsen 2006). In 1908, Winston Churchill emphatically announced that “These giant enterprises may in their turn prove

⁴In his 1878 *Report on the Lands of the Arid Region of the United States* Powell had defined 24 regions based upon natural land formations, subdivided into four subunits: nonirrigable lands, irrigable lands, pasturage lands, and timber lands. In later writings on “Institutions for Arid Lands,” Powell (1890) made more explicit institutional proposals: “Every man is interested in the conservation and management of the water supply, for all the waters are needed within the district. . . . Thus it is that there is a body of interdependent and unified interests and values, all collected in one hydrographic basin, and all segregated by well-defined boundary lines from the rest of the world...This, then, is the proposition I make: that the entire arid region be organized into natural hydrographic districts, each one to be a commonwealth within itself for the purpose of controlling and using the great values which have been pointed out... The plan is to establish self-government by hydrographic basins.” Such river-basin-based plans can be contrasted with the rectilinear state boundaries chosen by Jefferson out of fascination for Cartesianism and science (Anesi et al. 2002).

but the preliminaries of even mightier schemes, until at last nearly every drop of water which drains into the whole valley of the Nile... shall be equally and amicably divided among the river people" (McCully 2001).

In contrast to problems of navigation or flood control, plans for large-scale irrigation or river control initially made little direct reference to the unity of the river basin in which they were to take place, in particular when they were planned on major river basins where upstream/downstream and other negative impacts were not anticipated. The vision of the fullest utilization of a river basin emerged with the development of the Indus Basin by the British in the 1880s, and of the Nile at the end of that century, and was formalized in the beginning of the twentieth century. These conceptions were best embodied in the work of Sir William Willcocks who, inspired by his early experience in India and his research on ancient Mesopotamia, championed "the new-found powers of professional engineering to transform the world, and of the importance of state support in giving engineering's power to control nature full play" (Gilmartin 2003). Posted to serve in Egypt, Willcocks developed grand plans of gigantic irrigation works and emphasized that total river basin development needed strong and committed states, in line with undersecretaries for Public Works, Scott-Moncrieff and William Garstin, who saw the political control of the whole basin as a prerequisite for full river development⁵ (Tvedt 2003). Imperial designs, Promethean engineering, the need

for proper hydrological knowledge of the river system, the economic interests vested in the expansion of a stable cotton-based agriculture, all produced a new definition of the Nile River Basin, stressing its physical unity as one hydrological and planning unity. As aptly summarized by Tvedt (2003) "What had in the past been regarded by and large as a local river or as many rivers was now described as one basin or water system, hydrologically unified, and from source to mouth it was conceived of as a potentially more benevolent servant to the irrigation economies in the north and at the same time as a potent political weapon in the hands of London."

After traveling through the United States in 1912-1914, Willcocks pointed to the fact that flood-control structures on the Mississippi River were made without considering the overall dynamic of the river in its basin (Melville 2005). Willcocks came in praise of the power of modern technology (concrete, steam and electric power, dredging machinery, etc.) to shape river systems on a large scale (Teclaff 1967). High dams would allow "subduing nature," controlling flood and navigation, the generation of hydropower (extracting "work") and irrigation of land under "command" (water "duty") (Gilmartin 2003). Long-distance transmission of electric power made it possible to generate massive amounts of energy for the benefit of distant users. Industrialization created new needs. A more systematic approach to the economic potential of river systems was needed.

Marshalling Water Resources

Although the grand or utopian plans of combining river basin development and social engineering, elaborated during the nineteenth century, remained dormant, they nevertheless paved the way for a period of massive structural development, which would roughly take place

between the 1920s and the early 1970s. Scientism would be reincarnated into high-modernism, with both nature and people subordinate to higher state ideals named "progress" and "development" (Scott 1998). While the first years would see the emergence of—still

⁵This plan is well expressed by Cromer (1908), quoted by Tvedt (2003): "When eventually, the waters of the Nile, from the Lakes to the sea, are brought fully under control, it will be possible to boast that Man - in this case the Englishman - has turned the gifts of Nature to the best possible advantage."

scattered—dam projects and the growing recognition of the river basin concept for multipurpose reservoir development, the advent of the Tennessee Valley Authority in 1933 (Senate of the United States of America 1933) would further herald the effective realization of the river basin as a planning unit for wider comprehensive regional development.

The US: The Advent of the TVA and Other River-Basin Initiatives

In 1907, President Theodore Roosevelt appointed a commission (the Inland Water Commission) to study the possibility of developing conjunctive use of rivers for transportation, flood management and hydropower generation. Somewhat ironically, conservationists—forerunners of later ecological movements—and Roosevelt himself supported multipurpose dam development as a remedy to the feared exhaustion of the resource. This study supported the view, also emphasized in the Joint Conservation Conference held in 1908, that “all uses of the waters and all portions of each waterway should be treated as interrelated” (Teclaff 1967). Because of the pressing needs of water for the development of irrigation in the West and the demand for electrical energy throughout the country, Congress also embraced the ideology of multipurpose planning, as it saw coordinated approaches to river development as the best way to answer interstate economic requirements (Reuss 1991). In 1925, despite much foot-dragging from the Corps of Engineers, Congress commissioned surveys of navigable streams and tributaries in order to improve stream navigation “in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation,” resulting in comprehensive river studies known as the 308 reports (Reuss 1991; Kenney 1997). In the 1930s the term

“regionalism” gained increasing favor and was the object of much debate as to what the term meant and what factors should be given more emphasis. The region should become a unit for action: planning would be an antidote against market failure, lead the “effort to remake the face of America” (Hargrove 1994), achieve development, and drag the country out of the Great Depression (Wengert 1951).

As part of the New Deal, and as a means to trigger development in one of the most destitute regions of the country, F. D. Roosevelt established the Tennessee Valley Authority (TVA) in 1933, a major experiment in large-scale planning “not just for ourselves but planning for the generations to come, tying in industry and agriculture and forestry and flood prevention, tying them all into a unified whole” (Reuss 1992). Roosevelt’s long-time interest in planning⁶ would materialize on a scale never achieved before, and the TVA would become the “grand-daddy of all regional development projects” (Scott 1998). The TVA unleashed a period of more than three decades during which nineteenth century scientism, now provided with the technology to develop large-scale infrastructure, would fully blossom into the social engineering drive of what Scott (1998) has termed *high-modernism*. The TVA’s initial ideological underpinning, as shaped by Arthur Morgan, one of its three initial cochairmen, rested on the engineering ethos that scientific knowledge and systematic rational planning could radically change society if they could emancipate themselves from vested interests and politics. The TVA would not only attempt to ‘fully’ control the river system by a series of dams, thus providing protection from floods and producing hydropower but would also tackle poverty at the root by an ambitious range of activities, including training, agricultural extension services, soil conservation, afforestation, production of fertilizers, stimulation

⁶Roosevelt (1933) stressed that “many hard lessons have taught us the human waste that results from lack of planning,” and revealed that he had long thought about basin planning, influenced by an early paper from A. E. Morgan on “managing unified river systems:” “Before coming to Washington, I had determined to initiate a land-use experiment embracing many States in the watershed of the Tennessee River. It was regional planning on a scale never before attempted in history” (see EIR 2005). See also Hargrove 1994 and the early influence of G. Pinchot at <http://www.tva.gov/heritage/pinchot/index.htm>.

of local enterprises and welfare-oriented programs on education, health and sanitation (TVA Act 1933). Roosevelt was probably able to launch the TVA, that he envisioned as “a corporation clothed with the power of the state but possessed of the flexibility and initiative of a private enterprise” (Roosevelt 1933), because of the collapse of the market and the economic crisis. State intervention in social change was anathema in the US (Saha 1981) and the TVA had to respond to the accusation of “socialism,” not least from the private electricity sector.

Arthur Morgan’s views and idealism regarding elite-driven social planning as a means to promote morality and circumvent politics were eventually superseded by the policies promoted by the other two chairmen (Hargrove 1994): Harcourt Morgan, who made sure that the interests of local farmland owners and state institutions would not be jeopardized, and David Lilienthal, whose emphasis on “grassroot democracy” was very much an attempt to mobilize public support and legitimacy for a TVA focused on hydropower generation, and to co-opt local interests (Selznick 1949; Tugwell and Banfield 1950). The democratic rhetoric of Lilienthal (1944) and his intent to avoid the danger of centralized and technocratic authoritarianism by instilling people’s participation were soon dampened by local elites reasserting control over the Authority’s prerogatives, trimming its social programs, and narrowing down its focus to a mere planning and construction agency devoted to hydropower generation and flood control (Tugwell and Banfield 1950). Despite the gap between rhetoric and reality on the ground, the TVA’s democratic gloss, marketed in particular by the prophetic tone of Lilienthal’s (1944) book *TVA: Democracy on the March*, was to prove a major asset of US overseas development and diplomacy (Ekbladh 2002).

The “discovery” of the river basin as a necessary unit—encompassing both the resource

in its entirety and its multiplicity of uses—also appears to have suited larger bureaucratic interests.⁷ Although cloaked in the rhetoric of scientific, rational and apolitical planning, it was already apparent in the 1920s that multipurpose management was only embraced by some to provide justification for particular navigation, irrigation and public power projects (Reuss 1991). River basin planning was paralleled by something the Bureau of Reclamation called “river basin accounting,” which was an early attempt to expand cost-benefit analysis to multipurpose water resource development projects. In the early 1940s, according to Reisner (1986), by considering an entire basin as an integrated project and pooling all benefits (e.g., irrigation, navigation, hydropower, etc.) together, the Bureau was able to further projects which would not make economic sense if considered in isolation. Irrigation costs, for example, could be offset by hydropower benefits. According to Robinson (1979), the 1944 plan for the Missouri River was designed on such grounds and “encouraged the Bureau to enthusiastically prepare basin-wide plans for several western rivers.”

In contrast to its official presentation as a success story, TVA experience was never replicated in any other basin in the US, notwithstanding which, in 1934, President Roosevelt created the National Resources Board which recommended fully fledged studies of seventeen drainage basins. The country was later divided into 115 drainage basin subdivisions and their study was assigned to water consultants (Reuss 1992). Altogether 45 drainage basin committees were formed but further recommendations of the 1937 report of the National Resources Committee favoring “a unified plan of water control and development” were not implemented (Reuss 1992). Among other plans, a proposal by the Corps to construct 82 dams in the Ohio and Lower Mississippi Basin, primarily for flood control, did not materialize. Roosevelt

⁷Black (1995) also notes that “during the 1930s, river valleys became a popular method of selling ideas and establishing government authority [but that], however, it remains unclear why F. D. Roosevelt and others believed that river basins offered the most logical units for economic planning.” He explains the choice of dams as a booster of economic development by the iconic appeal of such projects to decision makers.

also proposed in 1937 to establish seven regional agencies partially based on river basin boundaries, but the proposal failed to pass in Congress, the looming war and State reluctance to transfer too much power to autonomous authorities militating against such plans (Teclaff 1967; Kenney 1997).

