Why enough is never enough:
The societal determinants of river basin ‘overbuilding’

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Paper prepared for the World Water Week 2006, Stockholm, August 2006

Abstract

Manifestations of water scarcity seem to be increasingly frequent, even in regions with temperate climates and endowed with good water resources. Population growth, poor management, climatic change or vagaries of weather, the growing needs of cities or the allegedly excessive share of water used in agriculture, are some of the reasons commonly cited as the roots of water scarcity. This paper argues that several 'bad good reasons' and mechanisms are at work to generate 'overbuilt basins,' whereby the development of infrastructural resources invariably tends to outstrip available resources. Despite its crucial importance and ubiquity, this phenomenon is often overlooked.

Eight main drivers of basin overbuilding are proposed and discussed. They draw our attention to the artificial nature of water scarcity and to how project planning may (and tend to) acquire a life of its own, overriding criteria of hydrologic or economic relevance. Overextended facilities beget water shortages and water shortages call for more water resources development that will come with more diversions and uses. Such processes have deep implications for policymaking and it is argued that unpacking the reasons why 'enough is never enough,' that is, why water resources become overcommitted and river basins overbuilt, is critical if these mechanisms are to be countered.

Introduction

Recurring accounts of water conflicts between countries, economic sectors or within irrigation schemes suggest that there is simply not enough water for all. Population growth, poor management, climatic change or vagaries of weather, or the growing needs of cities are some of the reasons commonly cited as the roots of water scarcity. With its 'lion's share' of 80% of diverted waters, and a higher percentage in many developing countries, irrigation is also often painted as the villain of the piece: Farmers allegedly ‘guzzle’ water while wasting a large part of it and depriving other users of needed resources. Yet, in many irrigation schemes a large proportion of the land often remains uncultivated in the dry season for lack of water. In some years, even reducing irrigation's share or discontinuing supply altogether does not prevent some cities from having their supply rationed.

This state of affairs, in a situation where the amount of renewable resources remains by and large the same,[2] questions the origin of water scarcity. This paper argues that several 'bad good reasons' and mechanisms are at work to generate 'overbuilt basins,' whereby the development of infrastructural resources invariably tends to outstrip available resources. Despite its crucial importance and ubiquity, this phenomenon is often overlooked.

Water scarcity thus appears as artificially created rather than the mere result of fatality. Eight main drivers of basin overbuilding are discussed in what follows: they do not, of course, entail that projects are necessarily unjustified, undesirable, or biased. They merely draw our attention to how project planning may (and tend to) acquire a life of its own, overriding criteria of hydrologic or economic relevance. This has implications for policymaking and it is argued that unpacking the reasons why 'enough is never enough,' that is, why water resources become overcommitted and river basins overbuilt, is critical if these mechanisms are to be countered.

Engendering water scarcity

* *The political economy of river basin development*

The most obvious driver of water resources development is the convergence of interests of all influential actors. a) The state sees large-scale projects as political icons that build up legitimacy and political support from beneficiaries, while assisting in alleviating poverty in rural areas. b) State line agencies, notably those involved in construction, consider the ever-continuation of projects as a professional necessity and as a way to perpetuate themselves and their budget. Examples from the US, Europe or Australia show that these agencies transformed themselves into environmental agencies when more construction became simply impossible.[3] c) Local politicians regard subsidized projects as means to ‘create a powerful supportive constituency that will ensure political control over many years’ (O'Mara,1990). d) Private construction companies and consultants take them as business opportunities and often have the political clout and linkages to push for such projects (Scudder, 1994). e) For development banks, big projects hold the promise of concrete and large-scale changes, maximizing aid flow while minimizing project management costs (Howe & Dixon, 1993).

