CITIES VS. AGRICULTURE: REVISITING THE "ALLOCATION STRESS"

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ABSTRACT

Water demand management, or making better use of the water we have—as opposed to augmenting supply—is increasingly proposed as a way of mitigating water-scarcity problems. Moving water away from agriculture to uses with higher economic value is one of the main measures widely seen as desirable. Sectoral "allocation stress" is seen as resulting from the disproportionate share, and inefficient use, of water in the agricultural sector. This apparent misallocation is often attributed to the failure of the government to allocate water rationally.

This paper revisits this commonly-accepted wisdom and examines the nature of urban water scarcity, showing the importance of economic and political factors, shaped by incentives to decision-makers, and sometimes compounded by climatic conditions. It shows that cities' growth is generally little constrained by the competition with agriculture. In general, rather than using a narrow financial criterion, cities select options that go along the "path of least resistance," whereby economic, social and political costs are considered in conjunction. The question of the allocation stress is thus reframed into an inquiry of how transfer effectively occur and can be made more effective.

INTRODUCTION

Human use of water is reportedly increasing with the growth of population and economic activities. As irrigation diversions rise, they tend to alter and displace natural uses; and as cities and economies expand, domestic, industrial, and in-stream uses also start to impinge on the quantity, quality and timing of water flows, not only for the environment but also for existing and potential agricultural uses. Conflicts amongst and between environmental and human uses intensify, and mechanisms – some planned, many unplanned – emerge to rebalance sectoral allocations. Handling these conflicts and the sectoral re-balancing that is implied are a major concern of the literature.

Sectoral reallocation is seen by many observers as one pillar of water demand management, defined as a "policy that stresses making better use of existing supplies, rather than developing new ones" (Winpenny 1997). It employs a variety of measures, including price incentives, market mechanisms, quotas, subsidies, conservation, treatment, re-cycling, awareness-raising and education (Hamdy et al. 1995; Winpenny 1997). For Gleick (2003) such efforts together

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with decentralization and user participation define a "soft path" approach. Pricing and markets to balance supply and demand have received particular attention (Rosegrant and Binswanger 1994; Bhatia et al. 1994; Easter et al. 1998).

Making better economic use of water implies emphasis on its productivity and the economic welfare to be derived from alternate uses. The World Bank's (1993) policy paper remarks that the value of water differs greatly between agriculture and other sectors, "often indicating gross misallocations if judged by economic criteria … Setting prices at the right level is not enough; prices need to be paid if they are to enhance the efficient allocation of resources." Price and market mechanisms are thus not only presented as a means of cost recovery and demand regulation but also as a way to reallocate water towards higher-value uses. Misallocation is held to be a manifestation of poor water management resulting in economic inefficiency. Rosegrant and Cline (2002) posit that "there is considerable scope for water savings and economic gains through water reallocation to higher-value uses", while Merrett (2003) states that "in the field of water resources management a widely held belief exists that allocation stress is to be found in many parts of the world" (emphasis added). The apparent strength of this argument is predicated on four interconnected assertions:

That agriculture gets the *"lion's share"* of all diverted water resources [70% at world level: much more (80–95%) in developing countries];

1. That agricultural use incurs large wastage, typified by ubiquitous statements to the effect that two-thirds of water delivered to agriculture fails to reach the crop or that irrigation efficiency is typically 30-40 percent;
2. That the value of water in non-agricultural sectors is much higher than in agriculture, typically by an order of magnitude; and
3. That cities are frequently water short, the situation varying greatly depending on climate, resource availability, economic development, etc. Reference is made to cities that ration supplies or fail to guarantee water pressure, either permanently or during dry spells, and to urban areas with precarious or nonexistent water supply facilities.

The juxtaposition of these four statements suggests that water is misallocated, with two corollaries. *First,* responsibility for this is attributed to the State, since water is generally allocated through centralized management. This assumed failure prompts proposals for pricing and market mechanisms as an alternative (Anderson and Snyder 1997). *Second,* the contrasting share of water used in agriculture with that in other uses suggests that a relatively limited level of water saving in agriculture would easily make up for the additional needs of the urban sector. This is well exemplified by Gleick (2001) who states that: "The largest single consumer of water is agriculture – and this use is largely inefficient … as much as half of all water diverted for agriculture never yields any food. Thus, even modest improvements in agricultural efficiency could free up huge quantities of water."[3]

[3] See similar statements in Winpenny (1997), IRN (2003), Simon (1998), Postel (2001).

The above four statements imply that urban scarcity is in large part due to excessive use of water in the rural sector and to state failure to reallocate water. In other words, irrigation profligacy and bureaucratic inertia help explain urban shortage. Consequently, solutions lie, in part, in demand management in the urban sector but more fundamentally in the improvement of efficiency in agricultural use. Substantial water can be freed and used in higher value uses, reducing the allocation stress for the common good. Water markets may be instrumental in such reallocation and avoid government failure. While not necessarily discarding these arguments, the paper will review the assumptions and the validity of the implicit causal links inherent in the conventional knowledge outlined above. We fill first look at the situation of agricultural use, then question the nature of urban water scarcity, and finally analyze empirical evidence on intersectoral transfers. This will take us to the final section which will attempt to revisit the "allocation gap" and its conventional explicative framework. The paper is anchored in a review of urban-rural water conflicts worldwide, to which the reader is referred for more detail (Molle and Berkoff 2006).

REVISITING THE ALLOCATION GAP

Agricultural Water Use and Productivity

Most water is used by irrigation. To stress that agriculture gets the lion's share implicitly establishes a causal relationship between its large share and the allegedly unfulfilled needs of non-agriculture sectors. But irrigated agriculture is a biophysical process that inherently needs a lot of water, much more water than other consumptive uses. Moreover, agriculture's share is typically dominant when the needs of other activities – apart from those of the environment – have still to compete for comparable amounts. This has been aggravated by the fact that states have invested massively in subsidized irrigation development for a host of (sometimes controversial) socioeconomic and political reasons, reasons which tend to be forgotten with time (see Molle forthcoming). Where other human uses do in fact compete for significant amounts, the balance shifts and irrigation almost always becomes the *residual* human use after other needs have been met. To keep with animal metaphors, the lion's share is perhaps better described as the hyena's share.

