Demand-Side Water Strategies and the Urban Poor

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1. Introduction

Demand-side water management is typically presented as part of an integrated approach to water-resources management, correcting a historic tendency to overemphasise supply-side investment. Somewhat ironically, demand-side water management itself has come to be associated with a narrow approach that emphasises conservation, and fails to address other demand-side issues. Meanwhile, especially in poor urban settlements, other demand-side approaches have been receiving increasing attention. This working paper attempts to bring some of the insights from these other approaches into the framework of demand-side management.

Demand-side management can be defined as a coordinated set of measures to improve energy, water or other environmental services by inducing changes at the point of consumption. The term was coined in the United States in the 1980s, when world energy shortages were in the headlines, regional water scarcity was a growing concern, and the country's urban infrastructure was beginning to fail. Both electric and water utilities were criticised for taking a 'supply-fix' approach, and assuming that increasing demands had to be met by increasing supplies. Advocates of demand-side management argued that what people wanted were services (e.g. lighting and washing). By increasing end-use efficiency and reducing waste, these services could be provided using less electricity or water. If only utilities would take a more balanced approach – went the argument – demand-side measures could be placed on an equal footing with supply-side measures, both utilities and their consumers could benefit financially, and scarce resources could be conserved.

Demand-side management did not prove to be as straightforward as some of its early proponents hoped, but the need for demand-side management is now widely accepted in international water policy debates. Indeed, there is increasing talk of a global water crisis, and of better demand-side management as a necessary part of any solution, Summarising the 'changing water paradigm', one of the world's leading water experts recently wrote that:

> "A reliance on physical solutions continues to dominate traditional planning approaches, but these solutions are facing increasing opposition. At the same time, new methods are being developed to meet the demands of growing populations without requiring major new construction or new large-scale water transfers from one region to another. More and more water suppliers and planning agencies are beginning to shift their focus and explore efficiency improvements, implement options for managing demand, and reallocate water among users to reduce projected gaps and meet future needs."
> (Gleick 2000a)

The goal of this working paper is to examine the relevance of demand-side water management to low-income urban settlements, where many households do not have adequate access to safe water supplies. The conclusion is that demand-side water strategies could play an important role. The need to move away from a narrow supply-fix approach is just as compelling in poor as in affluent settings. However, many of the insights, priorities and tools that have come to be associated with demand-side management are inappropriate to low income settings – they derive from a

conservation perspective, and ignore the health, economic and grass roots perspectives that tend to be critical in deprived urban areas.

In order to bring together these different perspectives, more attention must be given to:

i. *Securing better access to water for the urban poor*
Demand-side management in the North focuses on wasteful and excessive consumption of water. Waste and excess also occur in Southern cities, but under-consumption is usually a more critical problem in deprived areas. Many households do not consume sufficient water to meet their basic needs for health. It is not only important to prevent conservation-oriented measures from further reducing the water consumption of deprived households, but also to implement demand-side measures that improve access to water, even if (and in some cases especially if) this increases their consumption.

ii. *Promoting the hygienic use of water*
Especially in conditions of poverty, it is important that demand-side management include a hygiene component. Health is one of the major benefits water can provide, but it depends upon how the water is used. Users often lack a relevant knowledge of hygiene, and experts in demand-side management are often ignorant of both hygiene issues and of local conditions in low-income settlements. Taking health issues seriously will require a major shift in the approach to demand-side management, but can be seen as an extension of integrated water resource management.

iii. *Empowering deprived groups*
One of the goals of demand-side management in low-income areas should also be to give more influence to those currently deprived of water. The 'supply-fix' approach has often favoured affluent consumers over both future generations and the poor. Orthodox demand-side management attempts to address the concerns that are particularly relevant to future generations. Future generations cannot take an active part in designing and implementing demand management. The urban poor can. To assist deprived urban dwellers, demand-side management cannot simply rely on finding better means to manipulate the demand for water, but must help ensure that the residents (including especially women) gain more influence over water provision and use.

In short, even in low-income settings there are good reasons to concentrate more on the demand side, but not to prioritise water conservation or rely on expert-led water management. Indeed, one of the goals of demand-side management in low-income areas could be to prevent conservation strategies from undermining residents' entitlements to sufficient water to meet their basic health and welfare needs, and to increase the involvement of local residents in driving water provision.

While this could be seen as adding new requirements and conditionalities to demand-side management, it can also be seen as bringing together different strands of a new demand-side approach to water provision of particular relevance to low income settlements. Many of these strands have emerged independently of the conservation-oriented demand-side management prevalent in the North. Health specialists often argue that the supply-fix approach of most water utilities neglects the importance of

hygiene education, and its potential role in helping people get the most out of their water supplies. Economists and grass roots activists have been arguing that the supply-fix approach often fails because it is not sufficiently 'demand-responsive' (though economists and grass roots activists may have very different visions of what it means to respond to demand). Such arguments are notably absent from the more conservation-oriented literature on demand-side management (DSM).

In addition to adding these new concerns to demand-side management, it is also important to reconsider the role of utilities and their planners in demand-side management. Early proponents of demand-side management tended to be overoptimistic about the extent to which their goals coincided with those of the utilities (some of the initial successes of demand-side management relied on a particular combination of regulatory and economic circumstances that were constraining prices and increasing marginal costs). Adding new public health and equity goals to demand-side management is likely to further distance the goals of the utilities from those of demand-side management. Moreover, the water sector has undergone considerable restructuring since the early 1980s: privatisation has been promoted widely and many public utilities have been made more responsive to commercial incentives. Commercially-oriented utilities that get their revenue from selling water may favour higher prices, but they do not necessarily want their customers to find inexpensive ways to save water, achieve better health, or otherwise improve their welfare by using water more effectively. In short, there is no reason to assume that utilities have the incentive to engage in demand-side management, and there may be good reasons to look for alternative organisational homes.

It must also be recognised that in many low-income cities managerial capacity in the water sector is low (not least because of financial problems), and simply adding new management burdens is likely to be counterproductive. As such, forms of demand-side management that also ease overall management burdens are far more likely to be successful than initiatives that give greater responsibilities to already struggling utilities and government agencies.

In developing a more integrated approach to demand-side management, it is also important to debunk some of the misconceptions now being propounded in the name of integrated water resource management. Advocates of a new approach to water management are fond of attacking the 'myths' of the traditional water-planning approach. Unfortunately, they are allowing some to be maintained and creating others of their own. Simplifications and exaggerations are almost inevitable when new approaches are being promoted in the international policy arena. Some are relatively harmless. Others, however, can be pernicious. The following misconceptions may help make the case for a more ecologically sensitive water management, but they are in danger of undermining serious attempts to address water-related health and welfare problems:

Misconceptions that have been maintained or promoted by the 'new' water paradigm:

1. **That the consumption of contaminated water accounts for a large share of the burden of disease in low-income settlements.**

Exaggerated and simplistic claims about the relationship between water and disease abound in the international literature on water management. It is not uncommon for

80% of disease in 'developing' countries to be ascribed to the consumption of contaminated water (Kjellén & McGranahan 1997). One of the few certainties in this highly inexact field is that such figures are grossly misleading. A more considered estimate of the share of the burden of disease attributable to poor water supply, sanitation and hygiene is 8% (Murray & Lopez 1996), of which only a small part is likely to be the result of the consumption of contaminated water. This 8% still represents an enormous burden, second only to malnutrition in a list of major risk factors, and more than twice the next in line.[1] But these water-related problems are closely bound up with poverty, and should not be taken to reflect the technical mismanagement of water resources. Moreover, while exaggerated and simplistic claims may once have been a means of promoting water projects, they have helped to stifle research and informed debate, and their exaggeration is no longer stimulating action.

2. That inadequate access to safe water in urban areas reflects water stress.

The literature on water stress often cites international statistics on water-related diseases and inadequate access to clean water as evidence that water stress is of critical concern to the poor. However, there is no discernible relationship between national indicators of water stress and national indicators of inadequate access to water in urban areas. Moreover, there is considerable case-specific evidence of cities with plentiful water resources where poor households do not have adequate access to affordable water, and cities with scarce water resources where poor households are comparatively well served. In short, there is no reason to treat current water-related health problems in urban areas as early symptoms of an emerging crisis of water scarcity.

3. That freeing up water through demand-side conservation provides more water to meet basic needs.

It is often assumed that water saved in one part of an urban water system will be transferred to meet the basic needs of deprived residents in another part of the city (or town). This is a more technical version of the view that inadequate access to safe water reflects city-wide water scarcity, and is equally misleading. First, even if demand management reduces supply problems within the piped water system, the households with the most serious water problems are typically unconnected, and getting them adequate water is likely to require infrastructural improvements. Second, the reason they are unconnected is likely to be because their needs are not economically or politically influential, and freeing up water within the piped water system is unlikely to change this. Third, if conservation is being promoted in response to water supply problems, then there are likely to be competing demands for the saved water, and quite possibly a need to reduce water withdrawals. In short, it is extremely unrealistic to assume that water saving measures will yield water for the currently deprived, unless this is made an explicit and effective part of a broader water strategy.

[1] While it is difficult to find the original source, the 80% probably derives from the fact that diarrhoea alone accounts for roughly 80% of disease 'episodes' – whereby an episode of diarrhoea receives the same weight as a fatal heart attack. By rephrasing this as the share of disease, assuming all diarrhoeal episodes involve water-borne diseases (typically defined as diseases that **can** be borne by water) and then reinterpreting this as being caused by the consumption of contaminated water, it is possible to arrive at the 80% figure. The 8% figure is based on a more systematic procedure, based on Disability Adjusted Life Years (DALY's), which attempts to adjust for the severity of different diseases (Murray & Lopez1996).

4. That until recently most urban dwellers and policy makers thought of water resources as unlimited and free.

Wasteful water use is often ascribed to low water prices, themselves grounded in a popular belief that water is a free good. This 'popular belief' is frequently portrayed as a holdover from times when water really was plentiful – a view no longer appropriate in these times of scarcity. But cities have been facing water supply problems for centuries, and the view that water is a free good is exceptional. When claims are made that water should be provided freely to all citizens (as in the South African Municipal Workers' Union slogan: "No to privatization! 50 litres of water per day per person free of charge!" (Bond 2000)), it is normally in a particular political context. More generally, it is important not to confuse the claim that people have a right to water with the view that they have the right to unlimited water, that water scarcity is not an issue, and that there is no opportunity cost associated with using water. There is undoubtedly a tension between the rights-based approach often adopted by those arguing for more equitable access to water, and the conservation-oriented approach often adopted by those arguing for more ecologically sustainable water use, but this tension is not eased by dismissing rights-based claims out of hand.

5. That water can and should be treated as a 'normal' commodity.

The claim that water is an economic good is frequently evoked, and has even been adopted as an international guiding principle for the water sector. Since economists do not recognise a category of 'non-economic' goods, the claim is not, strictly speaking, very controversial. It is often taken to imply, however, that water should be priced at its marginal cost, taking into account the value of water in alternative uses. In situations where inadequate water use is facilitating the spread of infectious diseases, however, water is not a 'normal' commodity in the sense assumed in arguments for marginal cost pricing. The healthy use of water reduces negative externalities.[2] Healthy use may not be achievable through price mechanisms alone, but pricing policy should ideally take health externalities (as well as equity, assuming that it is considered to be of value) into account. Moreover, even piped water poses numerous challenges for water pricing, and many of the more deprived households do not have piped water connections. The cost and difficulty of getting connected is often far more important to low-income households than the unit price of piped water. What happens to the water after it leaves the pipes can be equally more important. Problems have undoubtedly arisen due to economically misconceived water policies, but appropriate policies cannot simply be read out of introductory economics textbooks.

These misconceptions have not been universally adopted, even within the water crisis literature. However, the scientific principles being brought to bear on water management are increasingly those of ecology rather than public health. Willingness to pay, rather than needs or rights, is increasingly promoted as the appropriate basis for allocating water. Conservation rather than hygiene or the welfare of the users is increasingly presented as the principal goal of demand-side interventions. There is a distinct danger that rather than creating a more integrated form of water management, as most proponents hope, demand-side management will accentuate conflicts between ecological and human health and welfare goals. It is one thing to recognise that water

[2] Someone who protects themselves from infection by the healthy use of water is also preventing themselves from becoming infectious to others. In somewhat crude terms, an infectious person can be seen as creating externalities in much the same way as a polluting factory does – by contaminating the environment for others.

is often wasted even in poor areas (leakage in particular is often a serious problem). It is quite another to treat water resource abuse as the defining environmental problem in areas where water-related health problems are pervasive.

This paper makes the case for a form of demand-side water management that actively serves both conservation and environmental health/welfare goals, recognising that the relative importance of these different goals, and the appropriate strategies for pursuing them, is very context dependent.

The remainder of the paper is divided into four sections: a review of urban water and sustainable development issues (Section 2); a review of how demand-side management, broadly defined, has shifted historically (Section 3); a review of contemporary approaches to demand-side management and how they could be combined (Section 4).

Section 2 starts by reviewing both the water-related environmental health problems associated with urban poverty, and the water stress problems often associated with growth and excessive water withdrawals. For both environmental health and resource stress, the review attempts do away with some of the exaggeration and oversimplification, without denying the severity of the underlying problems.

The section then goes on to examine the relationship between these two sets of concerns. Water scarcity is found to be central to both environmental health and water stress. The local water scarcity that typically threatens environmental health has little to do with the regional water scarcity causing water stress, however. Rather, it is argued, local water scarcity typically reflects the failure of low-income residents to gain economic or political entitlements to water.

The final part of this section examines the potential role of markets, bureaucracies and community organisations in water provision and demand-side management in low-income settlements. Historically, there has been a tendency for all of these institutional forms to be idealised: much intellectual and even political effort has been expended in pursuit of the perfect market, perfect plan, or perfect community. In relation to demand-side water management, the more immediate question is how to make the best use of existing institutions. For this purpose, it more important to consider the relative strengths of the private, public and voluntary sectors, how they can be combined in particular contexts, and how all three can be made to help improve water provision in low-income areas and to protect water resources.

Section 3 starts with an overview of the shifting approaches to demand-side water improvements in Northern cities, from the sanitary reforms of the nineteenth century up to the present. Over this period, the emphasis shifted from (A) getting people to use more water so as to protect public health, to (B) getting people to use less water to protect public and environmental resources. The urban sanitary ‘revolution’ does not provide a suitable model for contemporary cities, however poor and unsanitary they may be. It was based on now obsolete science and nineteenth century Eurocentric politics. On the other hand, many of the problems that motivated the sanitary revolution are still prevalent in low-income cites, and it must be recognised that the shift in emphasis in the North was itself driven by politics and changing conditions, rather than advancements in science and improvements in governance.

This is followed by a very brief overview of recent developments in the water sector internationally. Some very significant changes have occurred since the International Water and Sanitation Decade (1980s) was initiated with the goal of providing universal coverage by 1990. This goal was still far from achieved in 1990. By 1992, however, when a set of influential principles were adopted at an international conference in Dublin, universal coverage no longer held pride of place. Instead, the principles focused on: (1) sustaining water resources; (2) involving all stakeholders in water planning; (3) recognising the role of women in water management; and (4) treating water as an economic good. These principles were seen as helping achieve universal coverage, at some indeterminate time in the future, but reflect the increasing prominence being given to water conservation, along with a shift away from central planning as the assumed means of improving water supplies.

The scene having been set, Section 4 proceeds to examine four different perspectives on demand management in turn. The conservationist perspective on demand management is examined first, followed by hygiene-oriented demand management. Both of these approaches tend to be technocratic, but pursue different goals. The next two are more institutional: the market economic perspective, wherein demand management is induced through appropriate pricing policies; and the community action perspective, wherein local residents work together both to improve their water supplies and to manage their demands.

Section 4 ends by comparing these different perspectives on demand-side management, and assessing the potential for combining them. Several caveats are noted. First it is important to recognise that water sector priorities and hence approaches to demand-side management need to be different in different cities. It is especially important not to let rich city preoccupations drive poor city agendas. Second, it is important to recognise that in many contexts demand-side management is inherently political, with losers as well as winners. Reducing conflicts and identifying efficient compromises between different demand-side goals is a laudable aim, but treating demand-side management as necessarily, or even ideally, a ‘win-win’ response to water problems is misguided. Nevertheless, it is argued that if demand-side management is to fulfil the role it has been assigned in many discussions of improving water management internationally, it must be redefined to encompass insights from all of these perspectives.

2. Urban Water Issues and Sustainable Development

The two main water-related challenges facing many of the world's urban centres are:

1. Inadequate local water and sanitation, especially in poor settlements;
2. Growing regional water scarcity, especially where freshwater resources per capita are low.

The 'world water crisis' literature often presents these challenges as two sides of the same coin. As water demand grows, water stress increases, and the poor find it more difficult to meet their water needs. Often, statistics on water stress (e.g. national estimates of freshwater resources per capita) are presented alongside international statistics on access to water (e.g. national estimates of the percentage of households with access to safe drinking water supplies) (Hinrichsen, Robey, & Upadhyay 1998). The implied conclusion is that water resources need to be better managed in order to avoid a crisis of global proportions, and thereby ensure that the poor can meet their basic water needs. Within this crisis narrative, demand management measures are often presented as means for ensuring that there is sufficient water for the most deprived groups.

At least in the urban context, however, the international statistics do not support this account. No positive association is evident between the national estimates of freshwater availability per capita and those of urban household access to adequate water supplies (even after excluding affluent countries and taking account of variations in per capita income). Indeed, a preliminary analysis presented below finds a slight, but statistically significant, negative association. This could be the result of faulty data or some inadequacy in the statistical specification. But given that these same data are often presented as evidence of the severity of the crisis, and very little other evidence on the relationship between water stress and health-related water problems has been systematically assessed, a serious reconsideration of the crisis narrative is warranted. It is especially important in light of the increasing share of the world's population, including the poor, living in urban areas. We are looking to a future where not only is water scarcer, but the vulnerable groups will be increasingly urban.

Poverty, inadequate urban water provision and health

Water provision remains abysmal in many poor urban neighbourhoods in the South (Hardoy, Mitlin, & Satterthwaite 2001). Water sources are often distant, polluted or intermittent. The burden falls especially heavily on women (who typically end up doing most of the water collection) and children (who typically suffer most from the diseases associated with inadequate water supplies).[3] To add insult to injury, while low-income dwellers often pay high prices for small containers of potable water, wealthier households nearby often have piped connections providing subsidised water (Briscoe & Garn 1995).

[3] This pattern is common to a number of household environmental burdens, though the particularly high health burden among children is pronounced in the case of fecal-oral and respiratory infections, and is closely linked to susceptibility (McGranahan, Jacobi, Songsore, Surjadi, & Kjellén 2001).