This convergence of interests easily generates powerful coalitions (Moore, 1990) that are seldom challenged and even more rarely defeated. While there is nothing inherently wrong in having different actors joining forces towards a common goal, the financial and political private benefits and rewards of such projects have often fostered rent-seeking behaviors, as cogently illustrated by Repetto (1986). In public administrations such behaviors may be encouraged by low salaries (Mathur, 2004). In the US, the so-called ‘iron-triangle’ linking state politicians, federal agencies and private companies has long been famous for blurring the frontier between private and public benefits (Gottlieb, 1988; Worster, 1985; Briscoe, 1999[4]). Logrolling, or the trading of votes between legislators pushing for their own project (the ‘Thou shall not attack a project from another district’ principle, see Gottlieb, 1988) has, in particular, come to be one powerful engine behind water resources overdevelopment. In sum, ’irrigation is so obviously a good thing, who can be against it?’ (Berkoff, 2002).

** Ideology and state building*

Gigantic and prestigious engineering and technological feats have always been key elements of state building, flattering national pride, aggrandizing national leaders, and bringing legitimacy to rulers (Molle, 2006a). Just as Nehru famously spoke of dams as the ‘modern temples of India,’ big dams and irrigation schemes were seen as heralding modernity and delivering development and prosperity: the Guezira scheme in British Sudan would remain in history as a ‘great romance of creative achievement’ (Ertsen, 2006), while the French sought to restore ‘Rome granary’ in Morocco. Many rulers would picture themselves as new pharaohs mastering the whims of nature and presiding over the destiny of their people.

This crave for modernity and gigantism was accompanied, or fuelled, by a vibrant ideology of domination of nature which has its roots in the Enlightenment and in 19th century scientism, and blossomed during the 1930-1970 period (Molle, 2006b). Inaugurating the iconic Boulder dam, Theodore Roosevelt declared that ‘pridefully, man acclaims his conquest over nature.’ In virtually all countries nature was conceived as a threatening wilderness that needed to be tamed or subdued. In the Soviet Union, Gorki would support the plan to ‘make mad rivers sane’ (McCully, 2001), in France the *Compagnie Nationale du Rhône* would fight an ‘epic battle against nature’ and the ‘furious bull leaping from the Alpes’ [the Rhône river] (Pritchard, 2004), while Mao declared a ‘war against nature.’ In South Africa, scientists called for rivers to be ‘tamed and domesticated’ so that ‘deserts [could be] turned into gardens’ (Turton et al., 2004). In Brazil, engineers and politicians drew inspiration from the Bureau of Reclamation in the US and launched a massive construction of reservoirs in the northeastern region of the country under the banner of the ‘hydraulic solution’ (*solução hidráulica)* (Guerra & Guerra, 1980). Mexico proclaimed its plan to ‘win over nature’ (*vencer a la naturaleza*). In his recent celebration of the Three Gorges dam of the Yangtze river, President Zemin (1997) also referred to the ‘ancient Chinese people's indomitable spirit in successfully conquering nature.’

Nothing in the ingenuity, labor and idealism invested in such projects must, of course, be belittled; they have indeed contributed to material progress and comfort based on electricity, water supply or irrigated food production. With hindsight, however, this particular conception of nature as an enemy to be subdued has contributed to fuelling massive projects which have been blind to our interdependence with ecosystems and which have undermined our own resource base. Associated with the ubiquitous design to not let a single drop of water be ‘lost’ to the sea, this dream of fully controlling nature has contributed to the overdevelopment of river basins (Molle, 2006b).

* *Fuzziness of water rights and double accounting*

An important aspect of basin overbuilding is the imprecise or faulty nature of hydrologic knowledge, which lends itself to a degree of manipulation, when it is not simply overlooked. There is no shortage of projects with optimistic assumptions on basin runoff and of dams which have never filled up to the expected level. Even when hydrology was better known and a system of water rights designed, experience shows that the tendency (that minimizes political stress) of over-allocating water in order to satisfy more users has been hard to escape (e.g. in Australia, rights had to be bought back or capped).