Furthermore, irrigation often utilizes flood flows and other marginal sources that cannot provide the level of dependability required by domestic and industrial users. Irrigation thus typically uses a lot of water at times *when* it has no alternative use. In other cases, irrigation and urban networks are disconnected hydraulically and transfers are either impracticable or the costs of storage and/or integration are prohibitively expensive.

Farmers waste water**.** Irrigation's dominant share appears consistent with the conventional belief that farmers waste water: are not large consumers (necessarily) squanderers? The alleged wastage in irrigation has been the subject of a large literature, and decision makers and the media worldwide continue to refer to classical irrigation inefficiency in order to stress alleged mismanagement or to justify interventions of one sort or another. Without entering into the details of this question, it is important to emphasize that (1) waste is relative: if water has no other economic use – is not scarce – then *'wastage'* is of little concern other than for any impacts it has on the environment; (2) even in water short basins, a loss at one point typically flows back to the river or an aquifer and – subject to water quality – can be recycled downstream (Keller et al. 1996; Perry 1999). Efficiency at basin-level is typically much higher than within any individual use; (3) in situations of scarcity, tales of irrigation waste are both misleading and unfair to farmers. Irrigation managers and farmers respond to physical scarcity by optimizing water's value to them – adjusting crops, practices and calendars, and developing conjunctive use by digging wells and installing pumps (Molle 2004b; Loeve et al. 2003); the *"hidden hand of scarcity"* prompts (costly) adjustments that are often overlooked.

Low water productivity in agriculture. Urban water uses usually have higher value to society than irrigation uses, and this is reflected in the priority typically given to domestic – and often industrial – uses both in practice and in law. But this can be presented in misleading terms, either because water does not really constitute a production factor or because like is not compared with like. According to Gleick (2001), for instance, "supporting 100,000 high-tech California jobs requires some 250 million gallons of water a year; the same amount of water used in the agriculture sector sustains fewer than 10 jobs – a stunning difference". He sees a shift from the latter to the former as providing "tremendous gains in efficiency" as if they were really in competition. There is no indication that high-tech industry is ever short of water and it is equivocal to suggest it competes with agriculture.

The Nature of Urban Water Scarcity

Urban water scarcity is often associated with percentages of population not having access to tap water, occurrence of water-borne diseases, or other accounts of poor Water & Supply Sanitation (WS&S) conditions. It is sometimes also linked to alleged constraints to urban sprawl or industrial development. This section examines the nature of domestic urban scarcity and whether economic development is constrained by water being locked up in low-value uses.

Physical and economic water scarcity. Images of "thirsty cities" typifying urban scarcity usually convey a sense of physical scarcity, often made more vivid by dry climatic events. Cities in arid settings understandably run out of water in their immediate vicinity and must opt for costly and distant transfers. Indeed, many cities have developed in the *"wrong"* place and are chronically short (Winpenny 1994). Chennai, Mexico City, Las Vegas and Amman, are cities that have mushroomed despite limited nearby water resources. Even in water-abundant areas, cities outstrip proximate resources when located in upper catchments (e.g. São Paulo, Atlanta, Kuala Lumpur) or in small coastal catchments (e.g. Manila, New York, Boston).

Numerous cities provide water only one or two days per week, conveying a sense of sheer deprivation. Yet, Amman, for example, with its one-day-a-week delivery, still consumes 135 l/c/day, even if Amman East – the poorer area – uses 75 l/c/day (Darmame 2004). Intermittent supply is at least in part due to a concern for limiting the leakage that would result from constant pressure and is resolved by storage at the household level (Decker 2004). Low figures tend to be associated with less-than-ideal water conditions but it is often difficult to distinguish between core needs, comfort, superfluity, excess, and waste. Malé, capital of the Maldives, relies on desalinated water and consumption is 34 l/c/day though supply is 24-hour and reliable (McIntosh 2003) and is less problematic than Chennai with its 68 l/c/day (Brisset 2003).

The causal link between physical water availability and actual supply is loosened by the fact that water-short cities have often been faced with insufficient supply throughout their history, regardless of size.[4] Likewise, there is no shortage of large cities in water-abundant regions with deficient water supply and sanitation systems: e.g. Lagos and Calcutta, with their contaminated sources, dilapidated networks and limited treatment and distribution; or Ho Chi Minh City with only 44 percent of the people having piped water connections to their homes (McIntosh 2003).

This suggests that the root cause is economic rather than physical scarcity, even if the latter may compound the former. Precarious or underdeveloped infrastructure largely reflects a lack of funds and political will. As stressed by Camdessus and Winpenny (2003) "The root cause [of poor water supply to population] is our negligence and our resignation in the face of inequality… All governments, agreeing on the importance of water, subscribe to internationally inspired commitments and undertakings. But their spending performance is at odds with their rhetoric." The capital needed for infrastructural development varies widely but the central question is – unambiguously – who is to pay? Not, where are we going to find the water?, as is also apparent in the World Water Assessment Program (UNESCO 2003) and Anton's (1995) review of water supply in Latin American and Caribbean cities.

<u>Urban scarcity in times of drought</u>. Instances of drought leading to shortage and conflict are allegedly epitomizing allocation problems. They also reflect that allocation is not a problem of average but of extreme events, which reveal how scarcity is shared among users. Are crises due to unrestrained use in agriculture and failure to spare cities by reallocating irrigation water?