It is frequently noted that urban areas are, on average, better served than rural areas. In the latest WHO/UNICEF assessment of water and sanitation (WHO/UNICEF 2000), it was estimated that 94% of urban dwellers globally had some form of improved water supplies, as compared to only 71% of rural dwellers. But largely as a result of continuing urbanisation, this still implies 173 million urban dwellers without improved supplies, up from 113 million in 1990 (the number of rural dwellers without improved supplies, by way of contrast, fell from 1,013 million to 926 million). Almost 100 million of the urban dwellers estimated to be without improved supplies live in Asia, with a further 44 million in Africa and 29 million in Latin America and the Caribbean.

Urban dwellers without improved supplies are unlikely to be consoled by the knowledge that other urban centres and neighbourhoods fared better. Moreover, it is doubtful whether such statistics really capture the deficiencies in urban water supply. City studies often show far less satisfactory water supplies than official statistics imply (Hardoy, Mitlin, & Satterthwaite 2001). Water pipes may be present, but not functioning. Communal taps may be nearby, but with long queues. Improved supplies may still deliver highly contaminated water. And the alternatives to an improved supply vary considerably.

Detailed longitudinal studies of changing levels of provision are almost non-existent, but one recently completed study provides some relevant insights. A seminal study entitled Drawers of Water provided a telling account of the multiplicity of water-related problems faced by low income residents in 34 urban and rural sites in Kenya, Tanzania and Uganda in the late 1960s (White, Bradley, & White 1972). When researchers resurveyed the same sites some 30 years later, it was found that the share of urban households with piped water had increased from 56 to 60% (Thompson et al. 2000). However, the quality of the piped system had declined considerably, and the per capita water use of piped households had fallen by almost 50%. The results demonstrate that a simple division between the served and the unserved fails to capture the nature of the problems many poor households face. Moreover, given the increasingly run-down infrastructure in many countries, it almost certainly exaggerates the progress of recent decades.

While ill health is only one of the burdens of inadequate access to water, health statistics hold pride of place in attempts to illustrate the importance of water. Indeed, the disease burden of inadequate water is often exaggerated in an attempt to shock. As indicated in the Introduction, for example, it is frequently claimed that 80% of disease in developing countries is the result of drinking contaminated water (Kjellén & McGranahan 1997). Table 2.1 provides several versions of this 80% figure being cited. They are doubly misleading. Even for all water related diseases combined, 80% is a gross distortion of existing statistics. Moreover, contaminated drinking water is only one of many possible causes of water-related diseases.

Table 2.1: Misleading waterlines

"It has been estimated that as many as 80 percent of all diseases in the world are associated with unsafe water" *(Hofkes, E. H., (ed.) 1983. Small Community Water Supplies: Technology of Small Water Supply Systems in Developing Countries, p. 9)*
"Clean drinking water is essential for our health: according to the World Health Organisation 80% of all diseases are caused by polluted water" *(Van der Veken, M. and Hernandez, I. 1988. Women, Technology and Development, p. 11)*
"An estimated 80 per cent of all diseases and over one third of deaths in developing countries are caused by the consumption of contaminated water…" *(UNCED 1992, Agenda 21, paragraph 18.47)*
"Eighty percent of all disease in developing countries is spread by consuming unsafe water" *(Platt, A. E. 1996. Infecting Ourselves: How Environmental and Social Disruptions Trigger Disease (Worldwatch Paper 129), p. 42)*
"Let us not forget that about 80 percent of all diseases, and more than one third of all deaths in developing countries are caused by contaminated water" *(UNEP, News Release, World Water Day, 22 March 1996)*

Source: (Kjellén & McGranahan 1997)

World Health Organization estimates of mortality and morbidity from water-related diseases are summarised in Table 2.2, and are still shocking. They amount to over five million deaths a year, and over three billion episodes or cases of disease. In the 1990s, partly in response to claims that individual disease statistics were themselves exaggerated, a concerted effort was made to develop a coherent set of statistics on the burden of all diseases (Murray & Lopez 1996). The resulting mortality and morbidity estimates were somewhat lower than those provided in Table 2.2: some three million deaths ascribed to diarrhoeal diseases and one million to malaria, for example. Nevertheless, diarrhoea and malaria alone were still estimated to account for 7% and 2% respectively of the overall burden of disease in 1990.[4] Moreover, these burdens are concentrated in the poorer parts of the world. In Sub-Saharan Africa, for example, the percentages rise to 11% and 9%.

[4] These estimates are based on "Disability Adjusted Life Years", a combined measure of mortality and morbidity burdens.

Table 2.2: Estimates of Morbidity and Mortality of Water-related Diseases

Disease	Morbidity (episodes/year, or as noted)	Mortality (deaths/year)	Relationship of Disease to Water Supply and Sanitation
Diarrhoeal diseases	1,000,000,000	3,300,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Infection with intestinal helminths	[1]1,500,000,000	100,000	Strongly related to unsanitary excreta disposal, poor personal and domestic hygiene
Schistosomiasis	[1]200,000,000	200,000	Strongly related to unsanitary excreta disposal and absence of nearby sources of safe water
Dracunculiasis	100,000	-	Strongly related to unsafe drinking water
Trachoma	[3]150,000,000	-	Strongly related to lack of face washing, often due to absence of nearby sources of safe water
Malaria	400,000,000	1,500,000	Related to poor water management, water storage, operation of water points and drainage
Dengue Fever	1,750,000	20,000	Related to poor solid wastes management, water storage, operation of water points and drainage
Poliomyelitis	114,000	-	Related to unsanitary excreta disposal, poor personal and domestic hygiene, unsafe drinking water
Trypanosomiasis	275,000	130,000	Related to the absence of nearby sources of safe water
Bancroftian filariasis	[1]72,800,000	-	Related to poor water management, water storage, operation of water points and drainage
Onchocerciasis	[1,4]17,700,000	[5]40,000	Related to poor water management in large-scale projects

[1] People currently infected.
[2] Excluding Sudan.
[3] Case of the active disease. Approximately 5,900,000 cases of blindness or severe complications of Trachoma occur annually.
[4] Includes an estimated 270,000 blind.
[5] Mortality caused by blindness.
Source: World Health Organization, 1996. Fact Sheet Number 112, http://www.who.int/inf-fs/en/fact112.html, accessed on May 28, 2002.

Such estimates may seem small in comparison with the '80% of diseases in developing countries' frequently cited, but are enormous when contrasted with many well known health hazards. Moreover, they are not only concentrated in low-income countries, but are further concentrated with the poorest groups within those countries. There is no need to exaggerate to make a strong case for water and health issues in poor settings.

Clearly, water-related problems are critical to health. What is less clear is *how* they relate to health. Here there are more fundamental uncertainties and complexities. The diseases listed in Table 2.2 relate to water in many different ways. More important, the water-related changes needed to combat them vary. The extent of this variation is somewhat hidden by references to unsafe disposal of excreta, poor personal and

domestic hygiene, unsafe water and the like. It is clear, however, that many of these diseases are only very indirectly related to the use of water for domestic purposes, let alone the ingestion of contaminated water.[5]

Even for diarrhoeal diseases, contaminated water is typically only one of many (faecal-oral) transmission routes. A wide range of pathogens, including various bacteria and viruses, can cause diarrhoea. Diarrhoeal diseases are often classified as water-borne, because most of these pathogens can be transmitted through drinking water. The term 'water-borne' is misleading, however, inasmuch as it can seem to imply that these diseases are always (or at least mostly) transmitted in water. Almost all diseases that can be acquired by drinking contaminated water can also be acquired by eating contaminated food, through personal contact with infected people, and through direct exposure to faecal material (Cairncross & Feachem 1993). As such, a lack of water for washing, poor food and personal hygiene practices and inadequate sanitation can also facilitate their spread. The favoured routes vary depending on the nature of the pathogen (e.g. the infective dose, the existence of non-human hosts, the latency period, and the ability of the pathogen to persist and multiply outside of a host), and of course on local conditions. There is no reason to believe that the majority of cases of diarrhoea are contracted through drinking contaminated water.

For most other water-related diseases the links to drinking water are even more tenuous. The *Anopheles* mosquito species that spread malaria generally breed in open bodies of clean water, although the favoured breeding sites depend on the particular *Anopheles* species present in the region (Lane & Crosskey 1993)). In some parts of the world there are malarial mosquito species that have been found to breed in wells and water containers (e.g. *Anopheles stephensi* in India), or even in salt water. For the most part, however, while people may be attracted to malarial areas because of the proximity of water, in any given location the prevalence of malaria has little or nothing to do with the quality of household water supplies.

The *Aedes* mosquito species that spread dengue fever are often particularly well adapted to breeding in small water containers (Lane & Crosskey 1993). As such, they are more likely to find breeding sites in households with an irregular or distant water supply (i.e. households more likely to have water containers). Partly as a result, dengue is well suited to urban areas, particularly where the water system is inadequate. Again, however, the quality of the drinking water is largely irrelevant.

Trachoma is associated with insufficient face washing, and depends more on having access to water than on the quality of that water (Cairncross & Feachem 1993). The eggs of intestinal worms (Helminths) are generally excreted in faeces, and can be transported in water, but the parasites more typically enter the body in food than in water, and the hookworm enters directly through the skin of the foot. Schistosomes (the flatworms causing Schistosomiasis or what is sometimes called bilharzia) enter the body through contact with infested surface water, mainly among people engaged in agriculture, including in peri-urban areas. Schistosomiasis may be contracted while collecting drinking water, but not from ingesting it.

[5] Many of these diseases are also better suited to rural than to urban environments. Indeed, urban water pollution and the destruction of natural water bodies can actually reduce some water-related diseases. Since malarial mosquitoes generally prefer clean water, for example, urban water pollution may have helped to eliminate malaria from some cities.

A disproportionate share the health burden of water-related diseases, and especially diarrhoeal diseases, falls on infants and young children. The 'Global Burden of Disease' estimates suggest that about 86% of the burden of diarrhoeal diseases is accounted for by children under the age of five, with boys somewhat more at risk than girls. Children living in deprived urban neighbourhoods are highly exposed to infection, at least in part because of inadequate water supplies. They are also especially vulnerable. Young children have not built up resistance. Malnourished children are particularly susceptible to infection, and risk greater illness when they do become infected. Moreover, they are likely to be at risk of infection not only within their home, but from their close contact with other children minding or playing with them, and from the water, sanitation and hygiene deficiencies of the neighbourhood at large.

A disproportionate share of the labour burden of household and neighbourhood water inadequacies, on the other hand, falls on women (McGranahan et al. 2001). It is typically women who collect water from public standpipes, often queuing for long periods in the process. It is typically women who must try to use the, often inadequate, water supplies to clean the home, prepare the food, and provide the various other water services. It is also women who typically care for the children, both when they are well and when they are ill. It is important not to underestimate this side of the water burden. There are no compelling international statistics, comparable to the health statistics, documenting the labour burdens of inadequate water. There are many local studies, however, that illustrate how difficult it is to cope without adequate water, and with the threat of illness and all of the problems that brings.

Excessive water consumption and water stress

It has become common to refer to an emerging freshwater crisis of global proportions, likely to be made worse by increasing consumption on the one hand and global warming on the other. Urban water issues are increasingly being framed in this context. Moreover, international statistics on inadequate access to water and water related diseases are frequently presented alongside international estimates of water stress, implying that the current inadequacies are symptomatic of the emerging global water crisis. Before examining whether the growing stress on natural water systems might account for current inadequacies in urban water provision, it is worth reviewing how water stress is defined and measured in the crisis literature.

Much of the literature on the global water crisis is, in effect, a call to action. At its simplest, the message is that the world is running out of water, and must change its ways:

> "As populations grow and water use per person rises, demand for freshwater is soaring. Yet the supply of freshwater is finite and threatened by pollution. To avoid a crisis, many countries must conserve water, pollute less, manage supply and demand, and slow population growth." (Hinrichsen, Robey, & Upadhyay 1998)

> "Around the world, there are now numerous signs that human water use exceeds sustainable levels. Groundwater depletion, low or nonexistent river flows, and worsening pollution levels are among the more obvious indicators of water stress… Satisfying the increased demands for food,

> water, and material goods of a growing global population while at the same time protecting the ecological services provided by natural water ecosystems requires new approaches to using and managing fresh water."
> (Postel 2000)

> "[M]any countries, especially developing and newly industrialized regions in the Middle East, Africa, Asia and South America will be vulnerable to lack of water… [T]his will affect health, mortality and the prospects for peace if nothing is done to correct the imbalance between supply and demand… [S]carcity is largely the result of poor water management and… with the implementation of proven methods of raising the efficiency of water withdrawal, use and consumption on the one hand, and of more efficient and integrated water supply on the other, the problem could be solved."
> (Stikker 1998)

The problems of cities, and especially megacities, are sometimes presented in even more strident terms, as in the following example:

> "Megacities, i.e. cities with more than ten million residents are growing fast… Water-related problems in these cities are already enormous, and further degradation is expected. Water shortage is a growing problem and delivery of safe drinking water cannot be assured… Solution of this megaproblem of megacities requires efficient regulations and actions to stop further population growth and, in the water sector, to develop novel environmentally friendly and economically efficient methods of water conservation and treatment…. Technological change must be accompanied by basic changes in all sectors, social and central structures, educational and research programs, and in lifestyle."
> (Niemczynowicz 1996)

Numerous projections have been made of global water availability and use, often by region (Gleick 2000b). There is considerable debate about data, definitions and techniques. The analysis is inevitably somewhat confounded by the fact that water is not so much 'used up' as diverted or transformed, making it at least temporarily less useful, and having ecological consequences. Nevertheless, whatever techniques and definitions are applied, the central message is almost invariably that water problems are already serious in many parts of the world, and that unless people change their ways, they are going to get worse. What varies is when and where these problems are anticipated.

The models (and arguments) used to predict large scale water deficiencies typically rely on some form of supply-demand balancing, with sustainable supplies compared to demands[6], and problems are assumed to become increasingly severe as demand approaches or surpasses the available supply. Since water problems do undoubtedly exist in many parts of the world, and since water consumption is estimated to have

[6] Demand is being used here in a very loose sense. In more rigorous analysis, water withdrawal, use, demand and consumption are often defined differently, as are water scarcity and water stress (which itself is measured in a variety of different ways).

increased by a factor of six over the course of the twentieth century, it is hardly surprising that such models predict serious problems.

One of the most common indicators of national water stress is the Falkenmark indicator – renewable water resources per capita per year – named after the Swedish water researcher Malin Falkenmark (Falkenmark, Lundqvist, & Widstrand 1989). When this indicator is applied, a value of less than 1,700 cubic meters per capita per year is taken to indicate water stress, and a value of less than 1,000 cubic meters per capita is taken to indicate severe water stress (or water scarcity). From a supply-demand balancing perspective, this indicator assumes that demand is directly proportional to population.

The Falkenmark indicator lends itself to population-based projections. The authors of a report published by the Population Information Program of the Johns Hopkins School of Public Health used estimates of national freshwater availability and United Nations population projections to estimate the population living in countries with less water than the Falkenmark threshold in 1995 and 2025 (Hinrichsen, Robey, & Upadhyay 1998). The results indicate that about 460 million people lived in water stressed (or water scarce) countries in 1995, and that the number would be expected to reach about 2.8 billion – about 35% of the world's population – by 2025. Table 2.3 summarises the results for all countries projected to be facing water stress by 2025. Having presented these projections, the report proceeds to summarise the 'health dimension', by giving details on morbidity and mortality from all water related diseases.

Table 2.3: Growing Water Shortages

Population Size and Growth and Renewable Freshwater Availability in Water-Short Countries, 1995 and 2025

Country	*Population 1995 (millions)*	*Water Per Capita 1995[a]*	*Population 2025 (millions)*	*Water Per Capita 2025[a]*	*TFR 1998*	*% Growth Rate 1998*
Water Scarcity in 1995 and/or 2025						
Algeria	28.1	**527**	47.3	**313**	4.4	2.4
Bahrain	0.6	**161**	0.9	**104**	3.2	2.0
Barbados	0.3	**192**	0.3	**169**	1.7	0.5
Burundi	6.1	**594**	12.3	**292**	6.6	2.5
Cape Verde	0.4	**777**	0.7	**442**	5.3	2.9
Comoros	0.6	*1,667*	1.3	**760**	5.1	2.7
Cyprus	0.7	*1,208*	1.0	**947**	2.1	0.7
Egypt	62.1	**936**	95.8	**607**	3.6	2.2
Ethiopia	56.4	1,950	136.3	**807**	7.0	2.5
Haiti	7.1	*1,544*	12.5	**879**	4.8	2.1
Iran	68.4	1,719	128.3	**916**	3.0	1.8
Israel	5.5	**389**	8.0	**270**	2.9	1.5
Jordan	5.4	**318**	11.9	**144**	4.4	2.5
Kenya	27.2	*1,112*	50.2	**602**	4.5	2.0
Kuwait	1.7	**95**	2.9	**55**	3.2	2.3
Libya	5.4	**111**	12.9	**47**	6.3	3.7

Malawi	9.7	1,933	20.4	**917**	5.9	1.7
Malta	0.4	**82**	0.4	**71**	2.1	0.6
Morocco	26.5	*1,131*	39.9	**751**	3.3	1.8
Oman	2.2	**874**	6.5	**295**	7.1	3.9
Qatar	0.5	**91**	0.8	**64**	4.1	1.7
Rwanda	5.2	*1,215*	13.0	**485**	6.0	2.1
Saudi Arabia	18.3	**249**	42.4	**107**	6.4	3.1
Singapore	3.3	**180**	4.2	**142**	1.7	1.1
Somalia	9.5	*1,422*	23.7	**570**	7.0	3.2
South Africa	41.5	*1,206*	71.6	**698**	3.3	1.6
Tunisia	9.0	**434**	13.5	**288**	3.2	1.9
United Arab Emirates	2.2	**902**	3.3	**604**	4.9	2.2
Yemen	15.0	**346**	39.6	**131**	7.3	3.3
Water Stress in 1995 and/or 2025						
Afghanistan	19.7	2,543	45.3	*1,105*	6.1	2.5
Belgium	10.1	*1,234*	10.3	*1,217*	1.6	0.1
Burkina Faso	10.5	2,672	23.5	*1,194*	6.9	2.9
Eritrea	3.2	2,775	6.5	*1,353*	6.1	3.0
Ghana	17.3	3,068	36.3	*1,464*	5.5	2.9
India	929.0	2,244	1,330.2	*1,567*	3.4	1.9
Lebanon	3.0	1,854	4.4	*1,261*	2.3	1.6
Lesotho	2.0	2,565	4.0	*1,290*	4.3	2.1
Mauritius	1.1	1,970	1.5	*1,485*	2.0	1.0
Niger	9.2	3,552	22.4	*1,452*	7.4	3.4
Nigeria	111.7	2,506	238.4	*1,175*	6.5	3.0
Peru	23.5	*1,700*	35.5	*1,126*	3.5	2.2
Poland	38.6	*1,458*	40.0	*1,406*	1.6	0.1
South Korea	44.9	*1,472*	52.5	*1,258*	1.7	1.0
Tanzania	30.7	2,964	62.4	*1,425*	5.7	2.5
Togo	4.1	2,938	8.8	*1,370*	6.8	3.6
Uganda	19.7	3,352	45.0	*1,467*	6.9	2.7
United Kingdom	58.1	*1,222*	59.5	*1,193*	1.7	0.2
Zimbabwe	11.2	1,787	19.3	*1,034*	4.4	1.5

Water-stressed countries are those with annual water resources of between 1,000 and 1,700 cubic meters per person, shown in italic. Countries suffering from water scarcity are those with annual supplies of less than 1,000 cubic meters per person, shown in ***bold type.***
TFR = Total Fertility Rate
[a]In cubic meters per year

Source: Hinrichsen, D., Robey, B., and Upadhyay, U.D. 1997. *Solutions for a Water-Short World.* ***Population Reports***, Series M, No. 14. Baltimore, Johns Hopkins School of Public Health, Population Information Program. They based the first four columns on: Gardner-Outlaw, T. and Engelman, R. *Sustaining water, easing scarcity: A second update,* Washington, D.C., Population Action International, 1997 (69).