After the end of WWII, river basin development returned to the forefront with the Federal Interagency River Basin Committee (FIARBC) set up in 1943, which would emphasize coordination of federal agencies at the river-basin level, rather than the creation of overbearing River Authorities. In 1946 and 1948, the Bureau of Reclamation and the Corps of Engineers both elaborated comprehensive plans and found in President Truman a staunch supporter of federal water projects (Teclaff 1967) who saw rivers as “destructive giants unchained” which ought to be tamed (Truman 1953). Inaugurating the Grand Coulee Dam in 1950, Truman celebrated “man’s ingenuity and perseverance [which] have dramatically transformed the energy of a mighty river into a great new source of national strength” and repeatedly called for the establishment of a Columbia Valley Administration (1950). With respect to the TVA, he believed that “we demonstrated for all time the efficiency and the humanity of comprehensively planned, multi-purpose river basin development.”

The FIARBC Committees set up in six basins, however, remained reluctant to encourage coequal state responsibility and proved largely ineffective (Kenney 1997). In the 1950s, the US President’s Water Resource Policy Commission (1950) criticized these committees but reaffirmed that “the unit for planning further water resources development by federal agencies should be the river basin... [while] smaller watersheds should generally be planned as sub-units of the total basin. Groundwater as well as surface water should be included in all basin programs” (in Teclaff 1967). The region and the basin were

again taken as a coterminous single planning and development unit and river development was assigned the task of maximizing benefits for flood control, navigation, irrigation, hydropower, water supply, recreation and other uses. Adequate institutional arrangements, however, remained elusive, and ecological concerns were by and large absent (Wengert 1985).

Just as Truman was genuinely aware of the inadequacy of existing organizations to tackle the integrated development of river basins,⁸ the concept of regional development authority unsurprisingly faced multiple opposition: States’ unwillingness to share costs and give up power, opposition from private hydropower companies, unsympathetic federal agencies, water users fearing loss of customary water rights, congressional opposition to transfer power to federal institutions, etc. Although the TVA and the FIARBC models had failed to gain consensus, the goal of comprehensive plans remained alive during the Kennedy and Johnson administrations, and the 1965 Water Resources Planning Act authorized the President to establish interagency-interstate river commissions (called Title II commissions), which featured a more balanced state and federal representation but nevertheless failed to garner support (Reuss 1992; Kenney 1997).

Evolution in Industrialized Countries

European experience during this period covered two perspectives. In northern Europe, problems centered on pollution management, flood control and hydropower generation, while in southern Europe, notably Spain, dam construction was the most salient feature. In all these different contexts, however, the river-basin concept and approach were strengthened.

In the Ruhr and Nordrhein-Westfalen, Germany, early concerns regarding pollution and

⁸See for example: “The traditional method of organizing the Government’s resource activities, through departments and bureaus which carry on separate nationwide activities, does not itself provide for the unified consideration of each area’s resources which is so necessary, nor does it easily lend itself to decentralizations. It has long been apparent that some organizational adjustments are necessary” (Truman 1949b).

the many competing claims to limited water supply were tackled by cooperative structures on a voluntary basis (Betlem 1998). Around the turn of the century, the region was facing prospects of total environmental collapse due to industrialization, in response to which, therefore, river basin organizations (*Wasserverbände* and *Genossenschaft*/associations) were established. These organizations, also in charge of drainage and power generation, were self-financed and were composed of local government units and private corporations; they controlled six river basins and can be considered as the first basin-wide multipurpose agencies (Teclaff 1967).

In France, the Compagnie Nationale du Rhône (CNR) was created in 1921 (but only became effective in 1932) as part of a regional development plan to provide electricity much beyond its basin limits, up to Paris. The emergence of the concept of hydraulic regions was linked to the interests of industrialists and urban elites in trying to abandon the concepts of the river basin and independent/decentralized management to benefit from a wider approach at regional or national level. The company was concerned chiefly with the main stem of the river (and not the Swiss part of the basin) (Ghiotti 2001). The history of the development of the Rhône River shows abundant reference to the necessity of man's conquest over a wild and untamed nature and of "replacing the wild and devastating river with a useful river" (Pritchard 2004). After WWII, reconstructions of national identity and the search for new symbols for the new nation became closely intertwined with the CNR's dramatic transformation of the Rhône, epitomized by the Donzère-Mondragon Dam on the lower reach of the river (Pritchard 2004).

Major institutional and infrastructural changes took place in Spain in the 1920s, with policies based on the "maximum and intense utilization of rivers, which demands rigorous, methodical and orderly procedures" (Blasco n.d.). Attempts at

creating local river basin organizations with significant decisional power were frustrated until 1926, when quasi-autonomous *Confederaciones Sindicales Hidrográficas* (river basin authorities) were gradually established in all major basins, with the declared objective to "develop a comprehensive, coordinated and methodical plan for the use of the waters flowing in the riverbeds included in the basin" (cited in Olcina 2001). The *confederación* for the Ebro River Basin, perhaps with the exception of the Ruhr River associations, is the first example of a river basin organization with features of participatory and decentralized planning and management, including financial aspects. The *confederaciones* initially sanctioned the river basin as a decentralized governance unit but they were later deprived of much of their innovative participatory character and of their financial autonomy, and were placed under strong state control (Pérez-Díaz et al. 1996).⁹ After WWII, Franco endorsed the "hydraulic policy" advocated by *regeneracionists* at the beginning of the century as a major instrument to legitimize his political regime and took it to the extreme: the water storage capacity of the country increased from 3 billion cubic meters (m³) in 1940 to 40 billion m³ in 1980 (del Moral Ituarte 1999).

In Britain, the Commissioners of Sewers were abolished in 1930 by the Land Drainage Act and the country was divided into drainage districts based on 47 catchment areas, with duties centered on straightening and dredging waterways and improving overall drainage. In 1948, following the Water Act of 1945, these drainage boards were replaced by 34 River Boards (including two Conservancies) which also absorbed previous authorities with jurisdiction over fisheries and pollution. The idea that basin activities needed to be managed and controlled by specialist basin-based agencies gained ground and was strengthened by the 1951 Rivers (Prevention of Pollution) Act (Kinnersley 1988). New waste disposal was to be registered and authorized. The

⁹The *confederaciones* were created under the dictatorship of Primo de Rivera. They were renamed *Mancomunidades* during the 2nd Republic, from 1931 onward, and—although they embodied Costa's message and vision—they were significantly weakened because of opposition from some quarters. After the civil war, in 1942, they were renamed *confederaciones hidráulicas* ("sindicales" was dropped) (Fernández 2000).

1963 Water Resource Act extended licensing to water abstraction, introduced water fees and further consolidated the powers of the basin organizations into 29 River Authorities. The development of large-scale infrastructures like dams was not a central concern but the relatively small size of the river basins combined with high population densities and industrial development led to the emergence of the river basin as the unit for an increasingly centralized management and control. This culminated in 1974 in the reorganization of River Authorities into ten all-purpose Regional Water Authorities, with jurisdiction extended to water supply and wastewater treatment.

In Japan, a River Law was enacted in 1896 as a basic law on river management. Although its focus was on flood control, the most serious problem of Japan's steep and short rivers, it also introduced water rights and is the origin of the existing system of river administration. It asserted the dominance of the Ministry of Construction and the prevalence of structural and engineering approaches (IWMI 2003; Shindu 2004).

Exporting the Hydraulic Paradigm

With its democratic ethos, the TVA was made "a new export commodity" in Cold War politics (Ekbladh 2002). Truman's bid to export the TVA model arose from several factors: the genuine belief in successfully triggering development in a backward area and confidence that this success could be replicated; the power of the democratic rhetoric embedded in the model, serving geopolitical interests in the fight against communism;¹⁰ and the interest of engineering and construction companies that could benefit from implementing high-tech dams in countries which

did not have the technical capacity to construct them.¹¹ Beyond the TVA, regional development was often seen as a matter of paternalist and massive state investment in infrastructures and technology: river basin development would bring hydroelectricity, help control flood damage, bring prosperity to rural masses and thus be instrumental in modernization and state-building.

Truman's (1949a) inaugural address set the tone: "We must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas." Most third-world elites were all too eager to accept the offer and to spread modernism and progress to their newly independent countries, while intensifying their legitimacy. When India became independent in 1947, one of the highest priorities for the country was the rapid expansion of irrigation systems. In 1947, a senior Madras official asserted that "what is necessary in this Province is the application of the Tennessee Valley principle" (Wallach 1985).¹² Trans-boundary dilemmas and water issues soon came to the fore when delineation of states became a core issue of post-independence politics. As early as 1938, planner Meghnad Saha had built on consensus among the Congress Party that development ought to be centrally planned to emphasize how the intrinsic ecological integrity of river basins made them suitable territorial units to plan socioeconomic development (Saha and Barrow 1981). These ideas saw fruition in 1948, when the Damodar Valley Corporation (DVC) was created by the parliament to administer a comprehensive development plan of the Damodar River Basin. The DVC was explicitly inspired by the TVA and was followed by other river development schemes which, however, often focused on dam and irrigation development. Visiting the valley in 1954, Nehru wondered "where can be a greater and holier

¹⁰"The TVA was a weapon which, if properly employed, might outbid all the social ruthlessness of the communists for the support of the peoples of Asia" (Schlesinger 1949; cited in Ekbladh 2002).

¹¹Saha and Barrow (1981) refer to the "huge profits made by overseas construction and consultancy firms" in most cases.

¹²Postel (1999) reports that Floyd Dominy, Commissioner of the Bureau of Reclamation from 1959 to 1969, used to boast that "everywhere [he] went in India, they thought [he] was the second coming of the Buddha."

place than this, which we can regard higher” and when commissioning the massive Nagarjuna Sagar Dam on the Krishna River spoke of dams as the “modern temples of India.”

The TVA model also influenced the surge of large-scale water-based regional development in Mexico, at the end of the 1940s (Aboites 1998; Barkin and King 1970; Tortajada 2001). River basin commissions (Papaloapan, Grijalva, Fuerte and Tepalcatepec/Balsas) were established to coordinate the activities of the different ministries involved in regional development programs that aimed at developing coastal areas in order to alleviate poverty, provide land to be redistributed to populations of the congested central plateau, and achieve food self-sufficiency (Barkin and King 1970). The commissions were fully controlled by the central government (Ministry of Water Resources and the President himself) and spent federal funds for regional objectives although they had no clear mandate in terms of monitoring, enforcement or management, integrated or otherwise. Hydropower, industrialization, irrigation, roads and other development programs were a greater concern than planning the use of water resources in a coordinated way, and it is apparent that the packaging of the programs as river basin commissions owed much to opportunistic capture of the symbolic power of the TVA’s success story. River basin planning was “a politically acceptable way of obtaining the cooperation of state governments and government agencies who might refuse to surrender authority to other agencies” (Barkin and King 1970). The commissions are considered to have been relatively effective with their objectives of regional development in coastal areas, partly because the interdependencies between investment decisions inside the basin and outside were limited, but ironically they achieved little in terms of water management (irrigation was the least successful part) (Barkin and King 1970). They were eventually dissolved in 1976, in part because

they interfered with the prerogatives of state governors (Melville 2005).