There is uncontroversial evidence that the domestic and non-agricultural sectors get priority in times of shortage. For example, shortages in industry and tourism in the "Eastern Seaboard" near Bangkok have been quickly diffused by the implementation of six inter-basin transfers and drilling of 290 artesian wells for short-term relief (Samabuddhi 2005). The California State Water Project cut off farmers in 1991, and the Bureau of Reclamation reduced supplies in the Central Valley by 75 percent (Anderson and Snyder 1997). When Indonesia was hit with a major drought in 1994, residents' wells ran dry but supply to Jakarta's golf courses was ensured so as not to impact on tourism; a similar story unfolded in Cyprus (Barlow and Clarke 2003). Other examples where agriculture suffered first include Amman, Chennai (Ramakrishnan 2002); the Guadaquiver basin in Spain (Fereres and Cena 1997); the Alentejo region in Portugal; Bangkok (Molle 2004b), and Manila (McIntosh 2003).

Except for situations where irrigation holds 'senior' water rights (Colby 1993) or where allocation to agriculture is not reduced in time (crops have already been planted), agriculture clearly stands at the losing end and has to relinquish its share first; shortages only affect domestic use secondarily (and partially), while industries are usually affected last (but many rely on groundwater).

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[4] See for example Darmame (2004) for Amman, Swyngedouw (2003) for Guayaquil, and Ducrot et al. (2003) for São Paulo.

Industries and urban economic activities. Discussions of urban scarcity generally focus on domestic WS&S services, with little reference to stress undergone by industries, despite distinctions between the two sectors. *First*, industries generally need secure and continuous supply of high-quality water. They thus tend to exploit deep aquifers wherever feasible (e.g. 90 percent of industries in Bangkok). *Second*, the industrial sector represents an interest group that is affluent, powerful and closely linked to the highest levels of political and bureaucratic apparatuses.

Whether longer-term investments in services and industry are constrained by water remains perhaps a matter of debate. Very high water-consuming industries, such as aluminum, are unlikely to settle in water-short areas, and suggestions have been made that water-intensive industries should be moved e.g. inland from coastal China (Chan and Shimou 1999). Even so, there is little evidence that cities and industries are seriously constrained in their growth by water. By and large, industries that offer to create jobs and increase business taxes are unlikely to be denied preferential access to municipal water. Alternatively, they abstract groundwater regardless of whether this is sustainable or not. Ramakrishnan (2002), for example, describes the drastic restrictions on water supply in Chennai but, at the same time, reports that the Chennai Petroleum Corporation's demand for an additional 15,000 m^3/day needed for its expansion project has been readily agreed upon.

Simon (1998) notes that: "Ironically, the areas of the world with the fastest growing populations are also the areas with already severe water problems, and the shortage will get much worse." This serves to show that lack of water does not hinder expansion although growth outpaces financial capacity to expand supply networks. This contrasts starkly with the situation in many western countries where water is a prerequisite to expansion: many cities in the Western US, for example, require developers to prove their right to adequate provision of water before construction begins (Lund and Israel 1993).

The political economy of urban water supply. Given the prominence of the financial and political dimensions of urban water scarcity, the central question becomes: how do such investments become a priority? Several documents (Rijsberman 2004; UNESCO 2003; Smets 2004) give varying estimates of the financial resources needed to meet MDG targets or bring urban WS&S services up to standard. These amounts are substantial but not beyond the financial capacity of consumers, countries and international institutions. Incentives to decision makers, the political clout of a given city, and public mobilization all matter in defining priorities.

In Europe, in historic times, extension of WS&S facilities beyond the affluent can be attributed to a combination of the hygienist movement, a perceived "threat from below" (Chaplin 1999) and/or the need "to preserve order, cleanliness and a healthy workforce" (Goubert 1986). As early as the mid-18th century it was recognized that "prevention of further environmental degradation was cheaper and more effective … than continuing with expenditure on poor relief" (Chaplin 1999).

The capacity of city managers and politicians to fund investment is also closely linked to a city's location within the state/region/nation, both in geographical and in political terms. Capital cities are more likely to get access to public funds (e.g. Mexico: Connolly 1999). How taxes are distributed amongst administrative layers – central to local government – is also crucial.

Swyngedouw's study (2003) on Guayaquil and Bennett's (1995) on Monterrey show that the distribution of power determined whether investments were made or not, who paid for them, and what sources of water were to be tapped. Some cities attract foreign subsidies (e.g. EU funds for Athens) or benefit from geopolitical considerations (e.g. Amman) or broad reconstruction efforts (e.g. Phnom Penh). If society is receptive to privatization, the financial burden can be shifted to users, as in the UK.

In general, therefore, and notwithstanding that water projects are more or less costly, the state of the WS&S systems depends far more on political and financial circumstances than on competition with other sectors for the basic water resource.

Inter-Sectoral Transfers in Practice

Types of transfer mechanisms. Inter-sectoral water transfers do happen in practice and take several forms. *Temporary transfers* typically occur during a drought. *Permanent transfers* occur when a source of water already tapped by several users and is diverted to the benefit of a city. Such transfers can be gradual, often first amounting to a limited percentage of the source of origin. Its effects tend to be diffuse and unidentifiable since the source continues to provide a large share of water to other users. But they can also be *outright,* and if they amount to a large part or all of an existing source (e.g., the conversion of - irrigation reservoirs to municipal use in China) then they are likely to be problematic if no compensation is paid.

Transfers can also be categorized based on the mechanisms utilized in their implementation, with three apparent main types.[5] A first type of transfers occurs through the transfer of *formal rights* to the use of water. These are typified by practices in developed countries, notably the west US, Australia and other arid regions but increasingly also in the eastern US and other developed countries. Formal rights can in principle be transferred in a free market with the price reflecting market conditions either in real time, or over a longer period (a season or year), or permanently. Markets in *informal rights,* in contrast, develop spontaneously but generally involve farmer-to-farmer sales rather than inter-sectoral sales. An exception is the conversion of irrigation wells to tanker operations in Amman and some cities in India, which represents a significant case of an unregulated market transaction from agricultural to urban use.