At their best, such simple projections can help draw attention to certain types of water issues, provide heuristic tools through which these issues can be better understood, and create a useful framework within which to situate more detailed understandings of specific problems in particular places. At their worst, however, like oversimplified accounts of the relationship between water and disease, they create misunderstandings about the actual nature of water issues, and support misguided actions. Unfortunately, they also tend to attract a disproportionate share of the attention. More sophisticated and qualified attempts to explore global water futures find it difficult to compete in the public arena. Malin Falkenmark herself has recognised that while a simple message may be required to reach a large audience, there is a danger in the sort of water reductionism behind such projections (Falkenmark 1997).

Nobody claims that the Falkenmark indicator is precise. The quantity of renewable water resources is a crude indicator of water availability and the number of people is a crude indicator of the demands placed on those resources. Equally important, as the very term 'water stress' implies, water resource problems have a number of dimensions. These cannot accurately be collapsed into single measures or indicators. Moreover, problems can arise as the result of changes in the water system that do not have a clear impact on overall water quality or quantity; diverting a river's course can have major ecological impacts without reducing water quantity or quality in any straightforward sense.

When applying the Falkenmark indicator at a national level, some of the more obvious inadequacies include:

Local variation and boundary problems: National boundaries often cut across a number of drainage basins, making it difficult to assign renewable water resources unambiguously to individual countries. Perhaps more important, problems of water stress can vary enormously within a country, with different problems arising at different scales, and often extending unevenly over space. From an urban perspective, the scale issues are particularly acute, since cities concentrate certain water-related pressures and demands, accessible supplies depend heavily on location, and radically different levels of water stress are often evident in different cities within a single country. Alternatively, cities and even countries can import water intensive products, displacing some of their water demands beyond their boundaries.

Temporal variation and seasonal problems: Variations in water availability across seasons and years can be critical to water stress, so averages can be deceiving – a lack of water in one season is hardly compensated by floods in another. Seasonal variations tend to be greater in tropical countries, and some parts of the world are more prone to long-term variations. Anthropogenic climate change may also shift the patterns of water stress appreciably.

Adaptability and comparability problems: To some degree, both ecosystems and human systems can adapt to as well as alter the prevailing water regime, but adaptation requires time as well as capacity. Where water availability has been high historically, a decline to a lower level can lead to considerably more water problems than where water availability has historically been at that lower level. Thus, if Tanzania were to face a 50% decline in all of its renewable water resources, the effects would undoubtedly be devastating, although it would still have more renewable water resources available per capita than Morocco.

Accessibility and economic capacity problems: There can be a great deal of variation in how accessible a countries renewable water resources are, and what level of investment can be made to achieve better access. Thus a poor country, or one with comparatively inaccessible water resources, is likely to face more severe problems than a wealthy country with accessible water resources, even if according to the Falkenmark index their water stress levels are the same. A poor country is also likely to face greater problems adapting to changes in water availability, although this relationship is less straightforward.

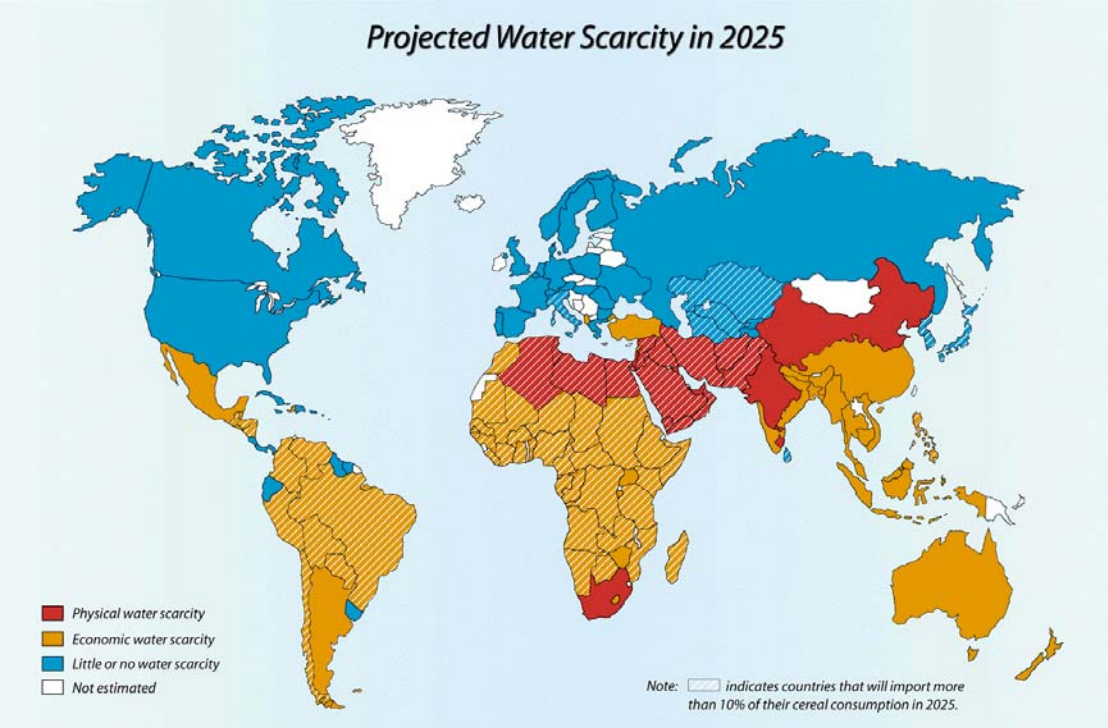
Unaccounted for water: Estimates of freshwater availability include neither stocks of water, nor what has come to be termed 'green water': the share of rainfall that is stored in the soil and eventually evaporates from it. Such water resources can make a large difference to the water resource problems a country faces.

Several more recent indicators of water stress attempt to correct at least some of these problems, though not altogether successfully. Indeed, what is striking is that different attempts to improve upon the Falkenmark indicator have very different consequences for where water stress is identified. Two variants are described in the following paragraphs, the first of which tends to identify more water stress in affluent countries (where water withdrawals are high), and the second of which tends to identify more water stress in poor countries (where the economic capacity to access more water is lacking, and population is growing quickly).

The WaterGAP model employed in the Water Visions exercise, employs what is termed the 'criticality ratio': withdrawals for human use divided by renewable water resources (Hinrichsen, Robey, & Upadhyay 1998). This indicator is sensitive to variations in water use per capita (though it does not distinguish between usage that prevents re-use and that which does not). It also applies this indicator to basins rather than countries, avoiding at least some of the boundary problems that arise with national indicators. The results indicate high water stress in areas with high withdrawals, including large parts of the United States and other affluent countries not identified as water stressed by the Falkenmark indicator. Not surprisingly, the 'business as usual' scenario indicates increasing water stress, and is used to argue for radical changes in water management.

Taking a somewhat different route, researchers at the International Water Management Institute project water demands forward to the year 2025, and then attempt to identify both absolute (or physical) and economic water scarcity (Seckler, Barker, & Amarasinghe 1999). A country is assumed to face an absolute water scarcity if projected demand exceeds renewable fresh water availability, while a country is assumed to face economic water scarcity if the estimated increases in water withdrawals required to meet projected demands are deemed to require economically excessive investments. As indicated in Figure 2.1 this procedure assigns economic water scarcity to most low income countries, but leaves North America, Europe and Japan with little or no water scarcity.

Figure 2.1: Projected Water Scarcity in 2025



Source: International Water Management Institute, 2001 Web Page, accessed on May 28 2002 at http://www.cgiar.org/iwmi/home/wsmap.htm#A1.

These adapted indicators, projections and scenarios still contain numerous crude assumptions. At the global level they are informative, provided the user and audience understand at least roughly what they are based upon. Unfortunately, in order to create a simple and powerful message, it is all too tempting to ignore uncertainties in the projections and complexities in actual and emerging water problems, and use the results to promote a narrative in which the increasing scarcity of water resources is **the** driving force.

There is a striking similarity between attempts to exaggerate the importance of growing water resource scarcity for human health and welfare and the attempts to exaggerate the importance of water contamination for human health described in the previous section. In both cases, an important problem is exaggerated in an attempt to attract attention. In both cases, this is done in such a way as to risk misrepresenting the nature of the water-related problems faced by the poor, and implying without much evidence that the poor will be major beneficiaries of measures to address water quality problems on the one hand, and water stress problems on the other.

No serious studies of water stress have tried to demonstrate that the water-related health problems faced by either the urban and rural poor are the outcome of water stress. Many do not even attempt to relate water stress to water related diseases. Nevertheless, this message is implicit, and often explicit, in the summaries that appear in the popular press and in many policy documents. It is, therefore, well worth examining the relationship between water stress and household access to water in more detail.

What does inadequate household water provision have to do with water stress?[7]

This section employs an analysis of internationally published data to explore the relationship between national freshwater availability per capita (a rough indicator of water stress) and the national share of urban and rural households with access to safe water (a rough indicator of water-related health problems). Past studies suggest that access to safe water increases with rising per capita income (Shafik 1995; Torras 1998). The hypothesis implicit (and sometimes explicit) in the global water crisis literature is that access to safe water declines with rising water stress.

The data used in this analysis are all taken from the World Bank's world development indicators (World Bank 2000). The data on national freshwater resources are based on estimates of total renewable resources, including the flows of rivers and groundwater from rainfall in the country, and river flows from other countries. These are divided by national population figures to get freshwater resources per capita. Percentage access to safe water is based on government provided estimates of the share of households with reasonable access to an adequate amount of safe water in a dwelling or within a convenient distance of their dwelling. It is available for both urban and rural areas. Per capita income refers to the country's Gross Domestic Product divided by its population.

Two ordinary least square regressions were undertaken (Mahmud 2001), with the percentage of rural households having access to safe water (% Access) as dependent variable in one regression and the percentage of urban households having access to safe water in the other. In both cases the independent variables were: the log of per capita income (PCI) and the log of fresh water resources per capita (WPC). The sample consists of 77(79) low and middle income countries in both cases, urban and rural.

The two equations can be represented as:

Urban: $\%\ \text{Access} = \alpha_0 + \alpha_1\ \text{PCI} + \alpha_2\ \text{WPC}$ (1)

Rural: $\%\ \text{Access} = \beta_0 + \beta_1\ \text{PCI} + \beta_2\ \text{WPC}$ (2)

The results of the regression analysis are as follows:

Urban (77 countries)

% Access = -6.6 + 0.672 PCI – 0.145WPC

(-0.40) (8.176) (-1.768)

Adjusted $R^2 = 0.48$

Rural (79 countries)

% Access = - 41.1 + 0.634 PCI + -0.21 WPC

(-1.18) (7.43) (-2.5)

Adjusted $R^2 = 0.44$

The results suggest that the variation in the independent variables explains somewhat less than half of the variation in Access in both cases: a reasonable result. The intercepts are negative but insignificant. The income coefficients are significant and

[7] This section is based on a paper by Minhaj Mahmud, based on work he carried out in 2000 as an intern at IIED.

have the expected signs in both cases. However, the coefficients on fresh water per capita both have negative signs, implying that the more fresh water resources per capita, the smaller the share of households with access to water. The coefficient is less significant (8% level) in the urban regression than the rural regression (1% level). In both cases, however, it is possible to reject with over 90% confidence the hypothesis that declining freshwater resources per capita are associated with declining household access to safe water. Several variations were attempted (e.g. eliminating outliers and assuming different functional forms), but in all cases the coefficients on water availability remained negative.

The data on access to safe water may have a built in bias that accounts for the finding that a greater availability of water resources per capita is associated with reduced access to safe water. Water is often defined as 'safe' if it comes from 'protected' source (at a 'convenient' distance). In countries where water is more plentiful, households may be more likely to rely on 'unprotected' sources (e.g. surface water), as these are more readily available. If unprotected sources truly are unsafe, this could create a situation where more plentiful supplies are associated with less safe household water supplies. Alternatively, however, not having access to a 'protected' source would be expected to impose more of a health and welfare burden where water resources are scarce. Labeling unprotected sources as unsafe, and protected sources as safe, could lead to a relative underestimate of the share of households without access to safe water in water-scarce countries. This underestimate might be expected to be more appreciable in rural than in urban areas, although to the extent that urban shallow well use is considered 'unsafe' the same bias could easily occur in the urban statistics. Since the underlying statistics are based on government estimates, without any clear indication of their source in individual countries, it is not possible to state with confidence whether the statistics are biased in this manner.

Nevertheless, these results are difficult to reconcile with the view that the increasing scarcity of freshwater resources leads to more difficult access to water at the household level. At the very least, it is highly misleading to present statistics on household access to water alongside statistics on water stress, as though their relationship were self-evident. And it is equally misleading to present the water related health problems of the urban poor as justification for prioritising the emerging issues of water stress within water sector planning. In the long run, water stress may aggravate water-related health problems, particularly among low-income groups. But reducing water stress is not going to solve their water problems.

Both inadequate water provision in poor neighbourhoods and water stress in urban regions are often critical problems demanding urgent attention. In principle, they could be addressed in tandem, with measures to reduce water stress also being used to secure better access to water for low income households. If water stress is not the cause of inadequate water access, however, this complementarity will not be achieved automatically or without conflicts of interest. Water freed up by demand management is likely to be used by consumers who already have piped water connections, and will not flow to those without such connections unless the reasons for their deprivation are addressed directly.

Up to this point, the discussion has centred on the physical dimensions of water stress and access. Any attempt to address these problems, however, must also come to terms with the political, economic and institutional aspects of water use and distribution.

Indeed, if water stress cannot explain why so many urban households lack access to water, then the obvious explanation is that the human-made water supply and distribution systems are not responding to their needs.

To at least some degree deprived households fail to meet their water requirements for the same reason that they fail to fulfil many other basic needs: they are poor, and lack the necessary economic resources. This would account for the positive relationship between per capita income and access to water noted above. Indeed, despite the enormous burdens imposed by inadequate access to water, it is important to ask whether the water problems that so often plague poor urban householders simply reflect their economic poverty? If their lack of water and their water-related health problems is the result of the same underlying causes that explain their lack of food and other basic needs, there is no reason to define the problem as a water sector issue, or to expect to find the solution in better water management.

Poverty alone does not, however, explain the lack of any evident relationship between freshwater scarcity and water access. Indeed, if the institutions between supply and demand were efficiently meeting households' water demands, then freshwater scarcity as well as poverty (or income per capita) would be expected to influence water access. While the lack of a relationship undermines the conventional case made for why we should be concerned with freshwater scarcity, it is entirely consistent with the view that human-made water systems do not respond efficiently to water scarcity.

More important to the topic of this paper, there are good reasons to believe that water is often less accessible to the urban poor than their economic poverty alone would dictate. In many cities, a large share of the urban poor live on land of disputed ownership, where private as well as public utilities are hesitant about investing in piped systems (Lyonnaise des Eaux 1998). Even where land ownership is not disputed, financially strained water utilities often fail to provide sufficient connections to meet demand, and it is typically low income neighbourhoods that are connected last, even if the residents would be willing to pay the full cost (Serageldin 1994). Alternatively, low-income residents may be willing to pay for the piped water, but unable to afford connection costs that require large lump sum payments (Johnstone & Wood 2001). Moreover, to the extent that water provides public goods to local residents (e.g. a lower likelihood of contracting infectious diseases from neighbours), one would not expect the amount residents would be willing to pay individually to reflect the full benefits of improved water provision.

Much depends upon the specifics of local urban water politics and institutions, which can vary enormously between different cities and countries. These politics and institutions are likely to be influenced by the overall quality of governance in a country. Indeed, a lack of democracy has been identified as a significant explanatory factor in regressions of household water access (Deacon 1999). It is notable, however, that in recent decades much of the debate on water sector institutions has centred on the appropriate roles of government, private companies and civil society organisations (Johnstone & Wood 2001). Often, it is at least implied that it is how these roles are assigned that determines how widely and how well water is made available.

The institutional context and the role of the public sector, private sector, and civil society

An important conclusion from the preceding analysis is that addressing problems of water stress will not necessarily improve matters for urban households lacking adequate water supplies. Amartya Sen, in his path-breaking analysis of famines, came up with a somewhat analogous conclusion in relation to starvation and food deficits (Sen 1982): aggregate supply is a poor indicator of individual access, particularly in times of crisis. It would seem that just as famines are not simply the effects of food deficits so urban water deprivations are not simply the effect of water deficits. Moreover, just as increasing food supplies will not necessarily address famines, so demand-side management, if it merely serves to free-up water, will not address urban water deprivation.

The framework that Sen developed for understanding famines built on the concept of 'entitlements', and an understanding of people's capacities and the institutions (including but not limited to markets) through which they obtain food. While dynamics of water deprivation in urban areas are very different from those of famines, there is a similar need to address the issue of entitlements, capacities and the different institutional forms through which entitlements can be achieved.

Under most functional water regimes, one would expect water scarcity to make it more costly to extend supplies, and hence to reduce coverage for households lacking secure entitlements to water (whether because the households or neighbourhoods lack the income, the political influence or the organisational capacity to access water). This ought to apply whether water is distributed through private enterprises, public utilities, or the initiatives of individuals and civil society groups.

Clearly a great deal does depend, however, on the nature of the institutions mediating water supply and demand. There have been long-running debates over the relative merits of public versus private water provision, as well as more recent discussions on the role of civil society organisations, such as Non-Governmental Organisations (NGOs) and Community Based Organisations (CBOs). In practice, water provision depends heavily on the particular forms of the local institutions, how they combine, and how they relate to the broader political economy. It is nevertheless useful to consider some of the more idealised versions of how private, public and civil society organisations ought to function, and in some accounts combine. Demand-side management is not associated with one or other of these idealised organisational forms. However, not only does the institutional context affect the opportunities for demand-side management, but also proponents of different organisational forms tend to advocate different types of demand-side management.