Within a few years, plans for TVA-like river basin development plans mushroomed all over the world. Plans for a Danube and a Yangtze Valley Authority, and proposals for a Mekong Delta Development Authority, aiming “to turn the Mekong into a Tennessee Valley,” were floated. The Khuzestan region of Iran would become another “Garden of Eden,” and the flows of the Senegal, the Zambezi or the Volta would be harnessed. River Basin Authorities were established or planned in numerous countries with mixed results: the Corporación Regional Autónoma del Cauca in Columbia, the Helmand Valley Authority in Afghanistan, created in 1947 under American supervision, and other projects in countries as varied as Brazil, Egypt, Mozambique, Salvador, Sri Lanka, Surinam, Tanzania and Turkey.

Beyond the iconic appeal of the TVA, almost any country, with climatic uncertainty and rural masses to feed, prepared plans to develop rivers and water resources during this period. In Morocco, for example, the government launched an irrigation and dam policy, rekindling the colonial project of putting one million hectares under irrigation. In South Africa, Le Roux was appointed Head of the Ministry of Water Affairs in 1959 and soon launched the Orange River Project heralded as the “biggest, most important and most spectacular water supply project ever initiated in the history of our country’s water affairs” (Turton et al. 2004). The project was compared to the Volta River Project in Ghana and was said to be bigger than the TVA itself: in brief “The project will change the face of South Africa... The Orange River Project will transform the desert into a paradise.” Above all, proclaimed Roux, the project would serve to project the country’s power: “In the history of all young civilised countries the time arrives when big and imaginative water development projects must be launched to promote the growth of areas of development... [and] to maintain the rate of progress for the country as a whole” (Turton et al. 2004).

Several river basin initiatives were also launched elsewhere in Africa (Scudder 1994). In 1973, the Nigerian government established two River Basin Development Authorities (RBDAs) in the Chad and Sokoto basins in the north of the country, followed three years later by another seven river authorities (Adams 1985). These authorities were given broad mandates (from flood or pollution control to fisheries, throughout to livestock breeding and rural extension services) and were widely seen as attempts to circumvent inefficient state ministries (Adams 1985). RBDAs were used to win support to the government by channeling money to regional projects and focused on costly dam/irrigation projects rather than on integrated development or management (Okafor 1985).¹³ Similar flaws were recorded in other countries, such as in Kenya (Newson 1997), with pervasive problems of resettlement, efficiency, environmental damage, and failure to account for existing production systems.

River basin development and “integrated development schemes” were fashionable concepts of the time, well befitting the “pseudo-comprehensive-programs,” described by Hirschman (1967), prone to extravagant claims that give decision makers the “illusion that the ‘experts’ have already found all the answers to the problems and that all that is needed is faithful implementation.” This trend was reflected, or maybe fuelled, by several international meetings. In the mid-1950s the UN Secretary General stated that “river basin development [was] now recognized as an essential feature of economic development” and the 1958 Report of a Panel of Experts on “Integrated River Basin Development” defined “integrated” as meaning “the orderly marshalling of water resources of basins for multiple uses to promote human welfare” (UN 1958). This technocratic and construction-biased approach would not be altered in later revised

versions (UN 1970) and conferences (UN 1976; Saha and Barrow 1981).

River basin development was at its peak. Looking back, in 1957, at the coalescing of the idea, White (1957) distinguished three contributing threads: the construction of dams for multipurpose use (cogently demonstrated by the Hoover Dam); the concept of basin-wide development, where the aim was to “harness” the full flow of a drainage basin; and the more controversial idea of comprehensive regional development, with the aim of instilling social and economic development through massive and coordinated public investment.¹⁴ It was attractive to governments because it was part of nation building and embodied national pride and faith in modernism, while bringing legitimacy to the state. In some cases, it embodied a strong ideological drive to prove the superiority of communism, as in the USSR (Pearce 1992) and in China (Shapiro 2001), where Mao declared a “war against nature.” It also appealed to donors and development banks, as well as to construction firms associated with them (Scudder 1994), because river basin projects held the promise of concrete and large-scale changes, while minimizing project management costs. They suited a developmental ethos based on capital and technological transfer. Massive state investments were also advocated given the limited benefits of earlier policies based on private investments, as in Spain (Fernández 2000) or the private sector’s inability to build robust and large-scale systems (as in the US with bankruptcy of irrigation districts).

The dominant theme of that period was to capture and harness water resources for ‘orderly’¹⁵ development, put them to work for human benefit¹⁶ and, as Winston Churchill had put it, see rivers “perish gloriously and never reach the sea” (McCully 2001): “not a drop of water should reach the sea” became the recurring motto of nations bent on redressing “natural deficiencies” through

¹³More recent assessments have remained critical: see Mitchell 1995.

¹⁴The concepts of integrated land and water management and of unified basin management, under the command of a basin authority, were also very much debated but were the subject of controversies, with little or rare application on the ground (White 1957).

¹⁵The word well summarizes the instrumental rationality of development and has enjoyed widespread use. See for example the TVA’s “general purpose of fostering an orderly and proper physical, economic, and social development” (TVA Act 1933).

¹⁶See the chapter “A river is put to work for the people” in Lilienthal 1944. Rivers are seen as “idle” and “destructive.”

ingenuity, technology and science. Although the motto well epitomizes the hydraulic thrust of engineers and politicians during this period of history, it is reminiscent of the words attributed to Parakrama Bahu I, King of Lanka (now Sri Lanka) in the twelfth century, who declared: "Let not a single drop of water that falls on the land go into the sea without serving the people."¹⁷ Such a conception of integrated basin planning and management, history would show, contained within itself the seeds of centralization and gigantism (Iyer 2004).

At the end of this phase, governance patterns for river basin management showed increasing limitations. It became ever more apparent that agro-economic, economic or political logics often

unfold at spatial scales or units other than the river basin. The river basin concept also came under fire from those quarters interested in developing long-distance interbasin transfers. Although interbasin transfers are as old as antiquity, the gradual exhaustion of convenient storage reservoirs led to proposals of massive transfers from 'surplus' to 'deficit' basins. Some projects, like the NAWAPA, proposing a link between Alaska and Northern Mexico, heralded an attempt to reinvent the hydraulic mission at the supra-basin scale. The hidden costs of such massive transformations of nature and local societies started to surface. The age-old dream of not letting a drop of water getting lost to the sea was soon to turn sour.

Remembering People and Nature

The frantic development of water resources initiated in the first half of the twentieth century and brought to a climax in the 1950s and the 1960s incurred massive social and environmental costs and ushered in a drastic reconsideration of the hydraulic mission. Obviously, environmental consciousness had not waited for such dire straits to arise. Nehru's marvel at India's "modern temples" in the 1950s was a contrasting reminiscence of John Muir's defense, half a

century earlier, of the Hetch Hetchy Valley,¹⁸ a "holy" valley threatened by "*temple* destroyers, devotees of ravaging commercialism" (Nash 1973; emphasis added). American conservationists had been influential in the early twentieth century but a rift had appeared between utilitarian conservationists, who put their faith in science, rational planning, and multipurpose dam development to conserve water, and preservationists, who stressed the nonutilitarian

¹⁷It is fascinating that similar statements have been made in most arid countries (and sometimes elsewhere) by leaders of all ideologies and faiths: Swyngedouw (1999), for example, refers to the Spanish motto that "not a single drop of water should reach the Ocean without paying its obligatory tribute to the earth" and writes that the dominant view at the time [beginning of the twentieth century] was that "Spain would never be rich as long as its rivers flowed into the sea" (Maluquer de Motes 1983). In India, Gandhi (1946) stressed that "owing to our neglect and folly, the year's rains are allowed to run down into the Bay of Bengal and the Arabian Sea. If all this water was trapped and harnessed into irrigational purposes by the construction of dams and tanks, there should be no famine or food shortage in India." In Brazil, at the end of the nineteenth century, Senator Francisco de Britto Guerra proclaimed that the "*sertão* would only be happy when its water would not reach the sea" (Guerra and Guerra 1980). In Cuba, Fidel Castro embraced dam building in the 1960s and stated his objectives that "not a single drop of water be lost, that not a drop of water reach the sea ... that not a single stream or river not be dammed" (Díaz-Briquets and Pérez-López 2000). Likewise, among numerous other examples, Stalin declared that "Water which is allowed to enter the sea is wasted" (Pearce 1992). Despite the awareness about environmental degradation gained in the last decades, the political/ideological appeal of such declarations remains high, judging from President Zemin's (1997) celebration of the Three Gorges Dam of the Yangtze River. After reviewing "examples of the ancient Chinese people's indomitable spirit in successfully conquering the nature," Zemin referred to the dam, "the scale and overall benefits of which have no parallel in the world... [and which] embodies the great industrious and dauntless spirit of the Chinese nation and displays the daring vision of the Chinese people for new horizons and better future in the course of their reform and opening-up." Likewise, the Indian Prime Minister has recently called for "the establishment of 'a TVA for the Brahmaputra' which would combine major water infrastructure with modern management approaches to make water a stimulus for growth" (Briscoe 2006).

¹⁸The Hetch Hetchy Valley is considered as the first major ecological controversy of the US. Considering that "no holier temple had ever been consecrated by the heart of man," Muir's Sierra Club led a countrywide emotional combat against "Mamon" but the valley was eventually dammed to supply water to San Francisco.

values of water (Nash 1973). From a natural temple to one made out of concrete, the pendulum would, several decades later, swing back to more concern for the environment.

To be sure pollution problems were not new in the 1960s. As mentioned earlier, the Industrial Revolution had, very early on in the nineteenth century, taken its toll on English and American rivers, as well as on industrialized regions like the Ruhr. Litigation between polluters (mines, industries) and other uses were generally resolved to the benefit of industrialists seen to serve a “greater public interest.”¹⁹ Legislation had been passed and some control of pollution attempted but local municipalities were reluctant to enforce rules for fear of penalizing the development of industries in their own locality (Kinnersley 1988). In sum, lack of standards, enforcement and political will from local authorities resulted in the fact that, until the 1960s, none of the European countries had succeeded in tackling the problem effectively and the situation was getting out of hand (Kinnersley 1988).

In the early 1970s, environmental costs were still considered as “intangible” and calls for integrating this dimension remained naive (OAS and UNEP 1978). Human costs, especially in terms of displaced populations, were also overlooked. The Stockholm 1972 United Nations Conference on the Human Environment rang the alarm by pointing to “growing evidence of man-made harm in many regions of the earth”²⁰ but still saw “rational planning as... an essential tool for reconciling any conflict between the needs of development and the need to protect and improve the environment,” while developing countries

would have to resort to “additional international technical and financial assistance.” It was only in 1980 that the World Bank required consideration of resettlement as a project cost (Scudder 1994). Several books, surveys, and international conferences²¹ contributed to raising industrialized societies’ awareness of environmental degradation in a context of shifting values. Somewhat paradoxically, while environmental degradation signalled the decline of the developmental concept of a river basin of the preceding phase, it also reemphasized the hydrological unity of the basin and its relevance for the management of pollution problems, particularly when nonpoint source pollution became critical.