Administrative decision has been by far the most important mechanism for transferring water from one use to another, both historically in developed countries and to this day in developing countries. *Formal administrative decisions* are taken by a national, provincial/state or basin entity depending on the functions assigned to each under the constitution or in law. They involve varying degrees of consultation between the interested parties (e.g. Seville, Tsingtao, etc.). Direct expropriation is problematic for any government, even an authoritarian one, especially in contexts where the local economy revolves around irrigated agriculture. This is true even if no

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[5] The potential of water pricing as a means for eliciting reallocation from agriculture to other sectors has also been emphasized by some economists but is now widely considered as negligible (Savenije and van der Zaag 2002; Cornish and Perry 2003; Hellegers and Perry 2004; Molle and Berkoff 2007), a point also recently acknowledged by the World Bank (2003).

formal rights are held. The buying out of agricultural wells around some cities (Chennai) is an example of outright and total reallocation of minor sources with appropriate compensation.

Negotiations can include financial compensations and/or efforts by the city to reduce its losses or its consumption. El Paso, for example, obtained water from the Rio Grande on condition that it reduce per capita consumption, recycle sewage water and eliminate leakage (Earl 1996). Well known agreements between the Imperial Valley Irrigation district and the Southern California Metropolitan Water Authority (CGER 1992), or between Delhi and the Upper Ganga irrigation scheme, included lining of irrigation canals by the cities.

When formal administrative decisions to transfer water are taken unilaterally, they merge imperceptibly into informal *transfers by stealth*. This may occur as a result of investment decisions (as in Hyderabad) or management decisions (as in Manila), or development decisions (as in the occupation of tanks in Bangalore or the conversion of irrigated land to urban use as in many expanding cities). Transfers by stealth by definition do not allow for compensation. Some transfers are explicit and obvious to observers (e.g. large pumping stations), not least to the farmers; others are more surreptitious, like when there is a long distance between the point of diversion and the downstream farmers/users. Groundwater abstraction by a city, or reappropriation of water through gradual encroachment upon irrigated land (e.g., Manila, Lima, Bangkok, Cairo) can pass virtually unnoticed at first.

In support of such transfers it is sometimes argued that farmers, who typically paid only a small fraction (if any) of the costs of irrigation, cannot object if the state subsequently withdraws a part of the water allocated to them. This has less force once the value of water is capitalized in land prices. Another argument is that the real costs to farmers of partial "expropriation" may be less than appears at first sight, given the room for adjustment in many irrigation systems and the fact that the *"hidden hand of scarcity"* elicits changes in behavior and factor use.

Predictably, cities do not publicize widely their water projects, minimize their impacts, and avoid talk of compensation. Analyses of conflicts (see above) show that nonagricultural uses almost always get priority but also that the crux of the matter is not so much the average amount diverted to cities but *what this share becomes at times of shortage*. When a drought occurs and the impact felt becomes critical, it is always possible to naturalize crises, blaming it on climatic change, El Niño, "the rain gods" (The Hindu 2003), or bad luck. Controversial transfers from the Veeranam tank to Chennai, from the Kinjhar lake to Karachi, or from El Cuchillo dam to Monterrey, all officially claim to use "only excess water" and to "preserve existing uses", despite evidence to the contrary.

<u>Environmental impacts of transfers</u>. While cities gradually displace agriculture, agriculture has to adjust and respond to the squeeze. Part of the response comes through an increase in efficiency, notably at the basin level where a greater part of return flows is reused and depleted, or through the use of wastewater instead of freshwater. In many cases, however, irrigation compensates this reallocation by taking more water from the environment, directly "displacing nature".

Cities dispose of 80 percent of the water they divert as wastewater. Only 10 percent of the effluents from cities in developing countries are treated (Joyce 1997). The growth of urban/industrial needs plays out not only in terms of transfer of equivalent volumes of water but also in terms of reduction of the stock of usable water by rendering part of it unfit for human, and even agricultural, use. A good example of this is provided by Janakarajan (2003) who describe the impact of tanneries on the Palar river basin, in Tamil Nadu. Tanneries use many toxic chemicals and generate heavy pollution, to the point that downstream farmers have refused to use the river. This has also happened in the Damodar river (India), in South Africa, because of mines, and in the Huai river basin (China) because of paper industries and tanneries (Postel 1999). It must be noted, however, that agriculture activities are now increasingly contributing to turning surface water and groundwater unusable for cities.

Tapping groundwater is the easiest solution because it generally relies on individual or corporate investments (as opposed to public ones), it is spatially spread with little need for infrastructure, and it frequently penalizes constituencies that often have little voice (nature and the next generations). That between 1.5 and 2 billion humans in the world, of which one billion urban dwellers in Asia (Foster 1999), rely on groundwater for domestic consumption gives an idea of how widely this solution has been resorted to. The hidden costs are becoming increasingly apparent and include:

Reduction in available stocks, drop in the water level and resulting increase in pumping depth and related expenditures. Other used are pumped out.

- Land subsidence in cities like Mexico City, Manila, Jakarta, Cangzhou, Beijing, or Bangkok (a third of the city is now under sea level). Subsidence affects not only buildings and roads but also the future water storing capacity of the aquifer itself.
- The quality of groundwater almost everywhere. Realization of its extent is increasing in proportion to the number of measures and investigations being carried out (Sampat 2000).
- Salinity intrusion due to the overdraft of coastal aquifers rendering water unfit for both domestic and agricultural use, in cities such as Tel Aviv, Lima, Jakarta, and Dakar.
- The drying up of springs and wetlands fed by groundwater flows that are affected by the lowering of watertables (e.g. Azraq wetland in Jordan.

The overall picture is that if cities have generally found ways to increase their water supply, this has often been in an unsustainable and damaging way, displacing agriculture and nature, and critically impacting water quality and the amount of usable water.