Table 2.4 summarises the three approaches to water provision built around three different mechanisms of social interaction: bureaucratic organisation, market processes, and voluntary association.

Table 2.4: The institutional basis of three approaches to local environmental improvement

	Physical Planning	Competitive Markets	Collective Action
Principal mechanisms	Bureaucratic organisation	Market processes	Voluntary associations
Decision makers	Administrators, engineers, public officials	Individuals, households, vendors, enterprises	Leaders and members of grass roots organisations
Criteria for decisions	Policy - and conformity with a plan	Efficiency – maximisation of profit or utility	Interests of members and visions of leaders
Guides for behaviour	Targets, regulations and technical standards	Price signals, incorporating taxes and subsidies	Agreements and accepted goals
Sanctions	State authority backed by coercion	Financial loss	Social pressure
Mode of operation	Top-down	Individualistic	Bottom-up

Source: McGranahan, Jacobi, Songsore, Surjadi, & Kjellén 2001, adapted from Uphoff 1993.

Bureaucratic organisation attempts to apply a higher-order rationality to people's behaviour. In an idealised plan, the government defines the goals of the water sector, experts decide how the water system should be developed to meet these goals, and public authorities ensure that these decisions are implemented. A planning approach to demand management would emphasise the technical fix: the plan could include both how and when the piped water system was to be extended, and where water saving devices should be introduced. From this perspective, entitlements to water should be embedded in government policy and planning. If water provision to low-income areas is planned for but not achieved, the residents' entitlements have failed to materialise, and the obvious recourse is for the residents to make more vigorous demands on the government.

Market processes rely on the 'invisible hand' of the market to transform individual preferences into collective outcomes. Ideally, residents' willingness to pay (or work) drives water provision, implemented by commercially minded providers. A market approach to demand management would be more inclined to focus on correcting price distortions, ensuring that users pay for incremental water consumption, and are aware of water saving options. From this perspective, entitlements to water are based on ability to pay (roughly income) and the cost of water. If water is priced correctly, a lack of entitlement to sufficient water is a reflection of income-poverty, and should be treated as such. If water is priced incorrectly, then the task at hand is to correct the market or policy failures that resulted in this 'distortion'.

With voluntary association, group decisions are collectively negotiated outcomes. Ideally, neighbours or larger communities get together and organise their own water provision. In practice, of course, once the ground and surface water is polluted, urban water systems do not lend themselves to independent local community provision. Thus even the more idealised versions of voluntary association tend to present community organisation in urban areas as a means for articulating water demands, and determining how water should be distributed within the community, with other institutions involved in the earlier stages of provision. A collective action approach to demand management would emphasise social obligations, norms and sanctions, and the need to find solutions suitable to local conditions, needs and priorities. Entitlements too would be based on collective decision-making at the local level, and

some form of public debate at the city and national levels. If people fail to obtain adequate entitlements through this process, the fault could lie in the community organisation or the political and economic context.

In the abstract, it is possible to talk of the perfect plan, market or community. Indeed, such utopian visions have at times proved all too alluring. For the most part, however, it is recognised that none of these approaches can or should be used exclusively. Indeed, it is common to distinguish between the public sector, private sector and voluntary sector, and to treat each as having its own niche with respect to water and more generally. Moreover, most real-world organisations involve all three institutional forms, and more. A typical private utility, for example, responds to market incentives, but uses planning and bureaucratic mechanisms to construct infrastructure, and attempts at least to emulate voluntary association with certain 'teams'. Indeed, the large international water companies, such as Vivendi and Ondeo, have far more elaborate planning systems than the typical public utility.

Nevertheless, researchers, politicians and practitioners can easily come to be affiliated with one or other of these approaches, treating them as competing alternatives rather than complements. While true communists, communalists and free-market ideologues may be rare (excepting perhaps the last), those who promote market solutions in one context will tend to promote them in others, and the same applies to planning solutions and voluntary association solutions. To some degree this reflects self-interest (e.g. those in the private sector traditionally favour markets, grass roots activists traditionally favour voluntarism, and government bureaucrats traditionally favour planning), and suspicion about the vested interests of others.

However, there is a growing perception that when the activities of the state, the private sector and the voluntary sector can be made complementary, or even combined, considerable synergies result (Evans 1996a; Evans 1996b; Ostrom 1996). This suggests a different focus for improvement. Arguing over the advantages and disadvantages of plans, markets or voluntary organisations, or trying to improve them on their own terms, may miss the best opportunities. Perhaps attention needs to be paid to how the sectors interact, and to providing mutually supportive environments. Perhaps what is needed is 'co-production', private-public partnerships, or perhaps even tripartite partnerships involving private, public and voluntary sector organisations (Caplan et al. 2001). Within such partnerships, the role of demand management could be explicitly negotiated.

Looking beyond the specific institutions mediating water supply and demand, one might also expect the form of a country's government to influence the provision of water. This too has analogies with Amartya Sen's analysis of famines and food security, and, for example, his claim that 'no substantial famine has ever occurred in a democratic country – no matter how poor' (Sen 1999). Such strong statements cannot be made for endemic water problems in low-income areas (or for that matter endemic malnutrition or starvation). Nevertheless, as noted above, a lack of democracy has been identified as a significant explanatory factor in regressions of household water access (Deacon 1999).

As a first approximation, one would expect demand-side measures designed to conserve water to be more beneficial for the urban poor in countries and cities where their entitlements to water are more firmly established, either through democratic or

other processes. Under such circumstances, water savings are more likely to translate into more secure or equitable access to water for basic needs. Demand-side measures have not always been oriented towards conservation, however, as the following section makes clear.

3. The Changing Focus of Demand-Side Water Management

This section attempts to provide a context for understanding the different perspectives on demand-side management that will be reviewed in the following section. It starts with an historical account of the changing approaches to demand-side management in Europe and North America. It then proceeds with a brief summary of more recent changes in approaches to the water sector in the international development arena and how they relate to demand-side management.

Taking a long term perspective on water issues in Northern cities helps to overturn some of the misconceptions that have accompanied the recent promotion of demand-side management, and provides insights potentially relevant to Southern cities. It emerges, for example, that attention to the demand side, recognition that water is a scarce and valuable good, and debate about private sector participation, are by no means new to the water sector. They were all important during the sanitary reforms that gained widespread international support in the nineteenth century. Indeed, the reliance on supply side solutions driven by the public sector is itself a relatively recent phenomenon. The early sanitary reforms were based on outdated science and questionable politics, and did create problems of water waste and over-consumption. They also illustrate, however, how international attention can help support local initiative, and that conservation does not have to be the only goal of demand-side management. Indeed, given the persistent sanitary problems in many Southern cities, the one-sided emphasis on conservation in much contemporary demand-side management can be seen to reflect the unfortunate tendency for Northern pre-occupations to dominate international agendas.

The review of current orthodoxy on water issues in the international development community also provides insights relevant to demand-side management. Recent years have seen a number of shifts in international attitudes towards water sector goals and approaches. Some seem to represent real progress in understanding new challenges and coming to terms with persistent problems. Others seem to reflect the tendency to focus on Northern pre-occupations noted above. In order to provide a better basis for demand-side management in Southern cities, it is important to distinguish the two.

The shift from hygiene to conservation in the North

This section provides an account of how urban water demand management in the North has shifted from an emphasis on hygiene and health to an emphasis on conservation and sustainability, using the United States as the principal example.

For much of the nineteenth century, urban water issues were firmly situated on the sanitary agenda. The sanitary movement effectively made local environmental improvement a priority, not only for public health and safety but even, according to its more ardent supporters, for addressing problems of urban poverty and class conflict.

By the end of the twentieth century, urban water demand issues had been placed on a very different environmental agenda. For the new environmental movement, water resource conservation became a priority, not only for achieving sustainability but also, again at least according to its more ardent supporters, for avoiding social conflict.

In his recent history of urban infrastructure in the United States, Martin Melosi distinguishes between The Age of Miasmas (Colonial times – 1880), The Bacteriological Revolution (1880 – 1945), and The New Ecology (1945 – the present) (Melosi 2000). During The Age of Miasmas, harmful fumes rising from urban filth were widely believed to cause an appreciable share of ill health. The sanitary movement amplified this concern, and supported a combination of water-using demand-side measures and water-providing supply-side measures. With the bacteriological revolution, the health focus shifted towards more targeted measures, designed to protect people from or cure people of identifiable pathogens. But on both the water supply and demand sides, the emphasis was still on getting more clean water to where it was needed. It was only with the rise of the new ecology that saving water through demand-side management truly came into its own as a response to one of the major challenges debated in the public sphere: how to achieve a more sustainable world.

Demand-side water conservation is not a new phenomenon, however. Growing cities almost inevitably encountered water constraints that forced them to confront the challenge of finding new supplies or using existing supplies more carefully. Cities through the ages have met this challenge in different ways, though there has been a common tendency to delay taking serious action until after – sometimes long after – the situation has become critical. At certain times and places, water supplies may have seemed so plentiful as to be virtually unlimited. Historically, however, this has been the exception rather than the rule. It is certainly not the case, as some proponents of the 'new water crisis' insist, that until recently urban dwellers thought of clean water as a free good of unlimited supply. The notion that contemporary cities will soon face unprecedented shortages of clean water is also hard to accept. However, given the damage that urban water crises have caused in the past – including for example the cholera and typhoid epidemics that devastated many of the most affluent cities in the nineteenth century – this is of little consolation.

One could argue that demand-side water conservation has itself been a recurring urban preoccupation since the first cities were formed. After all, whenever water scarcity prevents people from getting as much water as they would like, they are forced to manage their own demand. At the household level, fetching water for domestic use has been the historic norm throughout the world, and in many parts of the world it still is. People who fetch water are inevitably careful in their household water use: even carrying 100 litres a day home from a source a few hundred metres away is an arduous task. Also, when local sources are scarce, it is common for people to develop institutions, norms and technologies to help get more use from limited water supplies. Moreover, in some parts of the world, managing water demand has long been a central feature of statecraft in both rural and urban areas – as Wittfogel may have been guilty of exaggerating in his renowned theory of Oriental Despotism.

Indeed, it is the lack of demand-side conservation in so many contemporary cities that is historically exceptional. This relative lack is still evident in the United States, where the term 'demand-side management' was coined, and where numerous conservation programmes have been instituted. It derives at least in part from the success of the supply-side measures that tapped distant water sources, and enabled new forms of water provisioning that made water far more convenient to use and tempting to waste. Over the last two centuries, numerous American cities have faced water crises. However, while demand-side measures were undertaken, it was the large scale supply

projects, and the piped water systems delivering new water supplies to an increasing share of residents, that received the credit for resolving the crisis. These became the defining feature of the modern water regime.

In the nineteenth and early twentieth centuries, increasing access to clean water was a benefit to public health, and was generally recognised as such (Goubert 1989; Hamlin 1990; Koeppel 2000; Wohl 1983). In many ways, the sanitary movement was the environmental movement of the nineteenth century. Water use was central to sanitary reform, but unlike in the modern environment movement with its emphasis on conservation, the emphasis was on getting more and better water, and putting it to use (Melosi 2000). At the core of sanitary reform was an attempt to change the way people perceived cleanliness, and their relationship to their environment (Melosi 2000; Vigarello 1988). Scientists played an important role, and the agenda was to some extent expert driven. As with many environmental issues today, however, there were many disagreements among scientists. Also like the environmental movement today, the sanitary movement had political and moral dimensions, and was closely bound up with debates on the role of the state and the private sector. On the one hand sanitary reform required intervention in the private domain, while on the other it steered well clear of many of the most politically contentious sources of ill health, including overwork and low wages (Hamlin 1998).

The demand-side innovations of sanitary reformers promoted changes in the use of water to improve hygiene, along with technologies such as indoor piping, flush toilets, sinks and bathing facilities. The first clear empirical proof that drinking water could carry disease was John Snow's famous demonstration that the Broad Street pump in London was the source of a local cholera outbreak. When he convinced the local London water company to remove the Broad Street pump in 1854, he was in effect engaging in enforced demand-side management. But it took another 20 years for Koch to isolate the cholera bacillus. For much of the nineteenth century, diseases were blamed on stenches or 'miasmas' arising from urban filth, and other causes that bear little relation to current understandings of infectious diseases. However, these concerns could be used to justify numerous sanitary reforms, including forms of water demand-side management that entailed increasing water use (Rosen 1993).

On the supply-side, large-scale projects were risky, technologically difficult, costly and politically contentious, but they could transform the cities where they were successful, along with the careers of those politicians and entrepreneurs who could claim the credit. Already by the start of the nineteenth century a number of American cities were contemplating ambitious water systems, drawing on water supplies well beyond the city boundaries. Philadelphia was the first to act: in 1802 it completed a waterworks that brought water to the city from the Schuylkill river, and it soon became renowned for its public waterworks, which pumped unprecedented quantities of water to its residents, albeit at considerable cost. New York embarked on a less successful attempt to set up a major private water company to bring water to New York. But even though this may not have solved New York's water problems, the Chairman of the Board of the water company went on to become Vice President of the United States and the water company went on to become Chase Manhattan Bank (Koeppel 2000).

As engineers became more proficient at designing ways to bring water to cities, city governments became more proficient at financing and managing water systems (often

in partnership with private companies). By 1860, the 16 largest cities in the USA had waterworks, and by 1880 there were almost 600 waterworks in the country, about half of which were publicly owned. Public waterworks thereafter grew more rapidly in number (and had tended to be larger from the start), and by 1890 two thirds of America's urban population was served by public systems (Melosi 2000).

These new supply systems brought new challenges on the demand side. The waterworks were justified in terms of their public benefits: especially improving public health and controlling fires. But increased water use also brought some public bads: water disposal became a major problem, and overflowing privies and accumulations of dirty water posed their own public health threats (Tarr 1996). Moreover, not all the water was being used for improving hygiene or fighting fires. An appreciable share was believed to be wasted by users, who typically paid no additional charge for withdrawing additional water.

Wastewater and sewerage systems followed the piped water systems (Tarr 1996). These could deal with the local sanitation problems, and had their own public health benefits. But the sewers not only released human faeces (the source of most water-related diseases) into the waterways, but made it all the easier for consumers to waste water. An overflowing privy may bring down the wrath of neighbours, but pouring more water down the sewers is an anonymous activity.

Ignoring these tendencies towards overuse, these waterworks were ideally suited to the planning approach to water management. Combined with sewers they formed an integrated system that could be controlled by experts and planners far more easily than pre-existing decentralised systems. Expert-recommended hygiene improvements were also greatly facilitated. With water available at the turn of the tap, it was far easier to convince people to wash regularly. With flush toilets, people had no incentive to pollute their local environment with human faeces.

Planning could not, however, intervene effectively to prevent wasteful water use. It was one thing to convince people to use more water for hygiene purposes, but quite another to limit other uses. Unfortunately, the waterworks also undermined the potential for local collective action or markets to prevent overconsumption. Local collective action could play an important role as long as people were using communal sources or taps, but became relatively ineffective as water sources entered the home. Market incentives were also relatively ineffective, particularly in the absence of water meters.

From an economic perspective, a large part of the demand-side overconsumption problem is that piped water, and especially unmetered piped water, is not bought and used like a normal commodity. As long as water is purchased by the container, what people pay is proportional to what they consume. Similarly, when people fetch water, the effort is proportional to their consumption. The price may not be economically optimal, but it is bound to be significantly greater than zero, and people have a strong incentive not to waste water. Moreover, users receive visual indications of how much water they are using, and for which purpose: clean water containers empty at an observable rate, and dirty water containers must be poured out.

In early waterworks it was not uncommon to allocate water to different parts of the network at different times, allowing users or intermediaries to fill containers with

water to be used at will. Users' water supplies might still be limited, but the link between consumption and cost was beginning to fray. Sanitary reformers, however, considered individual connections with continuous water supplies to be far superior. With this development, the incentive to use water carefully was further undermined.

However much one pays for a connection to the water network, additional water is free unless the water is metered. A high connection cost or fixed monthly payment provides no incentive to limit the amount water that comes out of the tap. Furthermore, drains and sewers make it difficult for the user to know how much water they are using and for what purpose. There is no visible source to observe, and, except for certain uses, no sink to observe either. Even a leaky tap, visible to the user, is likely to represent an unknown loss of water if it flows directly down the drain.

The overconsumption problem was overshadowed by the numerous benefits that the piped water and sewerage systems brought. The expansion of water and sewerage systems was often accompanied by dramatic declines in death and illness from infectious diseases. The bacteriological theory of disease narrowed the focus of demand-side interventions (Rosen 1993). Sanitation became less of a generalised environmental concern, and began to focus on specific faecal-oral routes, and specific diseases (Melosi 2000). Nevertheless, bacteriological thinking generally supported the notion that getting more clean water to people's homes, and getting them to use it hygienically, was a critical route to better health. Indeed, supply side water quality improvements were spurred by the discovery that some of the most devastating epidemics, including cholera and typhoid, were being spread by contaminated piped water.

Despite the growing emphasis on increasing supplies of clean water, practitioners were inevitably concerned that although the new supplies were going to improve sanitation, some were being wasted, creating a demand for new infrastructure investment, and contributing to drainage problems. At times this led to attempts at demand-side management, such as the Boston (Cochituate) Water Board's attempt to ban or impose charges on the use of 'hopper closets' (flush toilets whose design meant that they were often left running continuously). Such attempts to manage demand were fiercely resisted, however (Jacobson 2000).

Partly in response, the water meter, probably the most significant tool for encouraging water conservation through demand-side management, began to become popular in the early twentieth century. The first patent for a water meter was issued in England in 1824 (Melosi 2000), but did not really become a practical tool for monitoring water flow at household connections until the late nineteenth century. Judging from Melosi's account, the debates surrounding water metering in the U.S. were similar to those in some Southern countries today:

> "Water-management officials drove home the point that meters would not only save water, but also reduce rates, thus making services more equitable…
>
> "Consumers were especially resistant to metering. They had experience with other forms of metering, most notably gas and electricity, and did not take well to this form of monitoring. It was regarded as an invasion of privacy, and a way to extract more money for services they believed were

already too expensive. Some argued that encouraging thrift through the use of meters might force frugal people and the poor to use less water than was necessary for proper health and sanitation. One critic noted, 'No restrictions should be made that would lead people to avoid bathing, or freely flushing plumbing fixtures. Anything which discourages a liberal use of water is an obstacle to social progress.' In one extreme case, the Free Water Association in Portland Oregon, formed to secure free water for all citizens. The cost of the plan would be paid through a one-mill levy on all taxable property."