In the US, the demise of the river basin concept was due, in part, to sheer weariness of environmentally unfriendly and costly projects. But it also reflected the way regionalism dissociated itself from the river basin and often adopted multi-scale and more urban or recreational planning units; water management ended up severed from other aspects of regional development and concentrated on river engineering (Wengert 1985). After the 1965 Water Resources Planning Act, six “Title II” water basin commissions²² were formed. These commissions sought to better balance federal and state power. Their mandates were limited to river basin planning and policy, with no enforcement, regulatory or water resource development functions, and no representation of local interests and stakeholders, other than through state agencies (Harrison 1980). These organizations appeared to have been mostly confined to the issue of water quality management, a somewhat

¹⁹For example, in a 1913 case opposing a summer resort in Colorado and a power company, the latter’s interests prevailed, as the court stated that “the dominant idea was utility, liberally and not narrowly” (Teclaff and Teclaff 1973).

²⁰“We see around us growing evidence of man-made harm in many regions of the earth: dangerous levels of pollution in water, air, earth and living beings; major and undesirable disturbances to the ecological balance of the biosphere; destruction and depletion of irreplaceable resources; and gross deficiencies, harmful to the physical, mental and social health of man, in the man-made environment, particularly in the living and working environment” (UNEP 1972).

²¹For example, *Silent Spring* by Rachel Carson (1962); surveys on water quality in different European countries which showed European standards were generally not met; the Stockholm UN Conference on the Human Environment in 1972 and “The Careless Technology” Conference (Farvar and Milton 1974); various oil spills on coastal areas, the Tchernobyl disaster and the chemical spill into the Rhine from a pharmaceutical factory in Switzerland, both in 1988, are examples of events which contributed to environmental awareness. The US National Environmental Policy Act was enacted in 1969 and would only gradually become effective.

²²Great Lakes, Missouri River, New England, Ohio River, Pacific Northwest and Upper Mississippi regions.

chronic problem,²³ with the need to integrate various new federal regulations²⁴ (Goetze 1980).

The conflicts and debates around the respective virtues of the state, river basin or federal levels for water pollution management revealed common lines of argument (Goetze 1980): river basin organizations are needed to internalize interstate conflicts and pollution impacts, they promote control projects such as waste treatment plants that are regional in scope, and they allow policies, standards and control measures to be sensitive to on-the-ground realities. Federal regulations do not allow adjustment to local realities but force states to respond to general public outcry over pollution problems and avoid the adoption of differential norms which could give economic advantages to states with less constraining standards. At the same time, it was recognized that some pollution problems were extremely local and could be solved by state agencies without referring to the basin level.

In 1980 and 1981, two major conferences were organized by the American Water Resources Association under the old banner of “Unified river basin management.” The legitimacy or relevance of “regional institutions” (that is, Title II river basin commissions), were described as limited, constrained by the traditional bickering between state and federal institutions and prerogatives. Overall, these basin-level organizations proved to be rather ineffective, and Goetze (1980) concluded that, irrespective of their technical merits, they would have difficulties in developing within the American political framework, due to the opposition of existing political institutions and their success in defending their prerogatives. In

addition, regional river planning ended up facing budget restrictions and a loss of support with the rise of environmental problems. President Reagan abolished the six river basin commissions in 1981 (Goldfarb 1994).

In the UK, the advent in 1974 of all-purpose and all-encompassing Regional Water Authorities was a response to the perceived necessity of internalizing basin externalities; of giving more attention to water-quality issues; and of the belief that improved management and economies of scale would result from centralization (Kinnersley 1988; Spillett et al. 2003).²⁵ The absorption of municipal utilities (but not of existing private ones) resulted in combining standard setting and operations under the same organization. The National Water Plan also emphasized interbasin transfers, and Pitkethly (1990) saw the Regional Authorities as a way of centralizing decision-making powers and facilitating such transfers.

In France, the emergence of the *Agences Financières de Bassin* (Financial Basin Agencies), as part of the 1964 Water Law, was also largely due to critical pollution problems,²⁶ forcing the recognition of the environmental value of water alongside its economic potential. But it was also a pragmatic way of addressing the huge financial requirements needed to tackle the pollution problem emerging at the time (Ghiotti and Haghe 2004). The unique facet of the *Agences* is the mix of economic incentives to users and polluters to improve their practices complemented by Basin Committees which allow representation of the state, local government and users (Barraqué 1999; Buller 1996). They have taken over new planning responsibilities and been renamed *Agences de l'Eau* (Water Agencies) but

²³The first Interstate Sanitation Commission had been created as early as 1935 to abate pollution in the port of New York and to enjoin the states of New York, New Jersey and Connecticut to collaborate in solving common problems. Similar commissions for the Ohio and Potomac rivers were established in the 1940s not only to regulate pollution impacts across states but also to forestall potential federal meddling. The Delaware River Basin Commission and the Susquehanna River Basin Commission, established in 1961 and 1970, respectively, based on interstate compact commissions, encompassed land management and they were given the power to define and enforce water-quality standards (Goetze 1980).

²⁴In particular, the National Environment Planning Act (NEPA) and the 1972 amendment of the Water Pollution Control Act.

²⁵Pitkethly (1990) believes that the reorganization was “largely a process of getting rid of irritating parochialism on the part of local councillors and councils and replacing it with a technical meritocracy.”

²⁶And also to the necessity to ensure the large flows needed by new nuclear plants for cooling (Nicolazo 1997).

water-quality control remains a central goal, especially after more stringent environmental standards were issued by the European Union in 1992 (Betlem 1998). In Germany, pollution was also the main issue to be tackled by river basin organizations. As in France, the German organizations have a crucial financial role, in that water treatment is self-financing through a system of charges, but in contrast to the French *Agences* they also build and operate facilities (Betlem 1998).

In sum, the period from the late seventies to the early nineties saw a certain demise and loss of appeal of the river basin concept, especially as a unit for development. Pollution and water-quality issues, which took center stage in all industrialized countries, partly reinstated the

importance of the basin but pollution was mostly tackled through treatment of point-source rather than through “unified basin management.” Responses to environmental degradation remained state-centered and expert/agency-driven and managerial, and were met with mixed success. Attempts at internalizing problems by increased concentration of powers (UK) or agency coordination (US) were bedeviled by the complexity of local problems and administrative infighting, and showed the necessity of spreading and articulating governance patterns across scales. Integrated management and basin approaches, although unable to exhibit much convincing success, would however make a remarkable comeback in the ensuing decade.

Complexity and Integrated Water Management

As apparent in the preceding sections, the idea of integrating the various parameters or activities which have a bearing on water development or use is not new. Successive management errors and interventions that were too narrowly conceived invariably led to a renewed call for a ‘unified’, ‘comprehensive’ or ‘holistic’ approach in which the river basin appeared as the spatial unit of analysis. The rise of the concept of Integrated Water Resources Management (IWRM) in the 1990s,²⁷ with its emphasis on river basins as planning and management units, is of course reminiscent of earlier conceptualizations and can even be seen as “old water in a new bottle” (Biswas 2004). Yet, IWRM also embodies several concerns that used to be minor but which have become more salient over time with the growing (over)commitment of water resources in many basins. For example, the overexploitation of aquifers, the outgrowth of diffuse pollution, sectoral competition, the importance of

nonconsumptive uses of water and the need to involve stakeholders, have all moved from the background to the limelight. Opposition to dams has also gained momentum. The human and environmental costs of river basin development revealed in the last two decades had been left largely unaddressed (it was only in 1991 that the World Bank was to make Environmental Impact Assessments compulsory). In 1993, in a landmark statement, the US Bureau of Reclamation publicly announced that “federally-funded irrigation water supply projects [would] not be initiated in the future,” marking a dramatic end to its historical mission (Postel 1999).

More radically, perhaps, these changes signal a time when problems are increasingly complex and not directly amenable to neutral, rational, or scientific solutions. Engineers, planners and economists cannot provide the answers to “messy” situations where shifting and conflicting interests, worldviews, and values constantly

²⁷OAS and UNEP (1978) and Barrow (1998) attempted to distinguish between several conceptions of River Basin Development Planning and Management, and Downs et al. (1991) looked at examples of integrated management. They showed that very different types of experiences are described with a similar vocabulary. This diversity shows not only that varied local contexts, types of use and management lead to different problems but also that hardly anywhere have truly integrated approaches been implemented.

reconfigure both the problem and its solutions (Lachapelle et al. 2003; Sneddon et al. 2002). Decentralization and democratization, wherever they occur, also mean that “adherence to historical centers of political and economic power is loosening” and that decision making cannot any longer be confined to a few line agencies or to the highest political authorities (Reuss 2004). In short, water problems have become too complex to be tackled by expert knowledge alone, especially that of conventional water experts (Biswas 2004).

IWRM and its Integrated River Basin Management (IRBM) derivative have now become a rallying call of mainstream thinking on water management. Earlier calls for IRBM were made by the UN in 1970 and 1976, at a time when system analysis was becoming fashionable.²⁸ Planning was to be interdisciplinary, continuous and adaptive, just as emphasized more recently (WWPRAC 1998). The 1992 Dublin Principles (finite nature of water, holistic approaches, necessity to consider economic and social dimensions, need to make water management more participatory) and Agenda 21²⁹ all stressed aspects of management that are supposed to be integrated at the basin (or aquifer) level. In the wake of the Rio Conference, the 1993 World Bank Water Policy underscored that “in many countries, institutional reform will focus on river basins as the appropriate unit for analysis and

coordinated management,” (World Bank 1993) while in 2000, the World Water Commission (2000) emphasized that “every river basin system should be managed holistically.”

The final consecration of the river basin as a management unit may have come recently, with the EU (2000) making the catchment principle the cornerstone of its Water Framework Directive, enjoining “Member States... [to] ensure the appropriate administrative arrangements, including the identification of the appropriate competent authority, for the application of the rules of this Directive within each river basin district lying within their territory.”³⁰ IWRM and river basin planning and management appear as consensual concepts, from water experts to international banks and from NGOs to multilateral agencies.³¹

The revival of IWRM and the river basin concept is strongly linked to the confluence of four strands of thought or concerns of growing influence. Environmentalists promote the “ecosystem approach,” described as a “strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way” (CBD 2000; Brown and King 2002), and reemphasize the interconnectedness of terrestrial and aquatic ecosystems and the hydrological logic of the watershed or the basin, while simultaneously recognizing that socioeconomic dimensions transcend the boundaries of the basin. Second,

²⁸In the 1970s, emphasis was still placed on development of river basins: see discussion of the findings of a 1976 UN Conference on “River Basin Development: Policies and Planning” in David 1976: River basin development is still conceived as a linear process in stages, where the water regime becomes increasingly “regulated,” towards a “long-range complete regulation of water resources” in “fully developed” river basins.

²⁹See UN 1992: “Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization... Integrated water resources management, including the integration of land- and water-related aspects, should be carried out at the level of the catchment basin or sub-basin.”

³⁰See also the European Declaration for a New Water Culture (Anonymous 2005): “The river basin is established as the regional framework for water management, in recognition of the systemic structure of the natural continental water cycle. Taking on board the indivisibility and integrity of ground and surface water systems, the Directive furthers integrated management at river basin level, surmounting borders in EU crossborder river basins.”