Reallocation stress: political and social costs. In a situation of competition, cities will generally have to re-appropriate water already used, allocated or "owned" by other users, generally agriculturalists or nature itself, and this inevitably generates stress. Such transfers appear to breed political tension irrespective of the mechanism used. Political stress is generated in proportion to the political clout of the constituencies that stand to lose in the transfer (the water users in the first place but also surrounding communities). Urban industrialists generally command considerable power over politicians. Conversely the cost of doing nothing, or little, is less when urban populations affected by prevailing poor conditions of WS&S are also voiceless. As the Camdessus Report put it: "with the mass of people not serviced politically weak or disempowered, it is tempting to postpone spending on maintenance and periodic replacements, likewise on investments with a long gestation period."

The difficulty of acquiring more water is also dependent on the political structure and administrative boundaries. A transfer within the same state, region or district – whatever the local structure – is easier to handle. Those involving different provinces/states in federal entities are more difficult and depend on the respective powers vested in the central government and the states, and on the clarity of their roles (see Barajas (1999) on Mexico and Richards and Singh (2002) on India).

It is tempting to circumvent political intricacies with a proposal to choose transfers or supply augmentation based on a full cost assessment. But in practice, decision-making incorporates wider aspects of the local political economy: social, transaction, political, and sometimes environmental costs attached to the various demand – or supply – oriented options; the nature of the possible source of funding; the degree of mobilization/pressure by various constituencies; pre-existing customary (or other) rights and water uses (Howe et al. 1990). Eventually, decision makers tend to follow the *"path of least resistance"* (Kenney 2004), which may differ from what a more narrow sectoral rationality might, *prima facie*, suggest to be the way forward. Of course while pursuing a mere economic logic is likely to be detrimental to equity, unchecked centralized and obscure decision making may favor costly options that only benefit a few constituencies. Political mediation has to follow a narrow path between public and private interests.

THE ALLOCATION GAP: CONCLUSIONS AND PERSPECTIVES

The allocation gap revisited

Industrial and domestic water use is often believed to be constrained by the excess amount of water used in agriculture. Since irrigation is usually inefficient both in technical (it incurs many losses) and economic terms (low value per cubic meter), this situation creates an "allocation gap" that amounts to an economic loss to society. This paper has challenged the magnitude of this gap and given alternative analyses of the nature of urban water scarcity, distinguishing between municipal and industrial uses, and between short term and long term reallocation.

Temporary reallocation often occurs in times of drought. Short-term crises may be partly due to climatic variability but they are compounded by lax management of security stocks: except for situations where irrigation holds 'senior' water rights or where allocation is not reduced in time (crops have already been planted), agriculture clearly stands at the losing end and has to relinquish its share first; shortages only secondarily (and partially) affect domestic use, and then industries. On the long run, cities also appear little constrained by the competition of agriculture. While suboptimal WS&S conditions in many cities, particularly in arid climates, point to a lack of water, this situation is mainly due to insufficient investments that have economic and political roots, and eventually reflect incentives to decision-makers for prioritizing such investments. Industries, in turn, either rely on groundwater or receive priority allocation justified by their economic importance, and contribution to local tax base and employment.

Contrary to received wisdom on state failure, states do give priority to cities and industries, transfers *do* occur, and the alleged economic benefits waiting to be realized are often much inflated. Thus, in both the short and long term, farmers are "losing out" (Winpenny 1994), urban interests are getting the "upper hand" (Lundqvist 1993), and "without a doubt, cities will continue to siphon water away from agriculture" (Postel 1999).

Yet, it is widely believed that increased supply to cities could enhance economic output, with scarcity attributed to excessive allocation to agriculture (see introduction). In the ADB's (2000) view, for example, "Irrigation is particularly voracious, accounting for up to 80 percent of water demand in hot dry regions … Major obstacles to the rational reallocation of water among users … are the legal and regulatory constraints on water transfers and, in many countries, the complex systems of water rights that inhibit the free movement of water as an economic good." Why does the literature appear to place such emphasis on the gains from reallocation, if these are in fact quite limited? The oft-stated problem of sectoral allocation as a significant hindrance to economic development is perhaps only a hasty generalization of the situation in the Western US (where the prior-appropriation doctrine has tended to lock up water use in low-value uses) to contexts where centralized management has by and large ensured inter-sectoral reallocation. This may also reflect the ideological inclination of those advocating markets as an allocation mechanism (Bauer 2004).

The question of the allocation gap was therefore reframed into an inquiry of how transfers effectively occur. While cities by and large succeed in accessing increasing resources this has often not been optimal in economic, social or environmental terms. Water has often been overabstracted from aquifers, taken away from ecosystems or from agriculture (which, in turn, has often displaced nature too), or from distant sources at a high cost. Economic rationality has often been abused but decision making reflects wider social and political considerations that are not easily captured by valuation techniques, as well as the distribution of political power within society. Eventually, all things being considered, cities select the path of least resistance. While "politics" is often construed in a negative sense because of its rent-seeking and pork-barrel dimensions, these aspects must be checked by democratization of decision making and increased public access to data, so that political mediation becomes an effective way of balancing antagonistic interests and world views, rather than a way to further vested interests.

Somewhat ironically it seems that it is where water rights are formally defined and enforced – and thus liable to transaction- that reallocation is problematic. Where water is centrally allocated reallocation occurs to bridge the allocation gap, but to the detriment of those deprived of the resources. The crux remains to rationalize and compensate transfers. In both cases the necessity - and difficulty- to account for all third-party and environmental impacts remains a challenge endlessly renewed by climate variability and shifting patterns of power.