Notwithstanding consumer resistance, and the fact that conservation did not sit well with the prevailing water ethos, metering did become quite common during the early decades of the twentieth century. By 1920, in a survey of 1,000 American cities, almost two-thirds reported metering water at the tap, and over a quarter metered all taps.

Metering turned water pricing into a potential tool of demand management. Current estimates suggest that even revenue-neutral metering reduces consumption by between 10 and 40%, since households have to pay more the more water they consume. Presumably appreciable savings were also achieved with water metering early in the century. But even with meters, water pricing is inevitably an imperfect tool. As indicated in Box 3.1, ensuring that the price of water reflects its true economic cost is no easy task, and even if it were consumers would still not necessarily have enough information to use water appropriately.

Box 3.1: Why even metered water cannot be treated as a normal economic good

Metered water is not a normal commodity of the type idealised in economic theory. In the ideal commodity market, at the market clearing price the (rising) marginal cost of supplying more of the commodity is equal to the (declining) marginal benefit of using more. Inter-firm competition ensures that costs are minimised and that revenues just cover total costs including a "normal" profit margin (ie that marginal costs equal average costs). Well-informed consumers ensure that only those uses whose value is at least equal to the price are met. There is no need for planners or others to manage demand, since the market price provides the incentive for users to manage their own demand efficiently. Indeed, provided the distribution of income is considered acceptable, the only obvious role for the planner is to ensure the market keeps working efficiently.

While few commodities fit this ideal perfectly, water does not even come close. For piped water systems, features on the supply side interfere with competition and the equalisation of marginal and average costs. Moreover, features on the demand side would prevent consumers from using water efficiently even if it could be priced at the marginal cost.

On the supply side, waterworks are inclined to be 'natural monopolies'. Left to the private sector, they do not support competitive markets. Rather, as the result of returns to scale and technical factors inhibiting competition, there is a tendency for a single enterprise to emerge as the dominant provider. A profit-maximising waterworks with a secure monopoly has a strong incentive to charge prices well in excess of marginal costs, securing excess profits and potentially threatening public health. Along with the fear that private companies would not take sufficient care to ensure that water was uncontaminated, this was one of the main reasons why municipal governments came to own or be actively engaged in planning and managing large-scale urban waterworks. It is also the main reason why even today, when private utilities are viewed more favourably than at many times in the past, it is still generally recognised that a public sector agency or regulator should be involved in water pricing decisions.

Finding the right tariff for metered water is also a challenge for the public sector, however (even ignoring the health and equity issues that arise on the demand side). For a start, politicians and bureaucrats and even independent regulators are far from being impartial representatives of the public interest. But even for well-intentioned public servants, defining and estimating the 'correct' marginal cost of water would be extremely difficult (Hanemann 1998). Water withdrawals often have environmental costs, and there is typically disagreement about the nature and magnitude of such costs. Also, water supply systems have notoriously high capital costs, and large new projects often increase supplies on a very large scale. This means that pricing at the short run marginal cost will typically induce demand to increase relatively rapidly up to a point at which the marginal cost increases dramatically (because only a large new investment will enable supplies to increase). The problems of price volatility alone make this undesirable. Water users could easily be induced to invest in water-using technologies and practices, only to find them uneconomical when prices suddenly rise. Thus economists generally favour long run marginal cost pricing, on the grounds that it provides more appropriate signals to users.

But long run marginal cost pricing is not equivalent to the clearing price in a perfect market. In practical terms, there are evident inefficiencies if water prices are set to reflect the costs of building a new reservoir or canal, when the current ones are only being partially utilised: Potential benefits from short term increases in water consumption are lost. Moreover, the very concept of long run marginal cost is somewhat incoherent: how long is the long run, and where is its 'margin'? The best one can realistically hope for is an estimate of marginal cost based on incremental operating costs and capital costs per unit of capacity expansion, averaged out over a period of time sufficient to avoid disruptive price changes.

Unfortunately, these are not the only complications on the supply side. Most important, the same cost characteristics that give rise to natural monopolies also mean that a price based on marginal costs (providing appropriate incentives to consumers) is likely to be inconsistent with one based on average costs (ensuring cost recovery). This problem can be circumvented to some degree by using connection fees and service charges to ensure cost recovery, and setting volumetric prices equal to an estimate of marginal cost. Such charges can themselves bring inefficiencies, however, if they induce potential users to 'opt out'. When these users are the urban poor, equity and health problems on the demand side can easily be compounded.

There are numerous other complications on the supply-side, ranging from seasonal variations in water availability to different costs associated with supplying different consumers. There may in theory be an equally large number of possible permutations in the tariff structure. However, not only are affordable meters unable to register all of these permutations, but if the tariff is not sufficiently straightforward as to be understood by the consumer, it is unlikely to be an effective tool for demand management.

On the demand side, one of the premises of sanitary reform was that people did not know how best to use water. This was often expressed in overly moralistic and patronising terms, but still has relevance. Even users well aware of the dangers of contaminated water have difficulty discerning whether a given water supply is potable. Few users are very knowledgeable about the relations between water use, hygiene behaviour and health. Even fully knowledgeable users are unlikely to consider that if they do contract a water-related disease they themselves become a health risk. Even when water is metered it is difficult for consumers to know how much water they are using for which purpose, and to respond in an economically rational manner.

These factors inevitably limit the role of pricing as a demand-management tool. A high water price provides users with an incentive to save water, but not the means to respond efficiently. A low water price provides an incentive to use more water, but not necessarily for appropriate purposes. And even with water meters and marginal cost pricing designed to simulate the ideal market, neither health nor conservation will necessarily be well served.

In any case, pricing decisions were not dominated by economists or conservationists, and even health issues faded from the policy foreground over the course of the twentieth Century. Water provision was progressively depoliticised, but the professionals who dominated the sector tended to be engineers. In the United States, as in most affluent countries, urban water systems came to be judged against an ideal of universal coverage, with household connections providing water of a potable quality. Pricing policy eventually came to be designed primarily to recover costs and to allocate these costs fairly. Until recently, water tariffs were only viewed secondarily as a demand management tool.

The standard recommendations on water pricing, at least until recently endorsed by the American Water Works Association, rely on embedded cost rate design, which attempts to allocate historic costs to present day consumers. Embedded cost rate design helps to ensure cost recovery, but even ignoring the demand-side problems, it is unlikely to provide appropriate incentives to consumers. It bears little relation to the marginal cost of providing more water to the consumer. In the 1970s many electric utilities in the United States made the transition from embedded cost to marginal cost rate design, while prior to 1990 only Tucson, Arizona had ever adopted marginal cost rates for water (Hall 2000).

However, over the course of the twentieth century urban water problems were becoming increasingly bound up with national water issues. As urban and non-urban users drew on more distant and interconnected supplies, urban water demands increasingly competed with alternative uses. The national government became increasingly involved in water management, in part because of the increasingly national character of water problems, and in part because of more general shifts towards interventionist government, at least until near the end of the century.

Simultaneously, in water as in other areas, ecological concerns began to become increasingly prominent. Already in 1950, the chief of the U.S. Conservation Service was asserting that "we have failed, generally, to understand the interrelationship of our natural resources, particularly the unity of land and water. Too often we have ignored the fact that Nature fashioned our landscape in the form of watersheds, whose protection is of vital importance to our water supplies", concluding that "Taken together, our existing and prospective water difficulties amount to a very serious national water sickness, contracted as part of our rapid national development and hidden for years by the lingering memory of our original abundance" (Melosi 2000).

This increasing prominence of ecological concerns, often associated with the new environmentalism of the 1960s, helped to provide a conceptual framework within which a broad range of conservation issues could be articulated. Moreover, there was a growing infrastructure crisis extending across a range of sectors, and including both water and electricity. Some of the large-scale water, transport and energy systems were beginning to deteriorate more rapidly than they were being renovated. Public funds for major infrastructure investments were increasingly difficult to come by. The oil price increases of the 1970s helped spur a conservation agenda in the energy sector. By the 1980s, the new environmental movement was able to catalyse conservation oriented demand-side management in both the energy and water sectors. The dominance of the sanitary reformer was truly over.

Despite the increasing attention being given to water conservation, even basic tools for water demand management such as water metering remain far from universal in affluent countries. According to a recent review of water pricing in OECD countries, most member countries meter almost all single family homes connected to the piped water system (Organization for Economic Co-operation and Development 2002). There are significant exceptions, however: as of 1997 there was no metering in Iceland, Ireland or Scotland, and little metering in England or Norway. Moreover, metering is far less common in individual apartments. Thus, for example, while all single family homes are metered in Germany, only 10-20% of individual apartments are metered, resulting in a total of 55-60% of individual households metered. Indeed, only five of 30 OECD countries provided estimates indicating that over 80% of individual households were metered (over half could not provide an estimate at all.)

Moreover, water pricing is still a politically sensitive issue, and simply cutting off water supplies to households that cannot pay their water bills is not generally considered an acceptable policy. Thus, even as most affluent countries are trying to move towards more conservation-oriented water pricing, affordability remains an issue, and in most OECD countries there are publicly supported measures to facilitate provision for disadvantaged households.

Looking back, it is evident that even at its height the sanitary movement had serious problems. However, the shift in priorities from sanitation to sustainability in the North, as conditions changed, does raise serious questions about the manner in which the new environmental agenda is being promoted in the South. Is the shift in priorities being oversold in the South, where local water and sanitary conditions remain far from adequate? More specifically, is the pursuit of sustainability displacing rather than assisting efforts to address local water and sanitation needs?

There has always been a role for markets and a role for demand-side management in the water sector. The question is what these roles ought to be. At least until recently, it was generally accepted that market forces did not drive the sanitary revolution, although it emerged in England at a time when market liberalism was particularly popular. Key proponents of sanitary reform argued that improving the provision and use of water in low-income neighbourhoods was one of the few areas where reliance on the market would be a mistake. Moreover, sanitary reform became an international movement, with local initiatives drawing heavily on international experiences.

Market liberalism is again very popular. Again, environmental issues are often presented as one of the few areas where it would be a mistake to rely heavily on the market. The new environmentalism does not embrace the sanitary agenda, however. Demand-side management has been taken to mean demand-side conservation. Contemporary environmentalists are far more concerned that free markets will result in the overuse of water than that they will result in insufficient water for the urban poor. Moreover, water is rising up the international environment agenda, with local initiatives again drawing on international experience.

The world has changed enormously in the last 100 years. The sanitary revolution of Europe and North America may not be an appropriate model for other countries to follow. It helped to create the water-wasteful systems that are now being called into question. More important, it is politically as well as scientifically outdated.

Nevertheless, for many cities the demand-side priorities of sanitary reform remain far more relevant than those of the new demand-side conservation paradigm.

International development and demand-side perspectives

By the second half of the twentieth century, indoor piped water and water closets had become widely accepted goals of 'development', espoused by governments of a wide range of political persuasions and in diverse social settings. For most of the world, the sanitary revolution had barely begun. Colonialism helped to spread the Northern model of sanitary reform, but in a particularly contentious form. Given the large investment costs involved in piped water systems, and the limited municipal budgets in most colonies, demand-side measures were particularly attractive to colonial governments. Even in the North, measures to improve water hygiene were often informed by prejudice as well as an (imperfect) understanding of environmental health, and could be used as instruments of control as well as of liberation. Thus, for example, it was often assumed that unhygienic practices were a reflection of the inherent moral and intellectual inferiority of the poor, who needed to be guided by their 'betters', if necessary by force. Prejudices and controlling tendencies were amplified in colonial settings (Feierman & Janzen 1992; Harrison 1994). Indeed, it was sometimes argued that more water and better sanitary facilities would be wasted on 'natives', and that the priority must be to change behaviour (Yeoh, 1991). Strategies to 'sanitise' colonial settlements may have emphasised the demand side, but they also served to undermine public support for demand-side strategies in the post-colonial period. Instead, it was the vision of a public utility providing water for all that proved attractive in the emerging international development arena.

Planned water systems were assumed to be the model for the future, even when in practice most people still relied on local water sources and institutional arrangements. Demand-side management, whether for health or conservation, was not a major policy concern. Far more than in the earlier sanitary movement in the North, the urban sanitary revolution came to be seen as a question of infrastructure provision.

The International Drinking Water and Sanitation Decade (the 1980s) was driven by the goal of attaining 100% coverage for water supply and sanitation by the end of the decade (Cairncross 1992). Rural areas were found to be particularly poorly served, and received much of the attention. Similarly, sanitation was found to be lagging behind water provision, and causing particular problems in urban areas. The Decade also heralded a significant change in the treatment of urban water issues, however. One of the challenges recognised at the start of the decade was to "embrace lower-tech alternatives, and to convince engineers and planners to include them in master plans for developing country contexts" (Black 1998). During the course of the decade there was also an increasing emphasis given to institutional rather than technical improvement, with community participation and gender awareness gaining prominence. More importantly, though perhaps more subtly, environmental and free market viewpoints were becoming increasingly prevalent in development debates generally, and had a profound influence on international policy debates in the water sector.

By the end of the decade, while the targets were still far from met, a new consensus appeared to be emerging within the international water sector. The 'Dublin Principles', that emerged from the International Conference on Water and the

Environment held in 1992, illustrate this new consensus, and have been sufficiently influential to warrant quoting in full:

The Dublin Principles:

"1. Freshwater is a finite and vulnerable resource, essential to sustain life, development, and the environment.
Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Effective management links land and water uses across the whole of a catchment area or aquifer.

2. Water development and management should be based on a participatory approach, involving users, planners, and policy makers at all levels
The participatory approach involves raising awareness of the importance of water among policy-makers and the general public. It means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of the users in the planning and implementation of projects.

3. Women play a central part in the provision, management, and safeguarding of water
The pivotal role of women as providers and users of water and guardians of the living environment has seldom been reflected in institutional arrangements for the development and management of water resources. Acceptance and implementation of this principle requires positive policies to address women's specific needs and to equip and empower women to participate at all levels in water resources programmes, including decision-making and implementation, in ways defined by them.

4. Water has an economic value in all its competing uses and should be recognised as an economic good
Within this principle, it is vital to recognise first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Past failure to recognise the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resources.

WMO (1992) *International Conference on Water and the Environment: Development Issues for the 21st Century: The Dublin Statement and Report of the Conference*, Geneva, World Meteorological Organization.

These four principles apply four development dictums of the 1990s to the water sector: care for the environment, increased participation, gender sensitivity, and an increased the role for markets. By and large, these principles still reflect international thinking, although attention has shifted away from abstract principles and towards practical examples (of, for example, 'good practice'). Moreover, meeting basic human needs has crept back up the list of principles and challenges, and is less likely to be represented as part of recognising water to be an economic good. Indeed, right at the start of the 'key' document prepared for the International Freshwater Conference in Bonn, ten years on from the Dublin Conference, it is stated that:

> "**The first key is to meet the water and security needs of the poor** – for livelihoods, health and welfare, production and food security and reducing vulnerability to disasters. Pro poor water policies focus on listening to the poor about their priority water security needs. It is time now to build on the national and international commitment on drinking water with the determination also to halve the number of those who do not have access to sanitation."

This should not be taken to imply that there is a real consensus on what should be done in the water sector, let alone what the priorities are and how they relate to each other. Even within the 'first key' cited above, there is a tension between the bottom-up vision of "listening to the poor about their priority water security needs" and the top-down determination "to halve the number of those who do not have access to sanitation". Such tension pales, however, beside the heady confusion evident in the first paragraph of the Ministerial Declaration of The Hague on Water Security in the 21st Century put out at the World Water Forum in 2000:

> "Water is vital for the life and health of people and ecosystems and a basic requirement for the development of countries, but around the world women, men and children lack access to adequate and safe water to meet their most basic needs. Water resources, and the related ecosystems that provide and sustain them, are under threat from pollution, unsustainable use, land-use changes, climate change and many other forces. The link between these threats and poverty is clear, for it is the poor who are hit first and hardest. This leads to one simple conclusion: business as usual is not an option. There is, of course, a huge diversity of needs and situations around the globe, but together we have one common goal: to provide water security in the 21st Century. This means ensuring that freshwater, coastal and related ecosystems are protected and improved; that sustainable development and political stability are promoted, that every person has access to enough safe water at an affordable cost to lead a healthy and productive life and that the vulnerable are protected from the risks of water-related hazards."

4. Alternative Perspectives on Demand-Side Water Strategies

A basic premise of this chapter is that demand-side strategies should be able to accommodate insights from a variety of perspectives, without necessarily adopting their promotional styles. The chapter summarises four somewhat stereotyped demand-side perspectives on water issues: a conservationist's, a health specialist's, a market economist's, and a grass roots activist's. These perspectives tend to focus on particular problems (e.g. sustaining water resources versus improving human health) and/or to advocate particular institutional approaches (e.g. expert-led interventions versus market mechanisms versus local collective action).

Some, mostly affluent, cities urgently need to conserve water, but have few water-related health problems. Some, mostly poor, cities have severe water-related health problems, but abundant freshwater resources. In some cities the most critical demand-side improvements could be achieved through getting water markets and prices right, while in others the key is to help low income communities organise to address their own water problems or make appropriate demands of water providers. Unfortunately, most urban centres face a variety of water problems, and their demand-side strategies need to reflect this. The institutional settings of different cities also vary, further complicating demand-side strategies. These issues are taken up more explicitly in the final section, which examines how these demand-side perspectives can be combined.

A conservationist's demand-side perspective

The phrase "demand-side management" is often taken to refer to measures designed to reduce water demand without compromising water-related services. It is often simply assumed that a planner's purpose in managing water demand is to reduce waste and thereby avoid the need for expensive infrastructure investment and excessive water withdrawals. As indicated above, this stands in sharp contrast to the archetypal planner of the sanitary era, who may not have used the phrase "demand-side management", but was certainly concerned with managing water demand – principally so as to improve public health.

Demand-side management did not emerge in opposition to sanitary reform, however. It was a response to a more recent tendency to assume that the role of water sector planning was simply to meet water demands and handle the wastewater. The following quotations from a recent book on urban water demand management and planning provides a useful summary of this demand-side perspective as it emerged in the United States:

> "Unlike the past, present urban water supply planning is a drastically different, challenging, and complex task. Traditionally, the planning process started by projecting the population to be served, estimating per capita water use, and then simply multiplying one projection by the other to derive future water use. Armed with an estimate of future water need, planners had to face the problem of identifying adequate and available sources of supply, usually additional reservoirs and/or well fields." (Page 6)
>
> "The first indication of widespread interest in urban water conservation appeared shortly after 1970. The [U.S.] National Water Commission conducted a study of the potential for water use reduction through conservation practices,

including pricing policy, and discussed water conservation as an alternative to, or adjunct of, water supply augmentation." (Page 7)

"The broadening of water planner's perspectives to include demand management alternatives and other innovative solutions has been brought about by a number of new challenges that water planners must face today and in the future.