The review by Molle & Berkoff (2006) of the conflict between cities and irrigation showed that many cities reappropriate surface water or groundwater used by farmers either surreptitiously or with purposive omission of hydrological impacts on third parties: diversions invariably concern ‘surplus water’ (even when coming from dams with hardly any spillage, as in the case of the diversion from Veeranam tank to Chennai) and ‘preserve’ the needs of existing users (like the water from El Cuchillo dam diverted for human consumption of Monterrey, in Mexico) despite preexisting downstream use for irrigation.[5] Double accounting of available resources is a common feature; in Algeria, for example, the World Bank supported both irrigation projects and urban water supply networks in competition for the same scarce resource (Winpenny, 1994).

Popular thinking tends to see sciences like hydrology as ‘hard’, neutral, authoritative, and beyond value judgment but differences in expert judgment on issues like estimating groundwater recharge, safe yields or even stocks, for example, show otherwise.[6] Our understanding of hydrology, and in particular of its stochastic nature, is always partial and sometimes crude. Scientific assessments or feasibility studies are also influenced by beliefs, viewpoints and ideology (see, for example, diverging impact assessments of the south-north interbasin transfer in China in Berkoff, 2003, or in Hill et al., 2003 for European cases). This hydrological uncertainty leaves room for interest groups to justify marginal projects in conditions of incipient basin closure.

* *The malleability of cost-benefit analysis*

It is nothing novel for anybody involved in project design that cost-benefit analyses (CBA) are malleable. Anticipated values of yields, cropping patterns, or market prices fall between wide open brackets and may vary widely (Berkoff, 2002). Categories of cost, benefit, life duration, discount rate, etc. can be manipulated to obtain very contrasting results (Ingram, 1971; Tiffen, 1987). While some acknowledge that the CBA are easily ‘corrupted,’ others consider the variable results as a product of incompetence or bias, not a weakness of the method (Williams, 1972). It provides scientific support and legitimization, a sense of ‘mechanical objectivity’ that seemed to override the passions and interests that informed political debate (Porter, 1995), but may serve as a powerful tool ‘to clothe politically desirable projects in the fig leaf of economic respectability’ (Marshall, 1965). Despite these alleged limitations and manipulations, the CBA may still allow one to identify and weed out projects that are absurd from an economic point of view (Ingram, 1997).

The history of cost-benefit analysis shows that two devices have been—quite early in the US—designed in order to come up with acceptable cost-benefit ratios for projects that had been turned down earlier. According to Porter (1995) ‘the Corps [Army Corps of Engineers] was engaged in a perpetual effort to push back the frontiers of cost-benefit analysis so that there would always be a manageable supply of economically approved projects.’ As early as the 1940s, this led the Corps to considering five classes of ‘extended benefits radiating outward’ categorized as merchandizing, direct processing, other stages of processing, wholesale trade and retail trade.

The Bureau of Reclamation exhibited similar ‘accounting inventiveness’ in making ‘intangible benefits’ tangible and quantified (Porter, 1995). It also resorted to what was called ‘river basin accounting,’ and 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.[7]

Such devices did not remain confined to the US but it seems that the CBA in developing countries have been the object of much less scrutiny and debate, making these devices generally unnecessary (for an example in Sri Lanka, see Molle & Renwick, 2005). Internal incentives in development banks have generated a pressure to lend[8] which has fostered what has been called ‘irrigation optimism’ (Jones, 1995), as well as distorted economic analyses, as indicated by ex-post studies on irrigation investments which in a large majority of cases found shortfall in internal rate of returns (ADB, 1986, 1995; World Bank, 1986; Jones, 1995).

* *Regional politics: equity and/or the 'grab-it-first' strategy*

Overbuilding of river basins is also often promoted by political and socioeconomic concerns for poorer regions, which lag behind other parts of a country and display higher levels of poverty. Politicians from these regions are likely to stress that other areas with stronger comparative advantages (for example, in terms of soil, water or linkages with markets) have benefited from earlier priority investments, and that concern for equity or poverty alleviation demands similar investments to be extended to other regions. Such demands often gain strength when local politicians are associated with the ruling party and expect a reward for their support.

State government may also be sympathetic to such demand when problems of migration affect the capital or the largest cities. Objectives of reduction of urban marginality and poverty prompt large-scale rural projects to retain the local population and spur regional development.