³¹The recommendations of the Bonn Conference in 2001 (GTZ 2001) reaffirms: “Watersheds, river basins, lakes and aquifers must be the primary frame of reference for water resources management. Institutional and participatory mechanisms need to be developed at this level.” ADB (2000), in its turn, observed “a broad global agreement” on concepts of IWRM and basin management and enshrined them in its water policy. The OECD (2003) optimistically notes that countries are recognizing the benefits of “using a ‘whole basin’ approach to water management” in order to “avoid problems” due to the existence of competing local political constituencies in the basin, and enjoins states to “apply the ecosystem approach to the management of freshwater resources and associated watersheds, based on integrated river basin management.” Green NGOs have endorsed these principles (*vide* the World Wide Fund For Nature [2001], which considers “the use of river basins as the basic unit for all water planning and management actions” and “promotion of Integrated River Basin Management (IRBM) as one of its priorities”).

the growing weight given to economic aspects of water management and the frightening financial burden of water supply and water treatment have also prompted the river basin as the natural unit where externalities could be internalized by charging users and polluters (the French experience in that respect being now consecrated and extended to Europe *via* the Directive). Third, as hydrologic interconnectedness between users and competition for water grew, it became pressing to address upstream/downstream and other environmental externalities at the basin level. Lastly, experiences in watershed management, although they can also signal the fragmentation of the basin approach, reaffirm the logic of the watershed, while emphasizing stakeholder representation and the principle of subsidiarity.

The watershed, or subbasin, is also the central feature of new philosophies or strands of social activism like bio-regionalism. Bio-regionalism emphasizes civic responsibility and ecological stewardship with respect to communities of place and is concerned with developing patterns of governance that benefit natural units defined on ecological and community grounds (McGinnis 2005). In a sense, it renews the old search for the organization of societies according to 'ideal' or 'natural' boundaries and fuels the proliferation of watershed-oriented groups, particularly in the United States. It is however recognized that ecosystems are not coterminous with watersheds and the debate on whether eco-regions should be preferred to watersheds (or how they may complement each other) is still open (Omernik and Bailey 1998).

Several promising initiatives, innovations and evolutions of river basin management have gradually developed in several countries and propose a variety of institutional arrangements. In Australia, the Murray-Darling River Commission started as a development and water sharing organization but evolved into a coordinating agency working between competing states, addressing issues such as over-allocation, salinity, algal blooms, waterlogging or degradation of rivers and wetlands (Haisman 2004). Coordination, monitoring and provision of

technical advice are also central tasks of the US Commission like the Delaware Commission, while councils providing negotiation arenas, conflict-solving and regulation of allocation can be found in countries like Mexico, South Africa, Zimbabwe or Brazil. The vogue of the IWRM concept has translated in a multitude of attempts to establish River Basin Organizations (RBOs) of all sorts, which are believed to be a necessary medium to achieve integration. The Australian or the French "models," for example, were influential in the setting up of RBOs, or water reforms, in countries such as Brazil, Indonesia, Morocco, Sri Lanka and Vietnam (Pigram 2001; Malano et al. 1999; Birch et al. 1999; Molle 2005).

With growing evidence that effective implementation of IWRM at the basin level (or otherwise) demands sophisticated institutional arrangements, democratic structures and patterns of governance that are polycentric rather than unicentric, it is apparent that IWRM is still often conceived as something that can be introduced by fiat, goodwill and expert knowledge (Molle et al. 2006). The proposal of the Plan of Implementation of the Recommendations of Johannesburg Summit to "develop integrated water resources management and water efficiency plans by 2005" (UN 2001) also reveals the adherence to old modes of bureaucratic command and control. There is no question that improvements through administrative reordering, better interagency coordination, or systematic examination of available options are desirable and achievable but when framed as an issue of managerial competence and know-how transfer IWRM tends to depoliticize resource management and to confine itself to calls for participation or deliberative democracy. Community/collaborative models of governance (Kenney 2000), and multistakeholder platforms or approaches focusing on negotiations (Edmunds and Wollenberg 2001) are often not effective in rebalancing power despite the appeal of their consensus-oriented framework.

While the river basin is, at a rhetorical level, becoming a hegemonic concept, fully supported and disseminated by the European Union through its Water Directive, it is too early to draw lessons on this drive towards the standardization of water

policies and river basin management. However, a few challenges and difficulties can already be identified:

1. The emphasis on Integrated River Basin *Management* is very much imposed by the evolution of water problems in industrialized countries which have, by and large, gone beyond the phase of large infrastructural development. The concomitant abandoning of Integrated River Basin *Development* may be resented by developing countries for which this is still a crucial issue (Thatte 2005), thereby limiting their interest in IRBM.
2. Like other buzzwords, IWRM is likely to fall prey to opportunistic hijacking by interest groups. It may become “no more than bureaucratic hoops to jump through in order to obtain financial aid” (Chéret 2004); or be used by consultant firms to repackage their business-as-usual strategies (Molle 2005) or to “obscure the top-down nature of projects, making them appear to be bottom-up approaches so as to dampen criticism and attract Western economic and technical assistance” (Tsering 2005, on China).
3. The limitations identified above in terms of governance mean that too little is likely to be achieved in terms of effective rebalancing of power, genuine empowerment of some constituencies (typically poorer segments of the society), or defense of the environment. Such rebalancing is tightly linked to wider processes of democratization, the dynamic of which obviously lies beyond the water sector proper and which typically develops only slowly.
4. Water resources remain strongly linked to the basin scale but the more we ‘integrate’ (with the exception, perhaps, of land-use management), the more we may get beyond the basin, both spatially and in administrative/political terms, towards regional or national planning and goals. Likewise, developmental dynamics increasingly revolve around urban expansion, industrial development, or tourism, which have spatial logics not coterminous with river basins (Narcy and Mermet 2003; Barreteau et al. 2004). With decentralization, regions and communes are given more power, and they claim a wider role in the planning of resources development.
5. Likewise, our ability to address environmental degradation is strongly determined by our understanding of ecological changes, by shifts in our conceptions of nature and even by paradigmatic changes in our views of human-environment relationships,³² all of which change only incrementally and relate to wider societal evolutions.
6. The suitability and the acceptability of centralized river basin management, or of a basin-wide administrative structure endowed with sufficient powers, are very much linked to the political culture of each particular country, notably the relationships between central and local government. Some have branded River Basin Organizations as incompatible with US culture. Barraqué (1999) emphasized that it is certainly not by chance that the three European countries with RBOs covering their territories are England, France and Spain, which were centralized and strong monarchies at the time of the emergence of modern nations. In addition, problems of “spatial fit,” stemming from the misfit between natural, social and administrative units remain pervasive (Moss 2004).
7. The emphasis on rather large river basins, and management of water at this level may contradict the principle of subsidiarity, which posits that all decisions must be taken at the lowest relevant level possible. It also overlooks the fact that many problems are local in nature (e.g., local point-source pollution or flooding in upper catchments) and

³²Scientists like Kay (1994) see “ecosystem management [as] an oxymoron, [since] it is our interactions with ecosystems which need management.”

may not concern the whole basin in the first place (Moench et al. 2003). There is a need to reconcile the basin level with local dynamics, centralized with local decision making. Centralized RBOs are poorly suited for such a task and complex management is best done by basin organizations that ensure monitoring, coordination and technical advice (Molle et al. 2006).

In France, this latter point has led to the combination of river basin master plans (SDAGE) with subbasin plans (SAGE) designed by local water commissions (*Commissions Locales de l'Eau, or CLE*) based on communal divisions (Buller 1996; Betlem 1998; Piégay et al. 2002), and implemented in a contractual manner (e.g., *contrats de rivière*³³). In Australia, the Murray-Darling Commission is now making links with local initiatives now lumped as Landcare. In the US, this contradiction led to a recommendation for the better integration of (large) basin and (smaller) catchment management and for making Watershed Councils consistent with federal and state policies and regulations (WWPRAC 1998). The fragmentation of river basin management by the development of local actions, as epitomized by the US watershed movement, not only demonstrates the growth of local problems but also encourages involvement of local populations in solving these problems (Kenney et al. 2000),

although this movement is not immune to criticism (Kenney 2000). There is a need to make sure that regional goals and national principles are not sacrificed to local economic interests while, at the same time, flexibility, cost-effectiveness and practicality must be ensured locally (Adler 1995).

If the ambitious, some would say utopian, objectives enshrined in IWRM principles are consensual, their operationalization tends to remain elusive. Institutional arrangements for river basin management, as stressed by Mitchell (1990), reflect perceptions, attitudes and ideologies which make certain combinations more acceptable than others. Basin organizations may or may not be acceptable and/or efficient depending on the type of problems, on the bureaucratic configuration, on the political culture, on the type of relationships between state and citizenry, and on who is paying for what. In that sense, if the hydrologic and ecosystem interconnectedness of a river basin is universal (with the caveat that the nature of this interconnectedness will vary a lot depending on climatic, physical and other characteristics), the ways in which interrelationships are addressed can vary. Paralleling the complex hydrological interconnectedness of subbasins/basins with adequate nested levels of governance and with corresponding allocation schemes of the financial burden remains a challenge for the current century.

³³See <http://www.gesteau.eaufrance.fr> and Allain 2002. In the 1980s, the contradiction between basin and local management was apparent in the development of river contracts independently of the Basin Agency.

Conclusions and Perspectives

The concept of a river basin as a management or planning unit has gone through several stages and is in a state of flux. From its western 'discovery' in the eighteenth century to its advent as an overriding concept of European water policy, the river basin has been conjured up and mobilized in evolving contexts and with varying intentions. Associated with utopian ideas of the late nineteenth century, it supported ideas of full control of the hydrologic regime and multipurpose dam construction in the 1930-1960 period, then partly faded and was revived to address water-quality problems, before reemerging in the 1990s as the cornerstone of IWRM, enriched and blended with watershed and ecosystem management approaches. These approaches reflect the growing complexity of the human-environment nexus and clearly distinguish themselves from the utilitarian and managerial approaches tested in the late seventies and eighties by putting humans at the heart of the ecosystem and citizens at the helm.

This historical retrospective made it apparent that concepts are often formulated quite early but that several decades may pass before they are taken up and materialize. Large-scale development of basins and projects to subjugate nature were already discussed in the second half of the nineteenth century but really took off only in the 1920-1930 period. Conservationism and preservationism were prominent in the US at the turn of the twentieth century but would become a political force to be reckoned with only many decades later. Multi-objective planning was developed in the late 1950s (Reuss 1992) but its philosophy took center stage only when embodied in the IWRM principles of the 1990s. This illustrates how ideas require proper technological, societal and political conditions to effectively influence the course of history.

Beyond its relevance as a geographical unit for the study of hydrology or for water resources development purposes, the river basin is also a political and ideological construct. We have shown how it was

associated with scientism and to the intellectual project of domination of nature, and how it was branded as a weapon by constituencies as diverse as the first conservationists in the US, the counterreform traditionalists in France and the revivalists of the Spanish *regeneracionism*. More generally, it was used by political establishments, both in the North and in the South, to symbolically legitimize and strengthen their power and to—supposedly—deliver the fruits of 'development' to their countries. The concept draws its strength from its 'naturalness' and, as it becomes more embracing and invasive, tends to be reappropriated by sectoral interests. It has been used to lump projects and to get the green light for economically unsound specific projects and is associated with IWRM as a way of legitimizing river basin master plans which may differ little from those proposed in the preceding decades. It has also been used by states to side-step inefficient established administrations.