- Untapped sources of water are becoming rarer, and the depletion and contamination of groundwater sources has further limited supplies.
- The increased frequency of droughts during the last decade has increased competition for water between urban and agricultural interests.
- Environmental concerns about increased water use have intensified during the last two decades to the point where the development of new supplies is politically infeasible, and the prospects for financing major construction programs are discouraging for many water agencies."

(Page 8)

Source: Baumann, D. D. & Boland, J. J. 1998, "The Case for Managing Urban Water," in *Urban Water Demand Management and Planning*, D. D. Baumann, J. J. Boland, & W. M. Hanemann, eds., McGraw-Hill, New York, pp. 1-30.

In short, demand-side management came to be seen as an alternative to increasing water supplies, which had become increasingly costly - financially, politically and environmentally. From this perspective, water conservation is often defined as inherently good. In the words of one of the editors of this book, conservation is "any beneficial reduction in water use or in water losses" (Baumann & Boland 1998). A reduction is only considered beneficial - and hence deserving of the label conservation - if its benefits exceed its costs. This allows conservation to become an unqualified objective of demand-side management.

Households only account for about 12% of water use in the United States, and about the same in Europe. Some typical demand-side measures for household water conservation are listed in Table 4.1. They extend from education and information to a wide range of technical devices that can reduce water consumption without unduly compromising water services. Since such measures were not given serious consideration in supply-side water planning, there is considerable unexploited potential for water conservation in most homes. On the other hand, because households only account for a small share of overall water use, household water conservation cannot radically change water consumption patterns. Nevertheless, public support for water conservation is critical, and in this context household demand-side management can be important.

Table 4.1: Typical Water Conservation Measures for Residential Use in Affluent Countries
General
Public information
Metering
Pricing policies
In-school education
Pressure reduction
Leak detection and repair
System rehabilitation
Toilets
Early closure flapper valve
Toilet leak detection and repair
Ultra-low flush toilets
Toilet displacement bags
Dual flush devices
Fill-cycle regulator
Showers
Low-flow showerheads
Shower flow restrictors
Shut-off valves
Washing machine
Water efficient vertical axis
Horizontal axis
Air conditioning
Air-cooled systems
Water efficient evaporative coolers
Gardens
Water efficient landscape design
Garden hose timer
Greywater systems
Soaker hoses
Reduction or limitation of high water use plant materials such as turf
Cisterns
Adapted from Opitz, E. and Dziegielewski, B. 1998. "Demand Management Planning Methods". In Baumann, Boland, & Hanemann 1998.

These measures seem so straightforward that the suggestion that water planning has become a far more "challenging and complex task" may seem out of place. From a technical perspective, building a dam is far more challenging than any of these demand-side measures (or, for that matter, the demand-side measures suitable to other sectors such as agriculture). The challenges and complexities of demand-side management lie in its institutional aspects. Dams suit an expert-driven planning approach. Demand-side management does not.

Even when conservation is clearly desirable, and appropriate technologies can be identified, creating the institutional basis for water conservation is complicated. It is not enough to undertake objective assessments, present the results, and then wait for the measures to be adopted. Both water users and water providers have ambiguous attitudes towards water conservation. Water users are likely to be sceptical of claims about large water savings, and are unlikely to be paying the full economic cost of the water they consume. Private water providers are likely to be making more money the more water they sell, and public water providers rarely have much incentive to get users to save water. Indeed, these are among the main reasons why demand-side management is needed in the first place.

Demand-side conservation involves creating appropriate institutional settings as well as identifying appropriate measures. It is about creating a closer relationship between water providers and water users. It is also about changing the way people – as consumers, providers or planners – perceive water.

If water users do not – and cannot be expected to – monitor how much water they use for different purposes, how can they be convinced that the benefits of a water-conserving device are worth the cost? Affluent consumers are constantly exposed to advertising, blending fact and fantasy, with no serious claims to impartiality. How can a careful presentation of the costs and benefits of low flow showerheads compete with advertisements for power showers that display glowing naked bodies glorying under the 'invigorating performance of up to 18 litres a minute' of hot steamy water? And why should consumers, accustomed to a barrage of misleading statistics, believe the claims of demand-side managers?

Much depends on public attitudes to environmentalists, to the environment, and to water in particular. Droughts and water rationing can quickly alter public perceptions of water, but in their absence generating concern for water conservation can be an uphill struggle. Corporate-style advertising is an anathema to most environmentalists, who tend to view it as a leading cause of overconsumption, rather than a source of information and awareness building. However, exaggeration and misleading simplifications are common in environmental campaigning, in the water sector as elsewhere. Developing a demand management campaign that is both reputable and effective is no easy task.

Much also depends on whether the 'demand-side managers' are located in water utilities, government departments, non-governmental organisations, or elsewhere. Superficially, utilities might appear to be the obvious centres for demand-side management. This might even seem to provide a means of overcoming problems of consumer scepticism and moral hazard. Ideally, utilities would invest in demand-side efficiency instead of supply-side expansion. Consumers would be given free water-saving devices, water prices would be increased to cover the cost of the devices, but due to their water savings the consumers' monthly bills would actually decline. A classic win-win situation! Unfortunately, such ideals are rarely practicable. Even private utilities do not control prices directly, and if they did they would probably be better off financially if they just raised prices and simultaneously tried to stimulate demand, not conservation, through other forms of demand-side management. There are certain circumstances when a water utility may have the incentive to invest in demand-side efficiency – if, for example, they are obliged to supply as much water as is demanded at a given price, and can only meet additional demand through expensive supply expansion.[8] By and large, however, both private and public water utilities have ambiguous incentives with respect to demand-side conservation, and cannot be relied upon to drive demand management.

In practice, demand-side management must emerge from the combined efforts of a range of different actors. Central government, local authorities, water utilities, consumer organisations, environmental groups – all have a role to play. In some

[8] This assumes that the utility receives the revenue from the water bills. In some concession agreements, the private water company is paid a rate for water delivered to consumers that is independent of the price the consumers pay.

situations it may be appropriate to set up a demand-management unit in a water utility, in others it will be more appropriate to give the lead responsibility to a government department or to an independent body. But in almost every case, success will depend on a significant degree of support for demand management from government, from the utility and from the public. In particular, it implies a more intimate relationship between water providers and water users, with both working together to find ways of using water more efficiently.

While water conservation in affluent countries may have come a long way since 1970, it still has a long way to go. Even simple measures such as low flush toilets have met with considerable resistance. Even in Europe, household water consumption increased in the 1980s, along with the growth of water-sing appliances, and it was only in the 1990s that this increase slowed and some countries registered declines in household water use per capita.

Many environment-minded water experts, including especially those located in universities and environmental advocacy organisations, are still working hard to alert policy makers and the public to the dangers of water stress and the need for more active demand-side management. If at times they seem single minded and overstate their case, this is perhaps an understandable response to the enormous inertia in the water sector. Conservation is also often promoted as an integral part of a new 'environmental consciousness', morally superior to the consumerism that characterises affluent societies. Again, this can be seen as a legitimate response to the environmental challenges that affluence has helped to bring into being. Problems arise, however, when this enthusiasm, single-mindedness and moral suasion is extended to low-income settings.

For reasons outlined in previous chapters, the more deprived neighbourhoods of low-income settlements face very different water-related problems from those motivating demand-side management in the North. Where the water infrastructure is far less developed, it is important not to exaggerate the economic or environmental costs of supply side expansion. Where people have to fetch water, getting the most out of small amounts of water is a major issue, but promoting awareness of the need to do so is not. Where hygiene is poor, focusing demand-side management on conservation could be extremely hazardous. Moreover, most of the measures provided in Table 4.1 are irrelevant in settlements where piped water is rare, flush toilets and the like are unaffordable luxuries, and flow restrictors are more relevant as a possible means of regulating lifeline water connections.

Even in poor cities, there are often people who waste large quantities of water, particularly in the more affluent neighbourhoods. Water losses due to leakage are often far higher than in affluent cities. Moreover, many poor cities do face serious problems getting enough raw water or treating enough water even for their limited supply systems, and economic constraints make it all the more important that cost effective demand-side options do not lose out to more expensive supply side investments. Nevertheless, it would clearly be inappropriate to simply adopt the conservationist's perspective, and assume that the goal of demand-side management is to save water.

A health specialist's demand-side perspective

From a health perspective, the principal urban water problem is the enormous unexploited potential for using water more effectively to improve health. This potential lies primarily in the deprived neighbourhoods of poor cities, where people do not have access to enough water of sufficient quality to meet their basic hygiene requirements. Superficially, at least, this sets the health agenda in direct opposition to the conservation agenda, which is looking for ways to reduce the use of water. However, the quantity of water required to meet basic hygiene requirements is only about 25-50 litres of water per capita per day. Providing 50 more litres of water per day to an additional billion people would still only come to only about 20 cubic kilometres a year, which is less than 1% of current global water consumption (Gleick 2000b). The health and conservation agendas may be pointing in different directions, and using contradictory narratives to justify their own importance. But in physical terms the increased water supplies needed to reduce the water-related health burden for the urban poor are insignificant in the context of the water-wastage that needs to be curbed to reduce water stress. As long as these supplies can be targeted, meeting basic hygiene requirements need not conflict with reducing water stress.

The most straightforward form of urban water demand management for health is to make potable water and sanitary facilities accessible and affordable to currently deprived households, thereby increasing demand where the health benefits will be greatest. This is, of course, more easily said than done, especially in light of competing demands from other users with more economic and political power. But more important from a demand management perspective, access to adequate water is necessary but insufficient for health improvement. In most of the cases where health impact studies have found significant impacts associated with the provision of water supply or sanitation, this provision has been accompanied by improvements in hygiene (WELL 1998). In short, much depends on how the water and sanitation facilities are used, and especially on what has come to be termed hygiene behaviour.

The same supply-fix approach that conservationists criticise for wasting water resources, hygiene advocates criticise for wasting the potential health improvements that water can bring. In both cases, a demand-side approach requires a better understanding of what people actually want from water, and shifts attention from the relatively more controlled arena of water engineering to the more unpredictable arena of human behaviour.

Consider the following list of behaviours that could be expected to improve health in many poor communities:

- Wash hands (preferably with soap) after defecation
- Wash hands (preferably with soap) prior to food preparation
- Wash food, especially vegetables, prior to preparation
- Clean food utensils with water after use
- Wash surfaces, especially in toilets and food areas
- Store water in clean containers away from human contact
- Boil water of doubtful quality before drinking
- Wash sanitary facilities regularly
- Ensure children as well as adults use sanitary facilities

- Dispose of infants' and small children's faeces safely (away from human contact)
- Wash body regularly – face first if reusing water while bathing
- Wash grazes and cuts with soap and water
- Avoid hand contact with water in water containers
- In case of diarrhoea, administer Oral Rehydration Therapy (a water-based solution)
- Avoid creating open containers of still water, especially in areas where dengue fever is a risk

There is no guarantee that people provided with better access to water and sanitary facilities will engage in these behaviours. The following quotation from a recent guidance manual developed by a water and environmental health programme makes this point very clearly:

> "Hardware by itself cannot improve health very much; what matters is the way in which it is used, and the ways in which it may promote changes in hygiene related behaviour. In some cases this change is fairly automatic; people around the world need little encouragement to increase the amount of water they use for washing once it is readily available at the household level. In other cases, however, a significant amount of time and effort is required to alter hazardous practices which are considered 'safe', or are simply not thought about.
>
> "Even after substantial investments have been made in water and sanitation hardware, hygiene behaviour in these areas often remains a substantial risk to health. In many cultures, for example, the excreta of young children are considered safe, and are thus not treated with the same hygienic concerns as the excreta of adults. In fact, as children are the main victims of faecal-oral diseases, they are consequently the main reservoir of infection. This means that the faeces of children are more infectious than those of adults, as they are more likely to contain disease-causing organisms.
>
> "The practice of washing hands with soap after defecation is another example of a behaviour that does not follow 'automatically' from the provision of hardware, and yet which has major health implications. A classic study by Khan (1982) in Bangladesh showed that the simple practice of washing hands with soap after defecation was sufficient to reduce the secondary attack rates of dysentery with participating families by 85 per cent (Khan 1982). Similarly, B.C. Deb et al. (1986) examined transmission within families with one proven case of cholera (Deb et al. 2002). Some families were provided with a traditional *sorai* water storage container with a small diameter inlet and outlet which does not permit users to dip into the storage container; control families used the more widespread practice of dipping into a common bucket. The rate of cholera transmission with the families with the *sorai* was 75 per cent lower than that in the families using conventional water storage and dipping. While such an intervention may not have had much impact on transmission between families, it is a simple, effective and low-cost intervention to reduce transmission within the family."
>
> Source: WELL, 1998, page 70

What is in effect being called for is a form of demand-side management, similar to that envisaged by the conservationist, but focusing on health. Superficially, health might seem to be a more straightforward goal for demand-side management than conservation. Hygiene promotion programmes have a long history. Human health is a less debatable and more self-motivating objective than resource conservation. And hygiene promotion should enable water to provide a better service, rather than simply maintain service levels while saving water. However, as for conservation, demand-side management for health cannot expect to succeed simply by undertaking objective assessments, presenting the results, and then waiting for the recommended measures to be adopted.

Again, the institutional setting and the relations between water users and 'demand-side managers' are critical. In the case of health, much depends on public attitudes towards the health establishment, and whether the 'demand-side managers' are located in water utilities, government departments, non-governmental organisations or health care establishments.

Hygiene promotion is complicated by the fact that it cannot be fully disengaged from other relations of power and authority, most of which work to the disadvantage of the urban poor. For example, many of the urban poor do not have legal rights to their homes, and unhealthy sanitation and hygiene practices are sometimes used to justify their eviction. Under such circumstances, water users are predisposed to view hygiene promotion programmes with suspicion. More generally, hygiene promotion can easily intrude on personal and social behaviours that people do not believe should be prescribed by 'outsiders', whether or not they have health expertise.

Even the best-intentioned hygiene promotion programmes face difficult decisions deciding which measures to promote and how to convey relevant knowledge to local residents. And even the best-informed and most receptive residents have good reason to be sceptical of some of the claims made in the name of hygiene. Identifying the most appropriate hygiene behaviour often depends upon having an intimate knowledge of local conditions, priorities and cultures, as well as health expertise. As indicated in Chapter 2, there is a great deal environmental health experts do not know about water-related health risks and their relative importance. Even if experts know that local groundwater is faecally contaminated, for example, they are unlikely to know which wells are safe to use for which purposes. Health experts are also typically unaware of the constraints on local behaviour, and misguided hygiene measures may create unanticipated health risks. Where fuels are costly, for example, boiling water to reduce exposure to water-borne pathogens may lead to reduced food consumption, and attendant problems of undernutrition. Water itself may be so costly that following all recommended hygiene behaviours could create poverty-induced health burdens.

Many practitioners perceive, however, that if they qualify or complicate their hygiene messages, people are less inclined to change their behaviour. The search for clear messages that are widely applicable can easily restrict hygiene recommendations to a few simple behaviours, such as handwashing after defecating and before preparing food. Such measures are undoubtedly important, but do not reflect the full potential for water-related hygiene improvement in areas where potable water is scarce and decisions on how to use water are critical to health.

One of the lessons taken from past hygiene promotion campaigns is that health concerns alone are rarely sufficient to motivate the desired changes in water-related behaviour. This probably reflects local scepticism regarding health claims, as well as the importance of other concerns. A common conclusion is that hygiene improvements also need to be grounded in more immediate concerns, such as convenience or social status. In situations where unhealthy habits and conditions are considered unpleasant or inconvenient, these aspects can be taken into account in developing recommendations and emphasised in their promotion. Where they are considered immoral or of lower status, these aspects too can be taken into account and emphasised. In focusing on the more immediate goals of the water users, the uncertainty of the health benefits becomes less critical.

Unfortunately, practices considered by experts to be unhygienic may also be supported by local social norms, cultural beliefs, and practicalities. This inevitably complicates matters, particularly since the health benefits themselves are often uncertain. Historically, hygienic behaviour has often been promoted as socially and even morally superior to local practices, even in programmes ostensibly grounded in health sciences. (Yet again, there are parallels with conservation-oriented demand-side management, which also tends to have strong moral overtones.) Such moralising is sometimes criticised for undermining the scientific credibility of hygiene promotion. More important, it can draw hygiene promotion more firmly into prevailing power relations that oppress the urban poor, and undermine their legitimate claims for a say in their own development.

The moral dimensions of hygiene promotion were more explicit in the sanitary reforms of the nineteenth century than they are today. The expert driven model prevalent during most of the twentieth century has also been attenuated. Participation, partnership and empowerment are often presented as central to hygiene promotion. Even market mechanisms are being adapted to hygiene promotion, and a recent initiative has enlisted a number of soap manufacturers in Kerala and Ghana to promote handwashing (Curtis 2002).

Nevertheless, expert knowledge is central to hygiene promotion, including health-oriented demand-side management. One of the key justifications for taking a health perspective is that social norms, developed through trial and error or normative reasoning, do not provide a sufficient basis for achieving the health benefits that water can provide. Where water is piped into toilets and kitchens, and drained away from sinks and toilets, a few simple hygiene conventions may suffice. For most of the urban poor, identifying appropriate behaviours is more complicated, but the potential benefits are higher. The image of the expert, prescribing local hygiene behaviour, may be misguided. However, the need to ensure that the urban poor have access to water-related health expertise (as well as water itself) remains a central task.

A market-economist's demand-side perspective

Market economists tend to focus on prices and the institutions through which prices are set rather than the practices that users ought to adopt. They are inclined to assume that consumers are rational and, if well informed, will demand and use a commodity in ways that best suit their budgets and needs. The price of water provides an indicator of scarcity, which both suppliers and consumers can respond to, both serving their own interests and ensuring that water only goes to uses that are valued at least as

highly as their cost. The appropriate price is usually taken to be the "marginal cost": the cost of providing an additional unit, ideally including resource depletion and other environmental costs. Facing this price, the consumer will, again ideally, use water up to the point at which the marginal benefits from consuming an additional unit are equal to the marginal costs of providing it.

The problems with treating water as a normal economic good were outlined in Box 3.1 and are dealt with in some detail in other publications (Johnstone & Wood 2001). In summary, while economists often favour the market as the best means for setting prices, it is generally recognised that the water prices of large scale providers need to be regulated – and that large scale providers are often more efficient than small scale providers. If water is metered at the point of use, there are more pricing options than with more conventional goods, since prices can comparatively easily be varied depending on the user and the amount they consume. Nevertheless, it is very difficult to define appropriate pricing rules.