When earlier investments have benefited areas located at the downstream extremity of a river basin (typically large fertile plains and deltas), upper regions claim that they have been discriminated against and that the river traversing their land is also ‘theirs.’ This leads to further development plans in subregions with sometimes only marginal land and to tap resources that are already partly appropriated by downstream users (Molle, 2003). Benefits are spread and equity enhanced but at the cost of basic economic principles, since late developments reduce the economic return of downstream facilities: benefits are merely shifted spatially and investments made redundant.

In addition, projects propelled by populist arguments are also frequently overextended in order to distribute benefits to the largest number of people, thus maximizing political reward. Likewise, new dams constructed for flood control or for easing water shortages will almost invariably have their attendant irrigated areas because of the necessity to raise the project internal rate of return and to offer compensation to the province which will support the consequences of flooding at the dam site. These processes contribute to increasing diversions and to basin closure.

A variant of this situation can be found in federal states where this balancing between regions is harder to achieve. States sharing the same river basin and do not depending on the center's fund for construction will tend to rush to develop water resources before other states do. In the absence of sharing agreements (such as the compact between states in the US), or of enforcement of these agreements, this ‘blue rush’ will fuel overdevelopment, with upstream states developing infrastructures to use water that is already (at least in part) used by downstream areas. Typical instances of such a situation can be found in the Krishna and Cauvery basins in India.

* *Low risk, high subsidies*

Development of public irrigation schemes is highly subsidized. Only in a very few cases have irrigators paid a small portion of investment costs and, in most cases, cost-recovery does not even cover O&M costs. Such projects developed at taxpayer expense are therefore much in 'demand' by local authorities and politicians, and sometimes local populations. Many economists argue that if users were made to pay the full costs (or to start with the full O&M costs) there would be much less 'demand' for them (Repetto, 1986).

Although it is clear that sunk costs of past projects will never be repaid (Garrido, 2002), a number of countries like Turkey, Spain or Australia have tried to change the rules and to make cost-sharing of future projects compulsory.

Since projects are funded with public money, possible failures carry less consequence than for private investors. This is paralleled with the fact that main international development banks face no sanction for failed or under-optimal projects, since they are assured to be reimbursed. As mentioned earlier, this has fostered what has been called a 'lending culture' which has also fuelled the design of projects with modest economic potential.

* *The push factor of agrarian pressure and shock events*

The responses and behavior of water users and of the society at large to water-related problems depend on their perception of the magnitude and seriousness of these problems. This perception, in turn, is often sharply influenced by extreme natural events, such as typhoons, droughts and floods, which are generally accompanied by food shortage, disasters and the disruption of livelihoods.

Shock events often allow governments to impose policies that would otherwise have been unpopular and opposed. Allan (1999) remarked that politicians are more likely to wait for the exhaustion of resources and the surge of crises before embarking on draconian reforms. Indeed drought crises are often manufactured (Mehta, 2001) or used as compelling proofs that the 'balance between supply and demand has been lost' and that supply needs to be increased. Projects of interbasin transfers or reservoirs that have often been considered during decades are rekindled. Water shortages in big cities create a psychological context where costly projects can be justified and launched.

Rural poverty can also be a strong driver of basin overdevelopment. Governments faced with prospects of famine or social unrest and secondary/tertiary sectors unable to absorb growing rural populations found themselves in a situation where the main way out was massive investment in water and other rural infrastructures. The El-Niño-related climatic perturbation of 1972, which severely affected grain production and sent prices rocketing up, combined a climatic shock event with fear of rural disintegration. The psychological impact of this event on both national decision makers and western countries (engaged in the Cold War and bent on investing in countries potentially threatened by the spread of communism) was so high that much of the huge investments in dams and irrigation infrastructures that were to follow can be ascribed to the threat of food shortage in the particular geopolitical context of the time (Barker & Molle, 2004).