In earlier years of the twentieth century, the use of the river basin for planning and management was not driven so much by an awareness of interconnectedness and the need to integrate the many dimensions of water. It was first and foremost a hydrologic or engineering concept (sizing structures with regard to the natural hydrologic regime and to human needs or 'demand') paralleled by a drive by states to centralize and control water at basin level in order to take control over allocation and secure needs that were considered as national priorities (urban supply, hydropower, industries, etc.). At the time when support for infrastructural development subsided, emphasis shifted to river basin management, in particular for the purpose of tackling pollution problems, but with mixed success. In developing countries, most river basin organizations have been instrumental in the development of infrastructures, with those involved in management generally remaining confined to dam management. In the US, the TVA and other models with various mixes of

federal and state responsibilities were tested but abandoned; in the UK, the trend has first been a gradual concentration of authority at the basin level; in France, river basin agencies were created to internalize externalities, notably in terms of pollution; in Australia, the Murray River Commission started as a development and water-sharing organization. All these organizations eventually metamorphosed into coordinating agencies and had to reconfigure themselves in order to accommodate local scales, processes and stakeholders.

The consecration of the river basin as an arena to address natural complexity, and to reconcile antagonistic human uses, values and worldviews, signals a radical change from earlier utilitarian approaches, even if the IWRM rhetoric tends to perpetuate a lingering conception of integrated management as an issue requiring expertise, technology, capacity-building and institutional fixes. The depoliticization inherent in mainstream approaches is, however, unlikely to dissolve the fundamentally political nature of natural resources management: interventions have financial, political, social and environmental costs, as well as direct and indirect, private and

collective costs, which are not spread evenly. Decisions tend to amount to a shifting of costs and risks by certain stakeholders onto other parts of the basin, or onto other segments of the society, or onto Nature. As pressure over land and water resources increases, both the basin hydrological and the social interconnectedness become critical, requiring elaborate governance to ensure, or restore, equity and environmental sustainability.

Patterns of governance may show varying degrees of (de)centralization and of public participation, and they may be based on administrative or basin boundaries, and they may cover many or few aspects which need to be integrated. So far, administrative infighting, sectoral and vested interests, lack of understanding of natural complexity, and insufficient attention to the diversity of uses and values have hindered progress. The way in which the concept of Integrated River Basin Management is to be operationalized will vary widely between countries and is likely to evolve constantly, in the endless search for elusive governance units that would unite nature and societies.

Literature Cited

- Aboites, A. L. 1998. *El agua de la nación. Una historia política de México (1888-1946)*. México: Centro de Investigaciones y Estudios Superiores en Antropología Social (CIESAS).
- Adams, W. M. 1985. River planning in Nigeria. *Applied Geography* 5: 297-308.
- ADB (Asian Development Bank). 2000. *Water for all: The water policy of the Asian Development Bank*. Manila. <http://www.adb.org/documents/policies/water/water.pdf>.
- Adler, R. A. 1995. Addressing barriers to watershed protection. *Environmental Law* 24(4): 973-1106.
- Allain, S. 2002. *La planification participative de bassin: Analyse des conditions d'émergence et des modalités d'élaboration des Schémas d'Aménagement et de Gestion des Eaux*. Rapport final de synthèse (Volume n 1). Cachan, France: Institut National de la Recherche Agronomique.
- Anesi, G.; Eppich, D.; and Taylor, T. 2002. Lines in the sand: A four corners regional perspective. Paper presented at the workshop "The New Power of Regions: A Policy Focus for Rural America" hosted by the Center for the Study of Rural America on May 9-10, 2002. http://www.kansascityfed.org/PUBLICAT/PowerofRegions/RC02_FourCorners.pdf.
- Anonymous. 2005. European declaration for a "new water culture". <http://www.unizar.es/fnca/euwater/index2.php?x=1&idioma=en>.
- Barkin, D.; and King, T. 1970. *Regional economic development: The river basin approach in Mexico*. New York and Cambridge: Cambridge.
- Barraqué, B. 1999. La politique de l'eau, le libéralisme étatique et la subsidiarité. *Journées scientifiques du LATTS*, Mars 1999.
- Barreteau, B.; Cernesson, F.; Garin, P.; and Belaud, G. 2004. Quels niveaux d'organisation pour la gestion de tensions sur l'eau? Etudes de cas dans le Sud de la France. Paper presented at the workshop « *Les territoires de l'eau* », Université d'Artois, Arras, 26 March 2004.
- Barrow, C. J. 1998. River basin development planning and management: A critical review. *World Development* 26 (1): 171-186.
- Betlem, I. 1998. River basin planning and management. In: *Selected issues in water resources management in Europe. Volume 2*, ed. F. N. Correia. Rotterdam, Netherlands: A. A. Balkema. pp.73-104.
- Birch, A.; Khan, M. H.; and Taylor, P. 1999. International mentoring; application of Australian experience for Sri Lankan water sector reforms under technical assistance of the Asian Development Bank. *Water International* 24(4): 329-340.
- Biswas, A. 1970. *History of Hydrology*. Amsterdam-London: North-Holland Publishing Co.
- Biswas, A. K. 2004. Integrated water resources management: A reassessment. *Water International* 29(2): 248-256.
- Black, B. 1995. Authority in the valley: TVA in *wild river* and the popular media, 1930-1940. *Journal of American Culture* 18(2): 1-14.
- Blasco, J. A. L. n.d. *La participación de los usuarios en la gestión del agua*. Las confederaciones hidrográficas españolas. RIOB.
- Briscoe, J. 2006. *India's water economy: Bracing for a turbulent future*. Delhi: Oxford Press.
- Brohier, R. L. 1934. *Ancient irrigation works in Ceylon*, 3 vols. Colombo, Ceylon: Government Press.
- Brown, C. A.; and King, J. M. 2002. Chapter 3. Environmental flows: Requirements and assessment. In: *Water resources management in southern Africa: Enhancing environmental sustainability*. SADC/IMERCSA/IUCN Publication. 25 p.
- Buller, H. 1996. Towards sustainable water management. Catchment planning in France and Britain. *Land Use Policy* 13(4): 289-302.
- Carson, R. 1962. *Silent spring*. Houston: Houghton Mifflin.

- CBD (Convention on Biological Diversity). 2000. *Conference of the parties to the convention on biological diversity, May 2000*. <http://www.biodiv.org/programmes/cross-cutting/ecosystem/default.asp>.
- Chéret, I. 2004. *Integrated water resources management and water efficiency plans by 2005: Some personal reflections*. SG/SD/RT(2004)1. Paris: Organization for Economic Co-operation and Development.
- CHES (Chinese Hydraulic Engineering Society) and CNCID (Chinese National Committee on Irrigation and Drainage). 1991. *A concise history of irrigation in China*. Beijing: CHES.
- Cromer, The Earl of. 1908. *Modern Egypt*. 2 Vols. New York: Macmillan.
- David, L. 1976. River basin development for socio-economic growth: Summary of discussions and findings. In: *River basin development: Policies and planning, vol. I*. Proceedings of a UN Interregional Seminar on River Basin and Interbasin Development September 16-26, 1975, Budapest. Washington, DC: UNDP/National Water Authority of Hungary. pp. 108-110.
- de Gamond, Thomé. 1871. *Mémoire sur le régime général des eaux courantes. Plan d'ensemble pour la transformation de l'appareil hydraulique de la France*. Paris: Dunod. Cited in Haghe 1998.
- del Moral Ituarte, L. 1999. Institutional framework of water management in Spain: Strengths and weaknesses for coping with environmental risks and the new social goals. *Quaderni del Dipartimento di Geografia* 19(1999): 33-43.
- Díaz-Briquets, S.; and Pérez-López, J. 2000. *Conquering nature—The environmental legacy of socialism in Cuba*. Pittsburgh, PA: University of Pittsburgh Press.
- Dooge, J. C. I. 2001. Concepts of the hydrological cycle. Ancient and modern. Paper presented to the International Symposium OH₂ 'Origins and History of Hydrology,' Dijon, May, 9-11, 2001.
- Downs, P. W.; Gregory, K. J.; and Brookes, A. 1991. How integrated is river basin management? *Environmental Management* 15(3): 299-309.
- Edmunds, D.; and Wollenberg, E. 2001. A strategic approach to multistakeholder negotiations. *Development and Change* 32(2): 231-253.
- EIR (Executive Intelligence Review) Online. 2005. This week in history: May 16-22, 1933 TVA created by Congress. Congress passes legislation creating the Tennessee Valley Authority. http://www.larouchepub.com/eiw/public/2005/2005_20-29/2005-20/index.html.
- Ekbladh, D. 2002. "Mr. TVA". Grass-root development, David Lilienthal, and the rise and fall of the Tennessee Valley Authority as a symbol for U. S. overseas development, 1933-1973. *Diplomatic History* 26(3): 335-374.
- Ertsen, M. 2006. Colonial irrigation: Myths of emptiness. *Landscape Research* 31(2): 146-167.
- EU (European Union). 2000. Directive 2000/60/ec of the European parliament and of the council of 23 October 2000 establishing a framework for community action in the field of water policy. *Official Journal of the European Communities*.
- Farvar, M. T.; and Milton, J. P. (Eds.) 1974. *The careless technology: Ecology and international development*. New York: The Natural History Press, Garden City. <http://www.uicn.org/themes/ceesp/Publications/SL/CT.htm#download>.
- Fernández, C. E. 1998. *El pensamiento y la obra de Joaquín Costa*. Working Paper No.145. Barcelona: Universidad de Zaragoza, Facultad de Ciencias Económicas y Empresariales.
- Fernández, C. E. 2000. *De la utopía de Joaquín Costa a la intervención del Estado: un siglo de obras hidráulicas en España*. Barcelona: Universidad de Zaragoza, Facultad de Ciencias Económicas y Empresariales.
- Gandhi, M. 1946. Quoted by Shri K. R. Narayanan, President of India, on the occasion of national conference on water harvesting - traditions, technologies, policies and social mobilisation (speech October 3, 1998).
- Garbrecht, G. 2001. The Sadd-el-Kafara, the world's oldest dam. In: *Historical dams*, ed. H. Fahlbusch. Delhi: International Commission on Irrigation and Drainage, pp. 1-18.