Despite these and other complications, long run marginal cost pricing is often taken as an appropriate 'rule of thumb'. The long run marginal cost may be difficult to define, let alone measure. However, water tariffs typically diverge so strongly from any reasonable version of marginal cost pricing that such difficulties are irrelevant. Most often, prices are clearly below the marginal cost. Governments have tended to set piped water prices very low, particularly for households. Moreover, when users access water from 'natural' sources they often get it for free (leaving aside time and labour costs), even when water use is depleting groundwater aquifers or diverting surface water from other users.

The following quotations from a book on "Managing water as an economic resource" summarise an economic perspective on the role of water prices in managing demand:

> "'Water stress' symptoms are breaking out everywhere." (Page 6)
>
> "These symptoms are clear signs that supply systems and consumption habits have, in general, failed to adapt to the increasing pressure of demand on the water resource and to the environmental strains that it causes." (Page 7)
>
> "The argument of this book is that the most basic reason why inappropriate habits of supplying and using water have persisted – with all of the problems described above – is that it has been under-priced as an economic resource. Users do not, in general, treat water as an economic (that is, scarce) commodity, and the market is insufficiently used as a means of solving the problem of scarcity." (Pages 7-8)
>
> "The professional consensus is that tariffs should be based on the marginal cost of supply, interpreted as the cost of adjusting long-term capacity caused by a given change in demand. The rationale for this pricing rule is that the use of water is optimised, in the economic sense, at the point where the benefit from the last (marginal) unit of supply equals the cost of providing that increment." (Page 9)

> "The aim of managing demand is to ensure that a given supply of water is distributed to accord more closely with its 'optimal' use pattern." (Page 27)
>
> "This book places emphasis on demand management not because these policies alone are sufficient for the water sector but because they have been neglected in the past." (Page 27-28)
>
> Source: Winpenny, J (1994) *Managing Water as an Economic Resource,* Routledge, London

The basic argument here is that getting water prices right is central to demand-side management, and would go a long way towards solving problems of water stress. In the current literature on demand-side management, water pricing is typically seen as complementing the more technical approach that conservationists have traditionally taken. It is worth keeping in mind, however, that when the term 'demand-side management' was coined a few decades ago, proponents were openly critical of what they perceived as market economists' over-reliance on prices as a means of balancing supplies and demands. Without the appropriate technologies and demand-side programmes, they argued, price-induced savings would have to be achieved by reducing service levels rather than providing the same service levels with fewer resources. Economists tended to counter that it was appropriate prices that would provide the incentives for users and private enterprises to seek out the appropriate technologies and demand-side measures. This difference in perspectives is still evident, even if conservationists are more inclined to accept pricing policy as an important tool of demand management, and economists are more inclined to accept that other tools of demand management can sometimes help price incentives to operate more efficiently.

Of more concern to this report, while the book cited above was explicitly concerned with low and middle income countries, higher water prices would hardly seem to be an appropriate response to the water problems of the urban poor. As indicated in earlier chapters, the urban poor often pay very high prices for water, purchased in small quantities from small water vendors. Even when the 'price' is zero, the cost of collection is often very high. This is not so much because water resources are scarce, but because the infrastructure required to deliver water cheaply and conveniently is lacking. The notion that higher prices will help solve such problems would appear, at least superficially, to be absurd.

Market economics can also explain, however, how 'underpriced' piped water may actually contribute to 'overpriced' water and excessive collection costs in low-income neighbourhoods. Very briefly, if a utility depends on water sales to meet costs, compelling them to charge excessively low prices for piped water will inhibit the expansion of the water supply system, low income neighbourhoods will remain unconnected (even if residents would be willing to pay the full economic cost), and resale markets will be undersupplied, leading to higher prices in these secondary markets. Moreover, economics predicts that efforts to control secondary water markets by punishing vendors who sell at high prices are likely to reduce supplies still further, leading to still higher 'black market' prices for the urban poor, or increasing collection costs.

While this may be an oversimplification, it at least bears a relation to some of the problems faced in many low-income cities. Water utilities are often required to sell water at prices well below those required to maintain the piped water system, let alone finance expansion. Subsidies rarely make up the difference, and these financially unviable utilities cannot attract private finance.[9] There is under-investment in many piped water systems, particularly in low-income areas. Partly as a result, the urban poor often pay exorbitant prices for water, restrict consumption, or do both (Kjellén, Bratt, & McGranahan 1996; Swyngedouw 1995). In North Jakarta, for example, a survey found that the poorest (20% of) households had to purchase potable water from vendors often charging more than ten times the official piped water price, and ended up paying an average price more than twice that paid by the richest households, despite using salinated well water for many purposes. It is also common for households to be prohibited from reselling water, although if a lack of competition is the reason for high vendor prices this is likely to make things worse (Crane 1994). In a number of cities, no water vending is officially allowed, even though it is common, leading to widespread opportunities for corruption.

On the other hand, it is also important to recognise that long run marginal cost pricing is not a very good rule of thumb for demand-side management in low-income urban settings, even from the perspective of market economics. At least two mutually reinforcing reasons have received a great deal of attention over the years, though they tend to be neglected in current water resource debates. The first reason relates to equity and is not strictly speaking a demand-side management issue: that water for the urban poor should be priced below marginal cost so as to serve redistributive goals, which the market does not spontaneously address, but which are valued by society. The second relates to public health and clearly does involve demand-side management: that water for the poor should be priced below marginal cost so as to reflect the public health benefits of adequate water (for example, the benefits that local residents receive from not being exposed to the infectious diseases their neighbours contract as a result of inadequate water supplies). These two reasons are interrelated. Subsidising public goods for the poor can be an efficient means of achieving redistributive goals (Dasgupta 1993), and while water itself is not a public good, some of the services it provides could be described as spatially localised public goods. To be efficient and equitable, it is critical, of course, that the finances for the subsidies are raised efficiently, equitably and are sufficient to ensure that enough water can be supplied at the desired price.

These are, unfortunately, some of the same reasons used to justify the low water prices that have undermined the financial viability of many public utilities, actually resulting in high water prices for the urban poor. In effect, policies adopted in the name of the poor have sometimes subsidised the better off, and left the poor unserved. This phenomenon is not peculiar to water, however. The interests of politically disadvantaged groups are often well represented in the early stages of policy formulation, and then lose out during implementation. There is no reason to believe

[9] In the water sector literature, price controls are often mislabelled subsidies. A water subsidy is a financial transfer, typically to a water utility, designated to fund water supplies. Price controls set the price of water. In theory, price controls can be matched by subsidies, allowing the utility to meet demand at a reduced water price. If such subsidies are guaranteed, they should help attract complementary private finance (though they may be difficult to justify for other reasons). Many of the water sector problems typically ascribed to subsidies are actually the result of price controls that are not accompanied by matching subsidies.

that equitable and efficient policies are more difficult to implement in the water sector than in other policy arenas. Moreover, there is a great deal of variation in the equity and efficiency of urban water provision, and in most urban centres there is considerable room for improvement. Setting low water prices for all households is unlikely to be either efficient or equitable, particularly if it not matched by efficiently financed subsidies. But more selective measures, assisting the least well off, are not as difficult to design as they are to implement.

There are a number of pricing measures that can be taken to target the urban poor and their economic needs. Which measures are most suitable depends heavily on local circumstances. Indeed, the demand-side economics can be quite complex, even if superficially the pricing options are straightforward. Examples include:

Free public water taps – Free public water taps can be provided in deprived areas. Water consumption per capita is likely to remain low unless the taps are actually located in house compounds (Cairncross & Feachem 1993). Moreover, where free water taps are scarce, economics predicts that long queues are likely to develop, eventually pushing the effective cost up to the point where users are indifferent between the public taps and alternatives such as vended water. If the cost of the alternatives is not demand-dependent, all of the benefits of the 'free' supplies may be dissipated. Social norms and pressures can act to prevent excessive queuing, but may also lead to conflicts (conventional economics does not really explain such behaviour). Alternatively, more formal measures can be taken to prevent excessive queuing and similar 'rent dissipating' behaviour, ranging from tying buckets together to create proxy queues, to hiring tap attendants to charge for water. Generally, however, neither the utility nor the government is in a good position to regulate such behaviour, and much depends on the organisation of the local communities. By providing more taps, the need for such controls is reduced, and though the quantity of water consumed may increase, it is unlikely to exceed the levels required to meet health needs. On the other hand, the incentive to prevent wastage at the tap declines as the marginal cost of water at the tap falls to zero.

Water hydrants for vended water – Water hydrants can be provided with low-priced water, for resale by water vendors. If vendor water is limited by the system capacity (rather than the willingness of the vendors to deliver water), economics predicts that even if the market is competitive the resale price will rise until supply and demand are balanced, regardless of the vendors' purchase price. Vendor competition may ensure that no excess profits are being made, but unless supplies can be increased, this will not reduce prices. Instead, vendors themselves will engage in queuing or other unproductive but competitive behaviour. Alternatively, vendors may collude with utility staff and share the rents (or utility staff may capture all of the rents).

Lifeline tariffs – Water can be provided free or at a very low price to residential users consuming quantities considered just sufficient to meet basic water needs. This works best when the urban poor have individual, metered water connections. In principle, minimal provision can also be supplied using water tanks or water connections that limit consumption through time of day or flow restrictors. Problems develop when most poor households cannot even afford lifeline connections, since supply restricted lifeline tariffs inhibit sharing.

Increasing block tariffs – With an increasing block tariff, the first block (typically a specified number of cubic meters of water consumed in a given month) is charged at lower price than the subsequent block, which is in turn charged at a lower price than the next block, and so on. Ideally, the blocks would be sized and priced to take into account public health, redistributive, water resource, and cost recovery concerns, though these goals can rarely be reconciled perfectly. As a possible compromise, the size of first block could be set at the quantity of water required to meet water-related health requirements, and priced low to reflect the public health and redistributive benefits; the last block could be priced at the long run marginal cost; and any intermediate blocks (and a fixed charge or rebate) could be sized and priced with a view towards cost recovery and redistributive concerns.[10] In practice, this rarely comes even close to being achieved, and in many low-income cities the first block is well above minimal requirements, and may even be sufficiently large to cover all water consumption of the majority of households. In any case, as with the lifeline tariff, if increasing block tariffs are to assist the urban poor, care must be taken to ensure that very poor residents do not end up paying higher prices as the result of meter sharing, or insufficient connections and high vendor prices.

Single volumetric rate with rebate – On the grounds that increasing block tariffs rarely serve either efficiency or equity goals, Dale Whittington has recently proposed a two part tariff, consisting of a single volumetric charge combined with a fixed monthly credit or rebate (Boland & Whittington 2000). The single water rate can be set at the long run marginal cost (or some approximation thereof), while the rebate can help ensure that purchasing small quantities of water is not a financial burden. A small minimum fee is also proposed to prevent abuse of the system. One of the main advantages of this system is its relative simplicity, though it does require metering, and does not address the problems of those without connections.

Reduced tariffs for 'low-income' housing or deprived areas – If deprived areas or housing types can be identified, connections for these residents can be charged preferential rates. Differentials can be applied to both metered and unmetered households, and even if the urban poor share connections, they can still receive the preferential rates. Area based systems are more likely to be effective where residential areas are relatively homogenous. Housing based systems are more likely to be effective where residential areas are mixed, but certain housing types are closely associated with poverty. Such systems are more likely to be considered 'unfair' by those who pay higher rates, since, unlike with the rising block tariff, households actually face different tariffs (when different prices emerge from a single tariff this is less likely to be viewed as discriminatory, even when that is the intention). Moreover, at least some affluent people are likely to live in 'low-income' housing or in deprived areas. It is also important to recognise that in a great many urban areas the poorest residents do not even have security of tenure, or the right to obtain water at the standard tariff, let alone receive preferential treatment. Nevertheless, in cities where there is the political basis for improving services to the poor, this remains an option.

[10] A simpler version sometimes proposed as a means for meeting cost recovery and marginal cost pricing goals is a two block structure with the second block priced at the marginal cost, and the first block designed to ensure that the utility breaks even. As long as all consumers face the marginal cost for some of their water consumption, the efficiency properties of marginal cost pricing are retained. In practice, even this is usually impossible to achieve, given the wide variety of consumption patterns.

Reduced connection costs – Economics suggests that reduced connection costs may be more advantageous to low-income households than reduced water rates. The urban poor often find it difficult to make large lump-sum payments. They rarely have substantial savings and often face very high borrowing costs. In some circumstances, a utility is in a good position to provide the equivalent of low interest loans to newly connected households, paid off through the water bills, or to cross subsidise connection costs with water bills. This assumes that the billing system is operating efficiently, and that the utility has the capacity to meet the demand for new connections.

A choice of tariffs – Utilities can offer a choice of tariffs to individuals or communities. This can include, for example, pre-payment meters which allow consumers to pay for water in small amounts in advance, the option of paying for a share of the connection costs in the monthly bill, or larger blocks for shared connections. This may be administratively difficult, but overcomes the disadvantages of either assuming that one tariff suits all connections or having the utility or government decide who should be charged at which tariff. It does, of course, limit the scope for preferential treatment for consumers for whom the public benefits of providing water are considered higher than their willingness to pay.

Despite these and many other qualifications that economists have examined, the principal demand-side insight of market economics is typically taken to be that water should be priced at its 'full economic cost'. As indicated in the previous chapter, this is what is usually implied by the admonition to treat water as an economic good. In well-functioning markets, however, prices also reflect willingness to pay, and provide a signal to suppliers as well as consumers.

On the other hand, as with the conservationist perspective, the demand-side perspective of the market economist need not focus exclusively on resource issues. Moreover, from an economic perspective it is important not to treat the demand and supply sides independently. How the water markets function, the scope for competition, the importance of non-market mechanisms of water access and distribution (whether based upon government intervention, the actions of user association, or social norms), and many other critical issues are all suitable topics for water economics, and influence both water demands and supplies.

A grass roots activist's demand-side perspective

For the grass roots activist, as for the market economist, the problem with supply-driven water planning is not so much that residents do not know about saving water or how to use it, but that they have often have little control over water provision. Thus grass roots activists and provision-oriented market economists tend to agree on the need for what has come to be termed the 'demand responsive' approach to water provision in low-income areas. The 'demand responsive' approach is typically presented as a critique of supply-side approaches driven by public authorities or private monopolists. When the urban poor are more directly involved in water provision initiatives, so the argument goes, supplying them with water becomes less expensive, more efficient, more sustainable and better suited to local needs. Even from the grass roots perspective, part of the argument is typically based on the observation that if people are not making a substantial commitment to acquiring their 'improved' water supplies, it is not possible to ensure that they will value the water system and help ensure that it is maintained.

Grass roots activists and market economists tend to have different interpretations of what a demand responsive approach entails, however. As indicated above, grass roots activists tend to focus on local politics and community organizing, whereas market economists tend to focus on prices and economic competition. Thus from a (stereotypical) grass roots perspective, the relevant demands are those of communities, and the most obvious way of ensuring that those demands are articulated and acted upon is to help communities organise and participate in their own water provision. On the other hand, from an (equally stereotypical) market economics perspective, the relevant demands are those of individual consumers or households, and the most obvious way of responding to those demands is to ensure that the water tariffs are set correctly, and that suppliers have the incentive to meet any demand at the correct tariff.

The grass roots approach is often taken to be one of 'community participation', although 'community' and 'participation' are somewhat contentious terms, that are themselves subject to varying interpretations. 'Community' is sometimes used to refer to idealised social grouping, while at other times it is simply meant to indicate people living in a certain area, or having other characteristics that give them common interests and the possibility of acting together to pursue those interests. Participation implies some level of involvement, but there are genuine (as well as tactical) differences of opinion on the level and type of involvement that should qualify as 'participation'. Since strengthening community participation is being presented here as a form of demand-side management, it is worth taking these semantic issues seriously.

The use of the term 'community' by advocates of community participation is often taken by detractors to imply the existence of well-bounded, non-hierarchical groups, living in harmony, and capable of making consensual decisions. No grass roots activists seriously believe that such communities exist, although some may be guilty of romanticising communities in opposition to governments and markets (just as economists have been guilty of idealising the perfect market, and planners have idealised the perfect plan). Many do believe, on the other hand, that better organised and better informed urban poor groups could do a great deal to address their water problems, and that conventional approaches to water provision do not respond to, and often undermine, this potential. This could be seen as a position on demand-side management, on the understanding that groups of users can themselves be considered demand-side managers.

The varied use of 'participation' reflects both legitimate differences of opinion, and dubious attempts to present conventional projects as 'participatory' (in order, for example, to secure donor finance). Unfortunately, it is often difficult to tell the difference, since what were once considered dubious definitions became conventional usage as the term became more popular. Table 4.2 provides a typology of participation in water and sanitation provision. It is doubtful whether 'passive participation', 'participation through consultation' or 'participation through contribution' should ever really justify labelling an initiative 'participatory'. Yet even these weak forms can make a difference where they have previously been absent.

Table 4.2: A typology of participation in water provision

Form of participation	Characteristics
Passive participation	Residents participate by being told about water initiatives that are being planned or have already been decided upon, without any attempt to elicit local opinion or knowledge.
Participation through information (giving)	Residents are asked questions about their water situation or needs through surveys or similar instruments. The information is fed anonymously into the decision-making process without feedback.
Participation through consultation	Residents are consulted as to what should be done to improve the local water situation, and may discuss different options being proposed by water sector professionals, but the professionals are not obliged to take residents' views into account.
Participation through contribution	Residents are asked to provide labour or financial contributions towards water system improvements, but do not choose what improvements are 'on offer'.
Participation through collaboration	Resident groups and other key actors (e.g. local government and a water utility) agree to take responsibility for certain components of a negotiated water system improvement, with residents taking primary responsible for some well defined components.
Participation through partnership	Resident groups and other key actors share resources, knowledge and risks, in pursuit of a commonly agreed upon water system improvements. Partnership can be taken to imply a long term, equitable relationship.
Participation through self mobilisation	Residents work together to demand and/or implement water system improvements. They develop contacts with external actors, some of whom may contribute organisational as well as technical skills, but resident groups retain control over how the resources are used.
Source: Adapted from Jules N. Pretty, Irene Guijt, Ian Scoones, and John Thompson. *A Trainer's Guide for Participatory Learning and Action*, London: International Institute for Environment and Development, 1995, page 61. (Pretty et al. 1995)	

International NGOs have helped to ensure that some form of community participation is adopted in most water sector initiatives purposefully targeting low-income areas. WaterAid, perhaps the best known international water NGO working in low income urban (as well as rural) areas, interprets community participation as follows:

> "Community participation means that communities are actively involved in the design and long term management of projects. Not only in terms of their time and labour, but also through their knowledge of local resources. They share the costs of projects by making appropriate labour, time and financial contributions to both the initial and long-term running costs.
>
> "WaterAid knows that only by basing projects on communities' needs and preferences is it possible to make the work sustainable. People will be committed to a project which solves their problem in the way that is most appropriate for them.
>
> "They will not be committed to a project that has been imposed by outsiders with minimal consultation. That commitment translates into the day-to-day work necessary to maintain and manage projects in the long term, a much harder task than the initial construction. WaterAid avoids creating 'white elephants' which look wonderful on the formal opening day but are neglected and unused within a year. Through their

involvement in projects communities can gain skills and confidence which will enable them to tackle other problems they face."
Source: *WaterAid Development Issue Sheet*, http://www.wateraid.org.uk/research/index.html

Even water engineers, economists, water companies and others not predisposed to take community level organisation seriously, have come to accept the importance of engaging with local groups in deprived areas, and not treating water as simply a service to be delivered or a product to be sold. In some cases, even telling local residents about a planned water initiative is an improvement over previous practices. More active consultation undoubtedly helps. Many conventional project managers have found that if residents can be convinced to contribute labour, land or finance to a project, that project is more likely to succeed. Even private water companies have been exploring multi-sector, multi-stakeholder partnerships for water and sanitation provision (Caplan, Heap, Nicol, Plummer, Simpson, & Weiser 2001).