In such situations, economic or hydrologic rationality is neither here nor there and infrastructures are designed to benefit the larger number of people and are therefore often overextended: this will increase the frequency and impact of coming shortages. Large tracts of these projects will remain uncultivated, and the images of parched fields and cracked soils will hit the news and trigger calls for more water resources development.

* *Lopsided governance and weak participation*:

A last reason why basin overbuilding occurs is the lack of openness in decision-making and, in many cases, the absence of participation of the segments of the population which are to be affected by the project, as well as the weak defense of environmental integrity. It is commonplace that feasibility studies or environmental impact assessments are not made public. Presentation and discussion of alternatives, identification of likely impacts with concerned populations, distribution of costs and benefits, and compensation schemes, are examples of issues that are imperfectly considered, if at all.

Experts too often insulate themselves from public debate on the basis that issues are too complex or technical to be understood by the layman. By suggesting that arguments are merely technical they close and depoliticize the debate.

Yet, river basin development appears to be a political process where asymmetries of information do not facilitate informed and inclusive processes of decision making. The financial and political interests involved tend to push for a hasty completion of the project. These interest groups easily convince themselves that they work for the common good but experience shows that losers tend to be first overlooked and then forgotten if they do not have political channels to make sure their rights are being taken into consideration. Since projects increasingly affect third parties and the environment as a basin closes, inadequate governance patterns tend to let the driving forces of basin overbuilding go unchecked.

Conclusions

Basin overbuilding and basin closure have occurred in many basins such as the Colorado, Yellow river, Amu-Daria/Syr-Daria, Jordan, Cauvery, and many rivers of Mexico, Iran, etc. Such processes seem to be on their way in the Ganges, Indus, Krishna, Nile and other river basins.[9]

The overcommitment of water resources in a given river basin may also be the result of uncoordinated and unchecked individual diversions of surface water or abstraction of groundwater. We have focused here on large-scale irrigation schemes, reservoirs and other infrastructures built and managed by state agencies, but it is worth mentioning that basin closure can also be compounded, and sometimes driven, by the development of diffuse individual or small-scale irrigation. This is the case in the Krishna basin and many Indian catchments where areas irrigated by wells and/or equipped with water harvesting structures have outstripped public irrigation areas.

Yet, large-scale water resources development is the chief driver of the closure of most basins: it is in the planning and decision-making process that the drivers of the overbuilding of river basins lie, whereby scarcity and crises are first generated by overextended facilities and then used to justify further storage or transfers. This self-sustaining vicious circle has led many basins to close, with a critical impact on ecosystems and increased vulnerability of users to variability in supply.

This draws our attention to the artificial nature of water scarcity when generated by overbuilding of river basins. Discussing and designing new policies and projects in response to water problems are paramount; yet, it is equally important to comprehend how and why we got there.

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[2] Climate change does increase climatic variability and affects hydrology but the discussion here is focused on human-induced scarcity.

[3] In the US it was only in 1993, in a landmark statement, that the Bureau of Reclamation publicly announced that 'Federally-funded irrigation water supply projects [would] not be initiated in the future', marking a dramatic end of its historical mission (Postel, 1999).

[4] 'Rent-seeking behavior is deeply embedded in the social and political fabric of all major irrigating countries and thus changes only slowly and usually because of major exogenous threats.'

[5] President Salinas' speech for the inauguration of El Cuchillo dam on October 17, 1994 was typical of the way politicians like to frame projects in terms of administrative state boundaries rather than in terms of hydrological ones, overlooking interactions that will however soon surface: Salinas declared that 'El Cuchillo dam is a project of Nuevo Leon and for Nuevo Leon, which will solve future water supply' (Barajas 1999).

[6] A striking example is that of the planned abstraction of an aquifer in the Mojave desert, in California, where experts of the private company proposing the project put estimates of the recharge rate at ten times that assessed by the US Geological Survey… (Booth, 2002).

[7] According to Reisner (1986), irrigation development was 'pursued with near fanaticism, until the most gigantic dams were being built on the most minuscule foundations of economic rationality and need.'

[8] In 1992, the Wapenhans Commission found that 'pressure to lend' was undermining the rigor of appraisals and project quality.