- Ghiotti, S. 2001. La place du bassin versant dans les dynamiques contemporaines du développement territorial. Les limites d'une évidence. Approches comparées en Ardèche et dans les Hautes-Alpes. Unpublished PhD thesis. Grenoble: Université Joseph Fourier.
- Ghiotti, S. 2004. Les territoires de l'eau et de la décentralisation. La gouvernance de bassin versant ou les limites d'une évidence. Actes de la journée d'étude "Les territoires de l'eau", Université d'Artois, 26 Mars 2004.
- Ghiotti, S.; and Haghe, J-P. 2004. *Bassin versant et politique de décentralisation : une instrumentalisation?* <http://www.cybergeopresse.fr/eauville/intro.htm>.
- Gilmartin, D. 2003. Imperial rivers: Irrigation and British visions of Empire. Paper presented at the conference "How Empire Mattered: Imperial Structures and Globalization in the Era of British Imperialism." Berkley: University of California, April 4-5, 2003.
- Goetze, D. 1980. A strategy for empirical evaluation of river basin institutions. In *Unified river basin management*, ed. R. M. North, L. B. Dworsky and D. J. Allee, Proceedings of a symposium, Gatlinburg, Tennessee, 4-7 March 1980. Minneapolis, MI, USA: AWRA, pp. 438-458.
- Goldfarb, W. 1994. Watershed management: Slogan or solution? Boston College *Environmental Affairs Law Review* 21(3): 483-510.
- GTZ (Deutsche Gesellschaft für Technische Zusammenarbeit). 2001. *Water—A key to sustainable development*. Bonn: GTZ.
- Guerra, P.; and Guerra, T. 1980. *Seccas contra as seccas*. Collection Mossoroense, No 29. Mossoro, Brazil 313p.
- Guowei, L. 2001. Hydrology in ancient time in China. Paper presented to the International Symposium OH₂ 'Origins and History of Hydrology,' Dijon, May, 9-11, 2001.
- Haghe, J-P. 1998. Les eaux courantes et l'Etat en France (1789-1919): Du contrôle institutionnel à la fétichisation marchande. Thèse de doctorat de l'Ecole des Hautes Etudes en Sciences Sociales, Paris, 649 p.
- Haisman, B. 2004. *Murray-Darling river basin case study, Australia: Background paper*. Study on Integrated River Basin Management and the Principle of Managing Water Resources at the Lowest Appropriate Level. Washington, DC: The World Bank. 81 p.
- Hargrove, E. C. 1994. *Prisoners of the myth. The leadership of the Tennessee Valley Authority 1933-1990*. Knoxville: The University of Tennessee Press.
- Harrison, D. C. 1980. Basinwide perspective: An approach to the design and analysis of institutions for unified river basin management. In: *Unified river basin management*, ed. R. M. North, L. B. Dworsky and D. J. Allee. Proceedings of a symposium, Gatlinburg, Tennessee, 4-7 March 1980. Minneapolis, MI, USA: AWRA, pp. 427-437.
- Hartshorne, R. 1939. *The nature of geography*. Lancaster, Penn.: Association of American Geographers.
- Hirschman, A. 1967. *Development projects observed*. Washington, DC: The Brookings Institution.
- Hundley, N. 2001. *The great thirst: Californians and water - a history* (Revised Edition). Berkeley, CA: University of California Press.
- IWMI (International Water Management Institute). 2003. *Development of effective water management institutions. Final Report Vol. III/Case studies of advanced river basins*. Report to the Asian Development Bank. Colombo, Sri Lanka.
- Iyer, R. R. 2004. Beyond drainage basin and IWRM: Towards a transformation of thinking on water (pdf/web).
- Kay, J. J. 1994. The ecosystem approach, ecosystems as complex systems and state of the environment reporting. Prepared for North American Commission for Environmental Cooperation, State of the North American Ecosystem meeting, Montreal, Canada. 8-10 December 1994, 42 pages.
- Kelly, W. 1980. Water control in an agrarian state irrigation organization in a Japanese river basin, 1600-1870. Ph.D. dissertation thesis, Brandeis University.

- Kenney, D. S. 1997. *Resource management at the watershed level: An assessment of the changing federal role in the emerging era of community-based watershed management*. Boulder: Natural Resources Law Center, University of Colorado School of Law.
- Kenney, D. S. 2000. *Arguing about consensus. Examining the case against western watershed initiatives and other collaborative groups active in natural resources management*. Boulder: Natural Resources Law Center, University of Colorado School of Law. 82 p.
- Kenney, D. S.; McAllister, S.; Caile, W.; and Peckham, J. 2000. *The new watershed source book*. Boulder: Natural Resources Law Center, University of Colorado School of Law.
- Kinnersley, D. 1988. *Troubled water. Rivers, politics and pollution*. London: Shipman.
- Lachapelle, P. R.; McCool, S. F.; and Patterson, M. E. 2003. Barriers to effective natural resource planning in a "messy" world. *Society and Natural Resources* 16(6): 473-490.
- Lacoste, Y. 2003. *De la géopolitique aux paysages: Dictionnaire de la géographie*. Paris: Armand Colin.
- L'Hôte, Y. 1990. Historique du concept du cycle de l'eau et des premières mesures hydrologiques en Europe. *Hydrologie continentale* 5(1): 13-27.
- Lilienthal, D. E. 1944. *TVA: Democracy on the march*. New York: Harper and Brothers.
- Malano, H. M.; Bryant, M. J.; and Turrall, H. N. 1999. Management of water resources: Can Australian experiences be transferred to Vietnam? *Water International* 24(4): 307-315.
- Maluquer de Motes, J. 1983. La depatrimonialización del agua: Movilización de un recurso natural fundamental. *Revista de Historia Económica* 1(2): 76-96. Cited in Swyngedouw 1999.
- McCully, P. 2001. *Silenced rivers: The ecology and politics of large dams*. London: Zed Books, Limited; New York: St. Martin's Press.
- McGinnis, M. V. 2005. Bioregionalism. In *The encyclopaedia of religion and nature*, ed. Bron Taylor. New York: Continuum International.
- Melville, R. 2005. La antropología y el estudio de las cuencas fluviales. Paper presented at the "Congreso Iberoamericano sobre Desarrollo y Medio Ambiente," CIDMA II, 2005.
- Mendis, D. L. O. 1986. Evolution and development of irrigation eco-systems and social formations in ancient Sri Lanka. *Transactions, Institute of Engineers Sri Lanka*, 1986. 1: 13-29.
- Mendis, D. L. O. 1999. Hydraulic engineering versus water and soil conservation ecosystems: Lessons from the history of the rise and fall of Sri Lanka's ancient irrigation systems. *Water Nepal* 7(1): 49-89.
- Mitchell, B. (ed.) 1990. *Integrated water management: International experiences and perspectives*. London: Belhaven Press.
- Mitchell, B. 1995. Addressing "edge" problems in land and water management in the Sokoto-Rima river basin, Nigeria. *Geoforum* 25(2): 133-143.
- Moench, M.; Dixit, A.; Janakarajan, M.; Rathore, S.; and Mudrakartha, S. 2003. *The fluid mosaic, water governance in the context of variability, uncertainty and change*. Katmandu: Nepal Water Conservation Foundation; The Institute for Social and Environmental Transition, Boulder, Colorado, USA.
- Molle, F. 1991. *Historical benchmarks and reflections about small tanks and their utilization*. Mossoro, Brazil: Collection Mossoroense, 190 p. [in Portuguese] http://www.bondy.ird.fr/pleins_textes/pleins_textes_7/divers2/010033410.pdf.
- Molle, F. 2005. *Irrigation and water policies in the Mekong region: Current discourses and practices*. IWMI Research Report 95. Colombo, Sri Lanka: International Water Management Institute. <http://www.iwmi.cgiar.org/pubs/pub095/RR95.pdf>.
- Molle, F.; Wester, P.; and Hirsch, P. 2006. River basin development and management. In: *Water for food, water for life*, ed. D. Molden, chapter 15, Comprehensive Assessment of Water Management in Agriculture. London: EarthScan. (forthcoming).

- Moss, T. 2004. The governance of land use in river basins: Prospects for overcoming problems of institutional interplay with the EU Water Framework Directive. *Land Use Policy* 21(1): 85–94.
- Narcy, J. B.; and Mermet, L. 2003. Nouvelles justifications pour une gestion spatiale de l'eau. *Natures, Sciences, Sociétés* 11(2) : 135-145.
- Nash, R. 1973. *Wilderness and the American mind*. Yale University Press, New Haven and London.
- Needham, J.; Wang, L.; and Lu, G. D. 1971. *Science and civilization in China*. Cambridge: University Press.
- Newson, M. 1997. *Land, water and development: Sustainable management of river basin systems*. New York, USA: Routledge. Second edition. 423 p.
- Nicolazo, J-L. 1997. *Les agences de l'eau*. Paris: Editions Johanet.
- OAS (Organization of American States) and UNEP (United Nations Environment Programme). 1978. *Environmental quality and river basin development: A model for integrated analysis and planning*. Washington, DC: Secretary General, Organization of American States.
- OECD (Organization for Economic Co-operation and Development). 2003. *Improving water management - Recent OECD experience*. Paris: OECD.
- Okafor, F. C. 1985. River basin management and food crisis in Nigeria. *Geoforum* 16(4): 413-421.
- Olcina, A. G. 2001. *Del plan general de 1902 a la planificación hidrológica*. Anales de la Universidad de Alicante, Instituto Universitario de Geografía. Alicante, Spain: Universidad de Alicante.
- Omernik, J. M.; and Bailey, R. G. 1998. Distinguishing between watersheds and ecoregions. *The Journal of the American Water Resources Association* 33(5): 935-949.
- Ozouf-Marignier, M-V. 2002. La re-naissance des pays. De la géographie à la politique. *Actualité du Paysage*, N 1, p. 55-69. Proceedings of the seminar "Jardins, paysage, territoire," 15-16 May 1998, Ministère de l'Aménagement du Territoire et de l'Environnement, Paris.
- Ozouf-Marignier, M-V. 2003. Bassins hydrographiques et divisions administratives en France (XIXe-XXe siècle). *Trames* 10(2002): 63-76.
- Parker, R. 1976. *The common stream*. London: Paladin. [cited in Newson 1992].
- Pearce, F. 1992. *The dammed: Rivers, dams and the coming world crisis*. London: The Bodley Head.
- Pérez-Díaz, V.; Mezo, J.; and Álvarez-Miranda, B. 1996. *Política y economía del agua en España*. Madrid: Círculo de Empresarios.
- Piégay, H.; Dupont, P.; and Faby, J. A. 2002. Questions of water resources management. Feedback on the implementation of the French SAGE and SDAGE plans (1992–2001). *Water Policy* 4(2002): 239-262.
- Pigram, J. J. 2001. Opportunities and constraints in the transfer of water technology and experience between countries and regions. *International Journal of Water Resources Development* 17(4): 563-579.
- Pitkethly, A. S. 1990. Integrated water management in the United States. In: *Integrated water management*, ed., B. Mitchell. London, UK: Bellhaven Press. 1990, pp. 22- 44.
- Postel, S. 1999. *Pillars of sand*. New York, NY: W.W. Norton & Co.
- Powell, J. W. 1878. *Report on the lands of the arid region of the United States, with a more detailed account of the lands of Utah*. House Executive Document No. 73, 45th Congress, 2nd Session, Washington, DC.
- Powell, J. W. 1890. Institutions for arid lands. *The Century*, Vol. XL (May to October), pp. 111-116. [cited in Kenney 1997].
- Pritchard, S. B. 2004. Reconstructing the Rhône: The cultural politics of nature and nation in contemporary France, 1945–1997. *French Historical Studies* 27(4): 765-799.
- Reisner, M. 1986. *Cadillac desert: The American west and its disappearing water*. New York: Penguin.