But from a grass roots activist's perspective, community participation ought to involve active collaboration at the very least, and ideally some level of self-mobilisation on the part of the community. A large share of water in poor urban areas is not provided through conventional water projects, and in such circumstances community mobilisation can be particularly important. Moreover, while from a conventional planning perspective, a lack of community capacity may be seen as the principal obstacle to increasing community participation, from a grass roots perspective organised communities may be seen to be needed to increase the capacity and capabilities of government institutions.

While the role of community action has not always been recognised within the formal water sector, it has always been central to water provision in many deprived urban neighbourhoods. Where neither the private sector nor the government are providing water (or where provision is very poor), community groups or local leaders often organise in an attempt to meet local water needs. The resulting systems vary in their efficiency, safety and equity, but they often involve very innovative measures, tailored to local conditions. Where piped water systems do not exist, communities may organise well digging or drilling, or piping water from nearby surface water sources. Alternatively, local groups or leaders may organise to demand conventional services from utilities, which tend to be hesitant about providing water to low-income settlements, particular when land tenure issues remain unresolved and economic costs of distribution are high. Where piped systems supply adjoining neighbourhoods, but are not extended to low-income areas, local groups may also request access to the system, but provide for local distribution themselves. Local groups may also tap the piped system without (formal) permission, and local officials may implicitly condone this, and even demand (informal) payments. Such activities can take an enormous range of institutional forms, and involve a wide array of technologies.

In most policy documents, community participation is assumed to mean that the community is participating in an initiative being organised by outsiders. Indeed, the term community participation can be taken to suggest this: if at one end of the spectrum passive participation comes close to being a contradiction in terms, at the other end of the spectrum so does participation through self-mobilisation. After all, if communities organise to drive their own water agenda, one could argue that they have ceased to be mere 'participants' in the process. But this makes community

participation a very limiting concept, and risks playing semantics with substantive disagreements over the role communities do or could play in water provision. Understanding the actual or potential importance of organised communities is a potentially critical part of a demand-side strategy, however community participation is defined. Moreover, mobilising communities is central to a number of grass roots approaches to water and sanitation provision.

The Orangi project in Karachi is probably the best known community-based sanitation project (Hasan 1990), and its approach has since been extended to other urban services and centres, including water supply in Faisalabad (Alimuddin, Hasan, & Sadiq 2002). In a recent summary of the lessons for working with communities, taken from the experiences of the Orangi Pilot Project – Research and Training Institute, Arif Hasan's first point emphasises the role of community organisation in increasing the government's capacity:

> "Capacity and capability' of government institutions can never be successfully built without pressure from organised and knowledgeable groups at the grass roots. Such groups can only be created by activists, who have to be identified, trained and supported financially. Formally trained professionals and technicians are not an alternative to such activists. The formation of such groups forces transparency in the functioning of government agencies."
> (Hasan 2001, page 159)

Thus, where many policy documents on community participation emphasise the need for governments to strengthen the capacity of communities (so as to enable them to participate), Hasan emphasises the need for communities to become better organised in order to increase government capacities.

In practice, grass roots strategies must be rooted in local politics. Experiences in Pakistan cannot simply be applied to other urban settings, even where poverty is equally pervasive and water supplies are clearly inadequate. Just as the physical context heavily influences which conservation and health measures are appropriate, and the economic context heavily influences which pricing and market measures are appropriate, so the political context heavily influences which sorts of grass roots measures are likely to be appropriate. The claim that community organisation must be "created by activists, who have to be identified, trained and supported financially", for example, is based on political assumptions that may not always apply. On the other hand, the importance of organised and knowledgeable community groups for the effective functioning of government institutions is likely to be more widely applicable, and formally trained professionals and engineers will rarely have either the capacity or inclination to engage in community activism.

Poorly organised communities – and especially their more vulnerable members – are inherently at a disadvantage when natural water sources are scarce and degraded and individual water connections are not being provided. A lack of good governance, unresponsive public authorities, private monopolists, tenure insecurity, ethnic conflict, and a range of other interrelated conditions very common in low-income settlements, can easily compound this disadvantage. However, the manner in which communities are organised can also make a major difference, again particularly for vulnerable groups. If, for example, communities are organised in a way that allows a small

number of powerful individuals to monopolise water supplies, problems are almost certain to arise.

Advocates of privatisation sometimes argue that by privatising public utilities, water can be depoliticised, and in effect supplied like most other marketed commodities. There is little evidence for this, either in relation to national, city-wide or community politics. Indeed, both large water concessions and informal water vending are almost always politicised, and well-organised communities are likely to be in a far better position to turn these politics to their advantage.

Early in the recent wave of water utility privatisation, the Buenos Aires water concession was often held up as a successful example. It was not especially successful in providing water to low income areas (Luftus & McDonald 2001). Moreover, particularly in areas where tenure conflicts arise – and a large share of the urban poor live – provision remained inherently politicised, since the water company was under no contractual obligation to provide water to unauthorised settlements, and without government support was unwilling to entertain their requests for water provision. When the private utility – Aguas Argentinas – did begin to extend water to low-income areas, this was done at the instigation of community groups (and an NGO), and only after the local government also lent their support (Schusterman et al. 2002). While the manner in which these communities were organised may have been far from ideal, it did provide the impetus for improvement.

In low-income settlements where private vendors provide most of the water, community organisation can also make a critical difference. In Kibera, the largest squatter settlement in Nairobi, privately owned water kiosks that get their water from the piped system provide a large share of the water (Katui-Katua & McGranahan 2002). The kiosks provide an important service, but also charge high prices, especially during periods of scarcity. Again, the situation is politically charged, and even these relatively small kiosk operators rely on political connections (and presumably kickbacks), both within and outside the community. A community-based organisation supplying water in part of Kibera reportedly charges both lower and more stable prices. When a large water improvement project was initiated with international funding, local stakeholder groups proposed that an association of water vendors be created to help ensure equitable and competitive water pricing (though some residents were concerned that any measures that might seriously reduce water-related profits could lead to retribution). Unfortunately, the project was stopped without consultation – or even much explanation – resulting in considerable disillusionment.

Even more than with the other approaches to demand-side management, the success of a grass roots approach is also likely to depend on who the demand-side managers are and where they are located institutionally: in a water utility, a government department, an NGO, a CBO or some combination.

A demand-side management group in a water utility is unlikely to be competent in grass roots organising, and would not want to mobilise communities to make costly water-related demands on their own utility. At a minimum, however, they could consult with community groups regarding the type of service they would like, where the pipes are to be laid, where public water taps are to be located, the options for cost recovery, and how the utility should relate to intermediaries (e.g. vendors) that purchase water from the piped system. They could likewise make it easier for

communities to organise around shared cost systems, whereby local residents, the utility and perhaps local government all make a contribution to extending water services. They could also work with community groups to resolve some of the problems that utilities often encounter in low-income communities, including violence towards company employees, non-payment of bills and vandalism. And at the same time, they could actively respond to the problems that communities often encounter with the utilities, including inflexible regulations, prohibitions on water redistribution, and extra-official charges. In some circumstances it may be easier for a utility to work with a well-organised community group than with individual households even if, as noted above, this may lead to greater demands on the part of the communities.

Whether the utility is public or private can also make a difference, though this difference should not be exaggerated. Two purported strengths of private utilities are efficiency and political neutrality. Two purported strengths of public utilities are a concern for the public interest and political accountability. In practice, however, even private utilities must be regulated well if they are to operate efficiently, and as noted above privatisation need not depoliticise water provision. Alternatively, public utilities are not inherently concerned with the public interest or politically accountable, and indeed are increasingly asked to become more commercial in orientation. Ultimately, the extent to which a utility can contribute to community driven demand-side management must be determined locally, not in the abstract.

Non-governmental organisations, or more generally what are sometimes termed voluntary organisations, are a more obvious institutional location from which to engage in a grass roots approach to demand-side water management. Indeed, one could interpret the WaterAid approach to water provision as an international attempt to support grass roots approaches that emphasise the demand side (even in its urban work). Numerous other international, national and local NGOs are also involved in urban water provision, especially in countries where state provisioning is in decline and private provisioning is poorly developed. Their relation to community organisation and demand-side management varies considerably, but they have become an integral part of the water sector in many countries.

Combining demand-side strategies and serving the urban poor

The different approaches to demand-side management are summarised in Table 4.3. They are united primarily by their common aversion to the supply-fix approach to water problems. According to the conservationist, unless the technical opportunities to save water are implemented, water resources will be overexploited (and capital will be invested in unnecessary infrastructure). According to the hygiene specialist, unless opportunities to use water more hygienically are seized, the health benefits of water will not be realised (leading to unnecessary ill health and hardship, especially in low-income areas). According to the market economist, the supply-fix approach has led to underpricing (with attendant misallocation of scarce water and resource depletion) and water systems unresponsive to the demands of individual users. And according the grass roots activist, the failure to engage constructively with deprived groups, has led to water provisioning ill-suited to the needs of poor communities.

Table 4.3: Comparing different approaches to demand-side water management in the household sector

	The conservation argument	The hygiene argument	The marginal cost pricing argument*	The community-action argument
Guiding Concern	Water stress is a growing problem in most parts of the world, due to excessive water consumption.	Water-related diseases still constitute a large share of the global burden of disease.	Water is a scarce commodity, with an economic value in numerous alternative uses.	Adequate water is a basic need, without which people cannot live healthy and fulfilling lives.
Key insight	There are numerous unexploited opportunities for saving water without reducing the services water provides.	Achieving health depends on how water is used as well as how much water (of adequate quality) is provided.	Piped water is typically priced well below its (marginal) economic value.	Dis-organised (poor) communities are at a disadvantage in both addressing their own water needs and negotiating with outsiders.
Contributory factors	Householders using piped water often cannot tell how much of their water is going to which purposes, are not aware when they are wasting water, and do not have the means of judging water conserving technologies.	Householders cannot discern the health consequences of their water use practices, and often rely on social norms which, especially in crowded and generally hazardous living environments, may be unhealthy.	Water is often treated as a social good, with provision organised as a non-commercial enterprise. Even commercial providers rarely bear the full (marginal) costs of water withdrawal and in any case do not operate in a competitive market.	Water utilities are not responsive to the needs and demands of low-income communities, especially if they are located in informal settlements. Local organisation is often suppressed for political reasons.
Demand-side consequences	Users are unaware and unconcerned about water conservation, and waste water unnecessarily.	Users often fail to adopt safe water practices, and do not achieve the potential health benefits even when they receive piped water.	Consumers overuse water, either leading to resource problems and/or depriving others of valuable water.	Residents receive inappropriate or inadequate water services, or must rely on informal and often costly and inadequate water sources.
Recommendation	Conservation education and promotion should become an integral part of piped water provision	Hygiene education and promotion should become an integral part of water provision.	Piped water pricing should be based on long run marginal costs, giving users the incentive to manage their own demand efficiently.	Poor communities should mobilise (or be mobilised) around local water issues, and providers should be responsive to community as well as individual demands.

* This column concentrates on the economic arguments for marginal cost pricing, and ignores the economic arguments more specific to low income communities. It also ignores the potential supply-side consequences of underpricing, including a lack of revenues for expansion.

At least superficially, both the conservation and hygiene approaches to demand-side management tend to be expert-driven, and conform to the planning approach to water provision. Thus, a key justification for demand-side management for conservation is that users are often unaware of how they could save water, while a key justification for hygiene interventions is that users are unaware of the health consequences of different water use practices. In both cases, the dominant response has been to have experts identify opportunities for improvement, and then try to develop programmes to ensure that these improvements are implemented. By and large, cultural beliefs and practices are seen as obstacles to overcome. This took an extreme form in the early decades of the sanitary movement, when the urban poor were often portrayed as sub-humans whose ignorance and immorality were an integral part of their poverty. But it remains a tendency in many hygiene and conservation programmes today.

The market-economic and grass roots approaches aspire to be user driven and conform to market and voluntary action approaches to water provision. As noted in the section on the market economists' demand-side perspective, one of the most common assumptions of market economics is that individual users are in the best position to judge the value of water (and other goods), while the literature on participation and community action typically assumes that communities are in the best position to articulate their needs. This clearly emerges in relation to demand-side management, with market economics focusing on individual (or household units) responding to prices, and the community action approach focusing on groups and collective action and negotiation.

In terms of physical priorities, both the conservation and market-economic perspectives tend to emphasise the dangers of overuse and abuse, while the hygiene and grass roots approaches tend to emphasise the benefits of adequate and appropriate provision. This emphasis is inherent in the conservation and hygiene approaches, and somewhat contingent in the market-economic and grass roots approaches. The logic of market economics, for example, can be used to make a case for low water prices in areas where public health is threatened by inadequate access to water, even if arguments for marginal cost pricing currently dominate, at least in policy arenas. Similarly, while the logic of collective action has been applied here to the community level where environmental health problems tend to be central, it could also be applied to resource issues that arise at the watershed level.

Despite all of their differences, it is possible to view these perspectives as supporting complementary rather than contradictory approaches to demand-side management. Serious contradictions arise primarily when one or other approach is taken to be **the** approach to demand-side management. Efforts to promote conservation, environmental health, market mechanisms or community participation are often grounded in simple, expansive narratives that leave little room for alternative perspectives. It is easy to mistake contradictions between these narratives as inherent conflicts between different demand-side processes and actions.

On the other hand, different cities have different water conditions, institutions and political and economic settings. In any particular city, some or all of the arguments may not apply. The fact that supply-side approaches have often been adopted uncritically is no excuse for adopting demand-side approaches equally uncritically. Moreover, while a paradigm shift may indeed be required in order to remove a longstanding bias towards supply-side 'solutions', it is important to recognise that any

new paradigm will have its own political and ideological content, which may be suitable in one part of the world, and destructive in another. Indeed, the danger that the environmentalist paradigm that has generated much of the concern about a forthcoming 'global water crisis' is undermining the case for providing water to the urban poor has been a recurrent theme in this report.

Demand-side management, in its conservationist form, is often presented as part of an integrated approach to water resource management. Proponents often deride the narrow-mindedness of conventional water engineers and planners, who fail to appreciate the importance of understanding and acting on the demand side. It is therefore somewhat ironic that demand-side management has come to be associated with a very narrow perspective on demand-side issues.

The principal focus of this report has been the potential of demand-side approaches for water resource management in poor urban neighbourhoods, where supply-side measures have often failed. In these neighbourhoods the main challenge is usually to get more water to local residents, not to protect regional water resources. As indicated in the previous section, conservationists, health specialists, economists, and grass roots activists all make convincing arguments for giving the demand-side more attention in urban water management. Generally, the arguments of health specialists and grass roots activists are of more immediate relevance in most low-income contexts. Indeed, a narrow focus on ensuring that water prices reflect the full marginal cost of water, or on conserving water so as to protect raw water resources, could be detrimental to the welfare of urban poor groups. On the other hand, as indicated in previous chapters, there are important insights in the conventional economic and conservation perspectives that should not be dismissed.

Even within a single city it is technically possible to get more water to the urban poor, while also introducing water-saving measures where wastage is a serious problem. Similarly, it is organisationally possible for communities to take more control of their own water services, even as water prices and water markets are being reformed to serve conservation efficiency and public health goals. Indeed, if the alternative approaches could be combined effectively, water conservation in one part of the system could mean more water for the urban poor, hygiene education could help residents use water more efficiently, and better organised communities might even press for economically efficient price reforms.

There are also likely to be measures that can help provide a better basis for demand-side management generally. Housing insecurity and legal and political systems ill-suited to the needs of the 'informal' city, work against all forms of demand management in low income settlements. Local residents do not trust outsiders, even those claiming to be working for their benefit, and better local organisation is often perceived by the government as a threat rather than part of a solution. Under such conditions, the more technocratic approaches to demand-side management are unlikely to make much headway on their own, and the politics of water provision is highly dependent on the broader political setting. (This should not be taken to imply that water improvements must await political improvement – in some circumstances water system improvements can help signal or cement political shifts.)

There are in any case conflicting priorities within demand-side management, as well as within the water sector generally. The compromises that emerge are often based on

very blunt approaches to demand-side management, and do not serve any of the interests represented in the declared goals. The classic example is water pricing, where the declared trade off has conventionally been between higher prices for water conservation and subsidised prices to keep water affordable for the poor. A typical compromise in low-income cities has been low water prices but minimal subsidies, leading to low water prices for the more affluent residents and scarce (and hence costly) water for the poor. Alternatively, in compromising over the extent to which local communities participate in water initiatives, it is not uncommon for residents to be consulted and for their views to be subsequently ignored, adding to their frustrations and mistrust rather than their empowerment.

In short, sound demand-side management cannot replace water politics, but can improve the basis for water politics. Each individual approach to demand-side management contains part of the means for improving certain aspects of urban water systems – as long as they are not interpreted dogmatically. By combining the different approaches, there is the potential for adapting demand-side management to diverse settings, and incorporating a concern for the urban poor as well as for the broader public and future generations. Moreover, by combining forces in the international arena, where water policies and agendas are currently being debated, the potential for overcoming the deficiencies of the supply-fix approach could be greatly increased.

As this report has reiterated many times, the priorities in low-income urban settings are likely to be very different from those that currently inform demand-side management in the North. In practice, each urban settlement has its own specific issues and problems, and it would be inappropriate to presume what the demand-side priorities are in a settlement, even in full knowledge of its economic status. Ultimately, priorities need to be driven locally, not prescribed internationally. But, for better or worse, international agendas do matter. If demand-side management is to have a positive influence internationally, it is important that it not be promoted in its conservationist form. This report has elaborated the conceptual side of demand-side management, the dangers of allowing Northern preoccupations to influence Southern priorities, and the potential for alternative approaches to demand-side management. For these problems to be addressed will require a more balanced set of tools and approaches for demand-side management – ones that do not presume what local water priorities are, but help ensure that local priorities can be identified, along with the means to address them.

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