How to improve reallocation of water

The option of water markets. Small-scale water markets have long existed in many arid countries. User sharing a common source (spring, qanat, etc) occasionally swap, lend, borrow, sell or buy water turns in order to fine-tune supply to time-specific individual demands. This also occurs in large-scale irrigation systems (e.g., warabandi in Pakistan and India). At these scales, transaction costs are minimized because users know each other (Reidinger 1994), can readily communicate, and transfers are across short distances and socially controlled. The extension of market mechanisms on a larger scale has been much less frequent and more difficult (Livingston 1995). Markets in the Western US are limited by constraints that reflect the crucial nature of water for life and the complexity of the hydrological cycle, which invariably generates third-party impacts (Dellapenna 2000; Kenney 2003; Libecap 2003). In the Colorado-Big-Thompson system market transactions have allowed smooth and gradual transfer partly because trading is occurring only within the system and because the water district holds the right to all return-flows (Howe and Goemans 2003). Water markets in Australia (Turral et al. 2004) or in Chile (Bauer 2004) remain limited in terms of volume traded but reallocation has performed reasonably well, although third party impacts and speculative behavior reduce their efficiency. China also started experimenting with inter-provincial trading of water but soon discovered the implications in terms of return-flow and environmental impact (Fu and Hu 2002).

Positive experience seems to be confined to countries with a strong legal, institutional and regulatory background and relatively wealthy stakeholders. Proposals for their adoption in countries where hydrologic data are scarce, physical infrastructure is lacking, and states have weak monitoring and enforcement capacity, are unrealistic. One may question why states that have allegedly failed to allocate water efficiently would be capable of creating the numerous preconditions and safeguards needed to ensure fair and transparent markets (Molle 2004a). It is doubtful that fully-fledged markets will constitute a major tool for the reallocation of water in the near future, most especially in developing countries (Frederik 1998; Dellapenna 2000; Livingston 1995; Meinzen-Dick and Appasamy 2002).

Contingency planning and temporary transfers. Conflicts between cities and agriculture surface primarily during water crises, when the share diverted by the former rises from a low average to a much larger share. This implies that permanent transfers of rights are often not necessary (Savenije and van der Zaag 2002). Agricultural and non-agricultural uses can usually coexist, if shares are expressed in terms of average. Emphasis should be placed on the design and provision of mechanisms to compensate farmers for losses and deprivation that *will* occur in times of shortage. This is easier to achieve than permanent expropriation of agricultural water, while allowing for a more efficient use of water.

State or cities which tap other sources prefer to present (and obscure) the impact of diversions in average terms. Technical agencies, too, are reluctant to engage in debates that would reveal that domestic supply is not fully reliable and undermine their professional legitimacy. Yet drought-management strategies are needed to provide an early warning of possible shortages and as a predefined set of actions for different conditions (Frederiksen 1992). If priorities are well-established and transparent information provided, negotiations can prepare for such arrangements and avoid the outcry and political crises that often accompany severe water shortages.

Participation and environmental justice. The displacement of agriculture and nature by growing cities/industries as well as their indirect impact through their contamination of freshwater have heavy social, environmental, and health costs. The magnitude and the distribution of these externalities is very much a reflection of the governance structure of the society. The "stamina" and the mobilization of the "people living downstream" (Narain 1999), and the political space offered to disenfranchised groups to voice their concern are paramount. They ultimately determine whether externalities are recognized and internalized, but also who pays for that. Because WS&S projects usually involve large outlays of money, decision-making remains largely centralized and technology-oriented. A shift from supply-oriented paternalistic development to process-oriented approaches leading to “informed consent” (Delli Priscoli 2004) is materializing only slowly. Deliberative development enables a better definition of social choice but can only develop in a political configuration where redistribution of power is possible.

REFERENCES

Abernethy, C.L. 2005. Financing river basin management. In Svendsen, M., Merrey, D. J., and Shah, T. (eds.): *Irrigation and river basin management: Options for governance and institutions*. CABI, Wallingford.

ADB (Asian Development Bank). 2000. *Water in the 21st century.* Annual report 1999. Manila.

Anderson, T. L.; Snyder, P.S. 1997. Priming the invisible pump, Political Economy Research Center: Montana, US.

Anton, D. J. 1995. *Thirsty cities: urban environments and water supply in Latin America*. Ottawa, IDRC. 180p.

Barajas, I. A. 1999. *Interregional transfer of water in Northeastern Mexico: The dispute over El Cochilo*. Knowledge base of the World Commission on Dams. www.dams.org

Barlow, M.; Clarke, T. 2003. *Blue gold*. New Delhi: LeftWord Books.

Bauer, C. J. 2004. *Siren song: Chilean water law as a model for international reform*. Washington: Resources for the Future. 173p.

Bennett, V. 1995. *The politics of water: Urban protest, gender, and power in Monterrey, Mexico.* Pittsburgh: University of Pittsburgh Press.

Bhatia, R.; Cestti, R.; Winpenny, J. 1994. *Policies for water conservation and re-allocation: good practice cases in improving efficiency and equity.* World Bank Technical Paper. Washington, D.C.: World Bank.

Brisset, S. 2003. *L'alimentation en eau potable d'une métropole Indienne (Chennai): Une lutte coûteuse pour quel développement?* Festival International de Géographie Saint-Dié-des-Vosges, France.

Camdessus, M.; Winpenny, J. 2003. Financing water for all. Report of the World Panel on Financing Water Infrastructure. www.wsscc.org/download/Camdessus%20document.doc

CGER. 1992. California’s Imperial Valley: A “win-win” transfer? In *Water transfers in the west: efficiency, equity, and the environment.* The National Academy of Sciences.

Chan, R. C. K.; Shimou, Y. 1999. Urbanization and sustainable metropolitan development in China: Patterns, problems and prospects. *GeoJournal* 49: 269–277.

Chaplin, S. E. 1999. Cities, sewers and poverty: India’s politics of sanitation. *Environment and Urbanization* 11(1): 145–158.

Colby, B. G. 1993. Reallocating water: Evolving markets, values and prices in the Western United States. *Water Resources Update*. Universities Council on Water Resources, Issue No. 92: Water Pricing and Marketing.

Connolly, P. 1999. Mexico City: our common future? *Environment and Urbanization* 11(1): 53–78.