[9] With the ambitious plan to develop more irrigated areas in the North Sinai and southern Egypt an additional 10 Bm^3 of Nile basin water will be extracted, that is, almost 20 percent of Egypt's internationally negotiated share of the annual storage releases from Lake Nasser (USAID, 2002). Flows to the northern Lakes, which are already polluted and where fisheries are declining are unlikely to receive water in adequate quantity and quality, and seawater intrusion into coastal groundwater will increase. Acute irrigation water shortages could also be expected for farms at the tail end of irrigation canals (USAID, 2002).

References

ADB (Asian Development Bank) (1986) **Review of Bank Operations in the Irrigation Sector 1966-1985.** (Manila, Asian Development Bank).

ADB (1995) **Sector Synthesis of Postevaluation Findings in the Irrigation and Rural Development Sector**. (Manila, Asian Development Bank).

Allan, J.A. (1999) Productive efficiency and allocative efficiency: Why better water management may not solve the problem. **Agricultural Water Management,** 40, 71-75.

Barajas, I. A. (1999) **Interregional Transfer of Water in Northeastern Mexico: The Dispute over El Cuchillo. Knowledge Base of the World Commission on Dams.** www.dams.org

Barker, R. & Molle, F. (2004) **Evolution of Irrigation in South and South-east Asia. Comprehensive Assessment of Water Management in Agriculture.** Research Report No 5. (Colombo, Sri Lanka, International Water Management Institute). http://www.iwmi.cgiar.org/Assessment/files/pdf/publications/ResearchReports/CARR5.pdf

Berkoff, J. (2002) Economic valuation: why is it often unsatisfactory? And does it matter? With reference to the irrigation sector. Paper presented at the ICEA meeting, 19 June 2002.

Berkoff, J. (2003) China: The south-north water transfer project--is it justified? **Water Policy,** 5, 2003, 1-28.

Booth, W. (2002) Water's flow from private hands. Thirsty, growing states turn to new sources to meet demand. **Washington Post**, Monday, August 12, 2002.

Briscoe, J. (1999) The financing of hydropower, irrigation and water supply infrastructure in developing countries. **Water Resources Development**, 15, 4, 459-491.

Ertsen, M. (2006) Colonial irrigation: Myths of emptiness. **Landscape Research**, 31, 2, 146-167.

Garrido, A. (2002) **Transition to Full-Cost Pricing of Irrigation Water for Agriculture in OECD Countries.** Paris: Environment Directorate and Directorate for Food, Agriculture and Fisheries, OECD.

Gottlieb, R. (1988) **A Life of Its Own. The Politics and Power of Water.** (New York, HBJ Publishers).

Guerra, P. & Guerra, T. (1980) Seccas contra as seccas. **Collection Mossoroense,** No. 29, pp. 313. (Brazil, Mossoró: Escola Superior de Agricultura de Mossoró).

Hill, G., Del Moral, L., Paneque, P., Pedregal, B., Spash, C. & Urama, K. (2003) Evaluation practices in water project decision-making processes: Comparative analysis of Alqueva dam (Portugal), Evinos reservoir (Greece), Ythan nitrate vulnerable zone (UK), the Grensmaas (the Netherlands) and Ebro river transfer (Spain). Report of Work Package 2, ADVISOR Project.

Howe, J. A. & Dixon, J. A. (1993) Inefficiencies in water project design and operation in the third world: An economic perspective. **Water Resources Research,** 29, 7, 1889-1894.

Ingram, H. (1971) Patterns of politics in water resources development. **Natural Resources Journal**, 11, 102-118.

Ingram, H. (1997) Water and equity: A direction for research. **Common Property Resource Digest**, No. 43,September.1997.

Jones, William I. (1995) **The World Bank and Irrigation.** Operations Evaluation Department, A World Bank Operation Evaluation Study. (Washington, D.C., The World Bank). Pp. 150.

Marshall, H. (1965) Politics and efficiency in water development. **Water Research**, 294.