- Reuss, M. 1991. *Reshaping national water policies. The emergence of the Water Resource Development Act of 1986*. Washington, DC: Office of History U.S. Army Corps of Engineers.
- Reuss, M. 1992. Coping with uncertainty: Social scientists, engineers, and federal water planning. *Natural Resources Journal* 32: 101–35.
- Reuss, M. 2004. *The emergence of multipurpose planning*. Office of History U.S. Army Corps of Engineers. http://www.usace.army.mil/cw/hot_topics/ht_2004/6jan_multiplan.htm.
- Reynard, P. C. 2003. Probing the boundaries of environmental concerns: Reactions to hydraulic public works in eighteenth-century France. *Environment and History* 9 (2003): 251-73.
- Robinson, M. 1979. *Water for the west*. Chicago: Public Work Historical Society. Quoted in Reisner 1986.
- Roosevelt, F. D. 1933. Message to Congress suggesting the Tennessee Valley Authority. April 10, 1933. <http://www.fdrlibrary.marist.edu/index.html>.
- Saha, S. K. 1981. River basin planning: A field of study. In: *River basin planning: Theory and practice*, ed. S. K. Saha and C. J. Barrow. New York: John Wiley & Sons. pp. 8-40.
- Saha, S. K.; and Barrow, C. J. 1981. Introduction. In: *River basin planning: theory and practice*, ed. S. K. Saha and C. J. Barrow. New York: John Wiley & Sons. pp. 1-7.
- Schlesinger, A. 1949. *The vital center: The politics of freedom*. Boston: Da Capo. Cited in Ekbladh 2002.
- Schreyger, E. 1984. *L'Office du Niger au Mali 1931 à 1982. La problématique d'une grande entreprise agricole dans la zone du Sahel*. Wiesbaden: Steiner.
- Scott, J. C. 1998. *Seeing like a state. How certain schemes to improve the human condition have failed*. New Haven and London: Yale University Press.
- Scudder, T. 1994. Recent experiences with river basin development in the tropics and subtropics. *Natural Resources Forum* 18(2): 101-113.
- Selznick, P. 1949. *TVA and the grass roots*. University of California Press, Berkeley. [discussed in Tugwell and Banfield 1950].
- Senate of the United States of America. 1933. Tennessee Valley Authority Act of 1933. <http://www.classbrain.com/artteenst/uploads/tva.pdf>.
- Shapiro, J. 2001. *Mao's war against nature: Politics and environment in revolutionary China*. Cambridge and New York: Cambridge University Press.
- Shindu, H. 2004. *Water resources in Japan and the development of IWRM in Kiso river*. Document for the Training Program on Integrated Water Resources Management and Strengthening of River Basin Committees, 26 July - 6 August 2004, Bangkok.
- Sneddon, C.; Harris, L.; Dimitrov, R.; and Özesmi, U. 2002. Contested waters: Conflict, scale, and sustainability in aquatic socioecological systems. *Society & Natural Resources* 15(8): 663-675.
- Spillett, P. B.; Tagg, A. F.; de Garis, Y. S.; and Lutt, N. W. 2003. Conflicts in river basin management: The example of the Upper River Kennet, UK. In: *Yellow River Conservancy Commission. Proceedings, 1st International Yellow River Forum on River Basin Management – Volume I*. Zhengzhou, China: The Yellow River Conservancy Publishing House. pp. 477-485.
- Swyngedouw, E. 1999. Modernity and hybridity: nature, *regeneracionismo*, and the production of the Spanish waterscape, 1890-1930. *Annals of the Association of American Geographers* 89(3): 443-465.
- Teclaff, L. A. 1967. *The river basin in history and law*. Nijhoff: The Hague.
- Teclaff, L. A.; and Teclaff, E. 1973. A history of water development and environmental quality. In *Environmental quality and water development*, ed. C. R. Goldman, J. McEvoy, and P. J. Richerson. San Francisco: W. H. Freeman and Company. pp. 26-77.

- Thatte, C. D. 2005. Sabarmati river basin: Problems and prospects for integrated water resource management. In: *Integrated water resources management in South and South-east Asia*, ed. A. K. Biswas, O. Varis, and C. Tortajada. Oxford India Paperbacks. Delhi: Oxford University Press, pp. 67-104.
- Tortajada, C. 2001. Institutions for integrated river basin management in Latin America. *Water Resources Development* 17(3): 289–301.
- Truman, H. 1949a. Inaugural address. January 20, 1949. <http://www.trumanlibrary.org>.
- Truman, H. 1949b. Special message to the Congress recommending establishment of a Columbia Valley Administration. April 13, 1949. <http://www.trumanlibrary.org>.
- Truman, H. 1953. Special message to the Congress on the nation's land and water resources. January 19th, 1953. <http://www.trumanlibrary.org>.
- Tsering, T. 2005. China's water politics: In whose interest? Unpublished MSc thesis, Portland State University, Portland, USA.
- Tugwell, R. G.; and Banfield, E. C. 1950. Grass roots democracy- myth or reality? *Public Administration Review* 10(1): 47-54.
- Turton, A. R.; Meissner, R.; Mampane, P. M.; and Seremo, O. 2004. *A hydropolitical history of South Africa's international river basins*. Report to the Water Research Commission. Pretoria: African Water Issues Research Unit (AWIRU), University of Pretoria.
- TVA (Tennessee Valley Authority) Act. 1933. http://www.tva.gov/abouttva/pdf/TVA_Act.pdf.
- Tvedt, T. 2003. *The river Nile in the age of the British*. London and New York: I. B. Tauris. 480 p.
- UN (United Nations). 1958. *Integrated river basin development: Report of a panel of experts*. New York: UN Department of Economic and Social Affairs.
- UN. 1970. *Integrated river basin development: Report of a panel of experts*. Revised edition. New York: UN Department of Economic and Social Affairs.
- UN. 1976. *River basin development: Policies and planning, vol. I. Proceedings of a UN Interregional Seminar on River Basin and Interbasin Development September 16-26, 1975, Budapest*. Washington, DC: UNDP/National Water Authority of Hungary.
- UN. 1992. *Agenda 21. Report of The United Nations Conference on Environment and Development*. New York: UN Department of Economic and Social Affairs, Division for Sustainable Management. <http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm>.
- UN. 2001. *WSSD plan of implementation - Chapter 4: Protecting and managing the natural resource base of economic and social development*. United Nations Division for Sustainable Development. http://www.un.org/esa/sustdev/documents/WSSD_POI_PD/English/POIToc.htm.
- UNEP (United Nations Environment Programme). 1972. Declaration of the United Nations Conference on the Human Environment, Stockholm 1972. <http://www.unep.org/Documents.multilingual/Default.asp?Documentid=97&ArticleID=1503>.
- Wallach, B. 1985. British irrigation works in India's Krishna basin. *Journal of Historical Geography* 11(2): 155-73.
- Wengert, N. 1951. TVA: Symbol and reality. *The Journal of Politics* 13(3): 369-392.
- Wengert, N. 1985. The river basin concept as seen from a management perspective in USA. In: *Strategies for river basin management*, ed. J. Lundqvist, U. Lohm and M. Falkenmark. Reidel Publishing Company. pp. 299-305.
- White, G. F. 1957. A perspective of river basin development. *Law and Contemporary Problems* 22(2):156-187.
- World Bank. 1993. *Water resources management. A World Bank policy paper*. Washington, DC: World Bank.
- World Water Commission. 2000. *A secure water world – Vision for water, life and the environment*. Marseilles: World Water Council.

- Worster, D. 1985. *Rivers of empire: Water, aridity and the growth of the American west*. New York: Pantheon Books.
- WWF (World Wide Fund For Nature). 2001. *Elements of good practice in integrated river basin management: A practical resource for implementing the EU Water Framework Directive*. Brussels: WWF.
<http://www.panda.org/downloads/europe/WFD-PRD-en.pdf>.
- WWPRAC (Western Water Policy Review Advisory Commission). 1998. Water in the west: The challenge for the next century. <http://www.waterwest.org/reading/readingfiles/fedreport.htm> (accessed in November 2006).
- Zemin, J. 1997. Jiang Zemin's speech marking Yangtze-damming for Three Gorges Project.
<http://www.china-embassy.org/eng/zt/sxgc/t36514.htm>.

Research Reports

3. *Water Management in the Yellow River Basin: Background, Current Critical Issues and Future Research Needs.* Mark Giordano, Zhongping Zhu, Ximing Cai, Shangqi Hong, Xuecheng Zhang and Yunpeng Xue. 2004.
4. *Does International Cereal Trade Save Water? The Impact of Virtual Water Trade on Global Water Use.* Charlotte de Fraiture, David Molden, Mark Rosegrant, Ximing Cai and Upali Amarasinghe. 2004.
5. *Evolution of Irrigation in South and Southeast Asia.* Randolph Barker and François Molle. 2004.
6. *Macro Policies and Investment Priorities for Irrigated Agriculture in Vietnam.* Randolph Barker, Claudia Ringler, Nguyen Minh Tien and Mark Rosegrant. 2004.
7. *Impacts of Irrigation on Inland Fisheries: Appraisals in Laos and Sri Lanka.* Sophie Nguyen-Khoa, Laurence Smith and Kai Lorenzen. 2005.
8. *Meta-Analysis to Assess Impact of Watershed Program and People's Participation.* P.K. Joshi, A.K. Jha, S.P. Wani, Laxmi Joshi and R.L. Shiyani. 2005.
9. *Historical Transformations of the Lower Jordan River Basin (in Jordan): Changes in Water Use and Projections (1950–2025).* Rémy Courcier, Jean-Philippe Venot and François Molle. 2005.
10. *Cities versus Agriculture: Revisiting Intersectoral Water Transfers, Potential Gains and Conflicts.* François Molle and Jeremy Berkoff. 2006.
11. *Prospects for Productive Use of Saline Water in West Asia and North Africa.* John Stenhouse and Jacob W. Kijne. 2006.
12. *Impact of Land Use on River Basin Water Balance: A Case Study of the Modder River Basin, South Africa.* Y.E. Woyessa, E. Pretorius, P.S. van Heerden, M. Hensley and L.D. van Rensburg. 2006.
13. *Intensifying Agricultural Sustainability: An Analysis of Impacts and Drivers in the Development of 'Bright Spots'.* A. D. Noble, D. A. Bossio, F. W. T. Penning de Vries, J. Pretty and T. M. Thiyagarajan. 2006.
14. *Multifunctional Agricultural Policy; Reduced Domestic Support; and Liberalized Trade: An Empirical Assessment for Taiwanese Rice.* Richard N. Boisvert and Hung Hao Chang. 2006.
15. *Tropical River Fisheries Valuation: A Global Synthesis and Critical Review.* Arthur E. Neiland, and Christophe Béné. 2006.
16. *Planning and Managing Water Resources at the River-Basin Level: Emergence and Evolution of a Concept.* François Molle. 2006.



Postal Address: IWMI, P O Box 2075, Colombo, Sri Lanka **Location:** 127 Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka
Telephone: +94-11 2787404, 2784080 **Fax:** +94-11 2786854
Email: comp.assessment@cgiar.org **Website:** www.iwmi.org/assessment

ISSN 1391-9407
ISBN 92-9090-652-9
ISBN 978-92-9090-652-0