Cornish, G. A.; Perry, C. J. 2003. *Charging for irrigation services: Lessons from the fields*. Report OD 150. Wallingford, UK: HR Wallingford.

Darmame, K. 2004. *Gestion de la rareté: Le service d'eau potable d'Amman entre la gestion publique et privée*. Amman, Jordan: Mission Régionale Eau-Agriculture; Colombo: International Water Management Institute.

Decker, Christian. 2004. Managing water losses in Amman's renovated network: A case study. Paper prepared for the International Water Demand Management Conference, June 2004, Dead Sea, Jordan.

Dellapenna, Joseph W. 2000. The importance of getting names right: the myth of markets for water. *William and Mary Environmental Law and Policy Review* 25 (317–377). 2000.

Delli Priscoli, J. 2004. What is public participation in water resources management and why is it important? *Water International* 29(2): 221–227.

Earl, R.A. 1996. Sunbelt water war: The El Paso-New Mexico water conflict. *The Social Science Journal* 33(4): 359–380.

Easter, K. W.; Rosegrant, M. W.; Dinar, A. (eds.). 1998. *Markets for water: Potential and performance*. Boston: Kluwer.

Fereres, E.; Cena, F. 1997. Social benefits and environmental constraints of irrigation in an era of water scarcity. In *Water: Economics, management and demand*, ed. Kay, M.; Franks, T.; Smith, L. London, UK: E & FN Spon. pp. 128-136.

Foster, S. 1999. The interdependence of groundwater and urbanisation. In *Proc. of the 9th Stockholm Water Symposium*. "Urban stability through integrated water-related management," August 9–12, Stockholm. pp. 125–138.

Frederiksen, H. D. 1992. *Drought planning and water efficiency implications in water resources management.* Washington, D.C., USA: World Bank. iii, 37p. (World Bank Technical Paper No.185)

Fu, C.; Hu, Z. P. 2002. The practice on water rights allocation and trade-off in China. Paper presented to the RiverSymposium 2002, September 2000, Brisbane. archive.riverfestival.com.au/2002/files/symposium/FuC.doc

Gleick, P. 2001. Making every drop count. *Scientific American*, February 2001.

Gleick, P. H. 2003. Global freshwater resources: Soft-path solutions for the 21st century. *Science* 302: 1524–1528.

Goubert, J. P. 1986. *La conquête de l'eau*. Paris : Robert Lafont. Collection « Pluriel », 300p.

Hamdy, A.; Abu-Zeid, M.; Lacirignola, C. 1995. Water crisis in the Mediterranean: Agricultural water demand management *Water International* 20(4): 176–187.

Hellegers, P.; Perry, C. J. 2004. *Water as an economic good in irrigated agriculture: Theory and practice*. The Hague: Agricultural Economics Research Institute (LEI). 152p.

Howe, C. W.; Goemans, C. 2003. Water transfers and their impacts: Lessons from three Colorado water markets. Journal of the American Water Resources Association, Oct 2003.

Howe, C. W.; J. K. Lazo; K. R. Weber. 1990. The economic impacts of agriculture-to-urban water transfers on the area of origin: A case study of the Arkansas River in Colorado. *American Journal of Agricultural Economics* December:1200–1204.

Janakarajan, S. 2003. Water pollution and groundwater depletion multi-stakeholders' dialogue as a key for finding ways forward. Paper presented to the Seminar on Water, Centre for Economic and Social Studies, Hyderabad.

Joyce, Stephanie. 1997. Growing pains in South America. *Environmental Health Perspectives*, Volume 105, Number 8 August 1997. http://ehp.niehs.nih.gov/docs/1997/105-8/focus.html

Keller, Andrew; Keller, J.; Seckler, S. 1996. *Integrated water resources systems: Theory and policy implications.* Research Report 3. Colombo, Sri Lanka: International Irrigation Management Institute, 15 p.

Kenney, D. 2004. Personal communication. By e-mail.

Kenney, D. 2003. Water allocation and management in the western United States: An overview. Paper presented to the International Working Conference on Water Rights: Institutional options for improving water allocation. Hanoi, Vietnam, February 12–15, 2003.

Libecap, G. 2003. *Transaction Costs and the Reallocation of Water Rights from Agriculture to Urban and Environmental Uses.* Working paper, Karl Eller Center, University of Arizona.

Liu, Bin. 2003. Water rights in China. Paper presented to the International Working Conference on Water Rights: institutional options for improving water allocation. Hanoi, Vietnam, February 12–15, 2003.

Livingston, M. L. 1995. Designing water institutions: Market failures and institutional response. *Water Resources Management* 9(3):203–220.

Loeve, R.; Hong Lin; Dong Bin; Mao, G.; Chen, C. D.; Dawe, D.; Barker, R. 2003. Long term trends in agricultural water productivity and intersectoral water allocations in Zhanghe, Hubei, China and in Kaifeng, Henan, China. In *ICID Asian Regional Workshop, Sustainable Development of Water Resources and Management and Operation of Participatory Irrigation Organizations, November 10–12, 2003, Taipei. Vol.1*. Taipei, Taiwan: ICID. 367–380.

Lund, J. R.; Israel, M. 1993. Water transfers in water resource systems. *Journal of Water Resources Planning and Management* 121(2): 193–204. 314

Lundqvist, J. 1993. Rural water for expanding cities: A case study on water re-allocation in Tamil Nadu, India. Paper presented to *the International Conference on Environmentally Sound Water Resources Utilization*, 8–11 November 1993, Bangkok, Thailand.

McIntosh, A.C. 2003. *Asian water supplies: reaching the urban poor*. Manila: Asian Development Bank and International Water Association.

Meinzen-Dick, R.S.; Appasamy, P.P. 2002. Urbanization and intersectoral competition for water. In *Finding the source: The linkages between population and water.* Washington DC: Woodrow Wilson International Center for Scholars. pp. 27–51.