Mathur, N. (2004) Unbundling ‘Lack of Access’ to Water in Rural India. In **Proceedings of the Workshop on Water and Politics: Understanding the Role of Politics in Water Management**. 26-27 February 2004, pp. 249-256. (Marseille, World Water Council).

McCully, P. (2001) **Silenced Rivers: The Ecology and Politics of Large Dams.** (London: Zed Books, Limited; New York: St. Martin's Press).

Mehta, L. (2001) The manufacture of popular perceptions of scarcity in Gujarat, India. Dams and water-related narratives in Gujarat, India. **World Development,** 29, 12.

Molle, F. (2003) **Development Trajectories of River Basins: A Conceptual Framework,** Research Report No. 72. (Colombo, Sri Lanka, International Water Management Institute). http://www.iwmi.cgiar.org/pubs/pub072/Report72.pdf

Molle, F. (2006a) River basin development: a few lessons to be learned from history. Paper prepared for "Mekong Region Waters Dialogue: Exploring Water Futures Together". 6-7 July 2006, Vientiane, Lao PDR.

Molle, F. (2006b) **Planning and Managing Water Resources at the River Basin Level: Emergence and Evolution of a Concept.** Comprehensive Assessment Research Report. (Colombo, Sri Lanka, International Water Management Institute).

Molle, F. & Berkoff, J. (2006) **Cities versus Agriculture: Revisiting Intersectoral Water Transfers, Potential Gains and Conflicts**. Comprehensive Assessment Research Report 10 Colombo, Sri Lanka, International Water Management Institute). http://www.iwmi.cgiar.org/Assessment/Publications/research_reports.htm

Molle, F. & Renwick, M. (2005) **The Politics and Economics of Water Resource Development: The Case of the Walawe River Basin, Sri Lanka.** IWMI Research Report No 87. (Colombo, Sri Lanka, International Water Management Institute).

Moore, M. (1990) The rational choice paradigm and the allocation of agricultural development resources. ***Development and Change*** 21, 1990, 225-246.

O'Mara, G. T. (1990) **Making Bank Irrigation Investments More Sustainable (It Is Time to Rationalize Policy Guidelines on Bank Irrigation Projects).** Agriculture and Rural Development Department. Working Paper. (Washington D.C., The World Bank).

Porter, T. (1995) **Trust in Numbers: The Pursuit of Objectivity in Science and Public Life**. (Princeton, Princeton University Press).

Postel, S. (1999) **Pillars of Sand.** (New York, NY, W.W. Norton & Co.).

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).

Repetto, R. (1986) **Skimming the Water: Rent Seeking and the Performance of Public Irrigation Systems**. Research Report 4. pp. 47. (Washington, D.C., World Resource Institute)

Scudder, T. (1994) Recent experiences with river basin development in the tropics and subtropics. **Natural Resources Forum,** 18, 2,101-113.

Tiffen, M. (1987) Dethroning the internal rate of return: the evidence from irrigation projects. **Development Policy Review**, 5, 4, 361-377.

Turton, A. R., Meissner, R., Mampane, P. M. & 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).

USAID (United States Agency for International Development) (2002) **Economic Instruments for Improved Water Resources Management in Egypt.** EPIQ/WPRP. (Cairo, USAID).

Williams, A. (1972) Cost benefit analysis: Bastard science? And/or insidious poison in the body politick? **Journal of Public Economics** 1, 2, 199-226.

Winpenny, J. (1994) **Managing Water As an Economic Resource**. Development Policies Studies. London, Routledge and Overseas Development Institute), 133 p.

World Bank (1986) **World Bank Lending Conditionality: A Review of Cost Recovery in Irrigation Projects.** Report No 6283. (Washington, D.C., Operations Evaluation Department, World Bank).

Worster, D. (1985) **Rivers of Empire: Water, Aridity and the Growth of the American West**. (New York, Pantheon Books).

Zemin, J. (1997) Jiang Zemin's speech marking Yangtze-damming for Three Gorges Project. http://www.china-embassy.org/eng/zt/sxgc/t36514.htm