Merrett, S. 2003. The urban market for farmers' water rights. *Irrigation and Drainage* 52(4):319–326.

Molle, F. 2004a. Defining water rights: By prescription or negotiation? *Water Policy* 6(3): 207-227.

Molle, F. 2004b. Technical and institutional responses to basin closure in the Chao Phraya river basin, Thailand. *Water International* 29(1): 70–80.

Molle, F. Forthcoming. Why enough is never enough: The societal determinants of river basin closure. *International Journal of Water Resource Development*.

Molle, F; Berkoff, J. 2006. Cities versus Agriculture: Revisiting intersectoral water transfers, Potential gains and Conflicts. Colombo, Sri Lanka: IWMI. (Comprehensive Assessment Research Report 10). http://www.iwmi.cgiar.org/Assessment/Publications/research_reports.htm

Molle, F., Berkoff, J. (eds.) 2007. Irrigation water pricing policy in context: Exploring the gap between theory and practice. Comprehensive Assessment of Water Management in Agriculture. Wallingford, UK: CABI. Forthcoming.

Molle, F; Mamanpoush, A.; Miranzadeh, M. 2004. *Robbing Yadullah's water to irrigate Saeid's garden: Hydrology and water rights in a village of central Iran.* IWMI Research Report No 80. Colombo, IWMI.

Narain, S. 1999. We all live downstream: Urban industrial growth and its impact on water systems. In *SIWI, Urban stability through integrated water-related management*: *Proceedings - The 9th Stockholm Water Symposium, Stockholm, Sweden, August 9–12, 1999.* Stockholm, Sweden: SIWI. pp.75–83.

Perry, C.J. 1999. The IWMI water resources paradigm: Definitions and implications. *Agricultural Water Management* 40(1): 45–50.

Postel, S. 1999. *Pillars of sand.* New York, NY: W.W. Norton & Co.

Postel, S. 2001. Growing more food with les water. *Scientific American* February 2001.

Ramakrishnan, N. 2002. Chennai water lorry operators on the back foot. *The Hindu Business Line*. August 01, 2002.

Reidinger, R. 1994. Observations on water markets for irrigation systems. In Water policy and water markets, ed. Guy Le Moigne, K. William Easter, Walter J. Ochs, Sandra Giltner. 65–78. World Bank, Technical Paper No 249.

Richards, A.; Singh, N. 2002. Inter-state water disputes in India: Institutions and policies. *International Journal of Water Resources Development* 18(4): 611–625.

Rijsberman, F. 2004. The water challenge. Copenhagen Consensus Challenge Paper. Fifth draft. http://www.copenhagenconsensus.com/Default.asp?ID=228

Rodríguez, J. E. Mestre. 1997. Case Study VIII - Lerma-Chapala Basin, Mexico. In *Water pollution control - A guide to the use of water quality management principles.* WHO/UNEP.

Rosegrant, M. K.; Cline, S. 2002. The politics and economics of water pricing in developing countries. Washington D.C.: International Food Policy Research Institute. Draft note.

Rosegrant, M.; Binswanger, H. 1994. Markets in tradable water rights: potential for efficiency gains in developing country water resource allocation. *World Development* 11: 1613–1625.

Samabuddhi, K. 2005. Mishandling of crisis leads to serious conflict. Bangkok Post, 19 July 2005.

Sampat, P. 2000. *Deep trouble: the hidden threat of groundwater pollution*. Worldwatch Paper 154. Washington, DC, USA: Worldwatch Institute. 55p.

Savenije, H. H. G.; van der Zaag P. 2002. Water as a economic good and demand management: Paradigms and pitfalls. *Water International* 27 (1): 98–104.

Serageldin, Ismael. 1995. *Towards sustainable management of water resources*. Washington, D.C.: The World Bank, cited in http://population.wri.org/pubs_content_text.cfm?ContentID=1030

Simon, Paul. 1998. *Tapped out: the coming world water crisis and what we can do about it*. Welcome Rain Publishers, New York, NY.

SIWI. 2004. *Report on the seminar on financing water infrastructure*. Stockholm, 15 August 2004. Organized by the World Bank and the Stockholm International Water Institute.

Smets, H. 2004. The cost of meeting the Johannesburg targets for drinking water. A review of various estimates and a discussion of the feasibility of burden sharing. Revised edition. Paris: Water Academy.

Swyngedouw, E. 2003. Flows of power: The political ecology of water and urbanization. The case of Guayaquil, Ecuador (1890–1990). Paper prepared for the 3rd Conference of the IWHA, Alexandria, Egypt, December 2003.

Teerink, J. R.; Nakashima, M. 1993. *Water allocation, rights, and pricing: examples from Japan and the United States.* World Bank Technical Paper No 198, p. 68.

The Hindu. 2003. *Use Bhavani Sagar dam water for drinking purposes: HC.* Friday, Sep 26, 2003. http://www.hindu.com/2003/09/26/stories/2003092605730400.htm

Turral, H.N.; Etchells, T.; Malano, H.M.; Wijedasa, H.A.; Taylor, P.; McMahon, T.A.M.; Austin, N. 2004. Water trading at the margin: The evolution of water markets in the Murray Darling basin. *Water Resources Research* 41(7).

UNESCO (United Nations Educational Scientific and Cultural Organisation). 2003. *Water for people water for life*. World Water Assessment Program. Paris: UNESCO, Berghahn Books, Barcelona.

Winpenny, J. 1994. *Managing water as an economic resource.* Routledge, Development Policies Studies, 133 p.

Winpenny, J. T. 1997. Demand management for efficient and equitable use. In Water: Economics, management and demand. London. In Kay, M.; Franks, T.; Smith, L. 296–303. UK: E & FN Spon.

World Bank. 1993. Water resources management: A World Bank policy paper. Washington D.C.: The World Bank.

World Bank, 2003. *Water resources sector strategy. Strategies Directions for World Bank Engagement*. World Bank, Washington DC.