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INTRODUCTION: WATER DEMAND AND WATER MARKETS

For many years we believed that water supply was difficult, but water demand quite simple. What passed for demand analysis consisted of projecting growth curves of consumption forward in time as a function of some independent variable such as population (or, in more mathematically sophisticated models, several independent variables). At the risk of irritating many friends and colleagues, I would suggest that we got it backwards. In reality, dealing with supply is relatively simple — a matter of working with the physical laws of hydrology and with engineering principles — whereas demand, which depends on variables linked to human needs and behaviour and which changes over time and space, cannot be so easily grappled with.

Even our terminology for demand is confusing. We refer on different occasions to needs (or basic needs), demands, wants, and desire. The amount of water needed to satisfy thirst is only a few litres per person per day; whereas the amount needed to grow enough food for a person is 50 times larger, and the amount needed to run something close to a modern economy perhaps 100 times larger than that. How are we to define demand?

Fortunately, for most purposes it is less important to debate the exact definition of demand than to draw lessons from its range of measures. Most importantly, water is both a physical substance and an economic good, and it is the latter aspect that is most relevant to management and policy. (A nation could have as much water as it desired provided it had the money and the energy to desalinate seawater and ship it to the point of consumption.) Another lesson is that the value of water depends not merely upon its quantity but on at least four other factors: quality (see below), reliability, time of availability and location.
Markets for water always exit, but are typically obscured by the fact that water is available free or is grossly under-priced. Sometimes however, markets are visible, as with water vendors in the poorer parts of many cities or with owners of bore holes in rural areas. Sometimes they are hidden, as when governments supply water at more or less subsidized rates. In many cases, water is available ‘free’, but a real cost is incurred (generally by women and children) in the time and effort expended to carry it from its source to its place of use. In addition, water must go some place after use, so there is commonly an even less visible price on (or cost for) waste water as well.

Finally, water is characterised by a uniquely large gap between the average price (what a consumer will pay for water in general), which is generally quite high, and the marginal price the amount consumer will a pay for a bit more water), which is generally not very much. In practical terms, we will pay a lot for a glass of drinking water but practically nothing for another cubic metre of irrigation water.

Only recently has demand management been recognized as an essential and effective policy tool for South Asia. Indeed, in the absence of water demand management, it will be impossible to satisfy the three goals essential to continued human use: water equity, ecological sustainability and efficiency.

**PERSPECTIVES ON WATER DEMAND MANAGEMENT**

Rather than pursuing a definition of water demand, it is more useful to look at three levels of water demand management. They range from the relatively mundane (and commonly ignored) level of the demand of individual firms or households through the more important level of the demand of a society as a whole to the truly radical level of questioning common notions of need and consumption.

**Firm or Household:** Water utilities, industrial firms and households can be treated at the same time because they are all individual economic units, and to one degree or another, they are all interested in savings. For each of them, water demand management (or demand side management, as it is typically termed by a water utility (Stiles, 1996) is simply a matter of cost effectiveness. Will an investment of time, money or effort in saving water pay off in whatever terms are relevant to that economic unit? Of course, lots of assumptions may get in the way of making an accurate balance, particularly when water is priced very low. Also, incentives can be misplaced (from an economic perspective) as when it is women who carry
water but men who decide when to invest or when buildings are charged for water instead of applying rates to individual offices or apartments. In sum, calculations for the individual firm or household may be complex, but the principle is not.

**Society:** A much wider set of variables comes into play when we view water demand from the perspective of a society as a whole. Concerns here arise because water, which is partially renewable and partially nonrenewable, moves around, crosses (or underlies) boundary lines, and has an enormous absorptive capacity. The use of water by a person, community as firm affects the ability (or even the possibility) of another person, community or firm to use water. Therefore, we need social rules to define who can use water, how much water, and when. Because all human communities and livelihoods indeed, human life itself – depend upon water, equity demands that we have special rules to ensure that everyone can satisfy his/her basic needs for drinking and sanitation. And, of course, the withdrawal, use and disposal of water all have environmental effects. Calculations at the level of a society are more complex and less definitive than those involving individual economic units. Concepts such as externalities, common property resources, and public goods all come into play, and a large literature has grown up to deal with them.

**Soft Water Paths:** Finally, there is the radical perspective that asks what the purpose of water use is anyway. Modelled on the highly successful approach to energy analysis dubbed soft energy paths (Brooks, 1995), the theory of soft water paths is still too nascent to discuss extensively at this stage. However, we can already see lessons that are analogous to those we learned from energy.

One lesson is that, beyond the few litres needed to sustain life, there are many ways to satisfy demands for water. For example, importation of food is an alternative to using water for irrigation (Allen, 1996), particularly to grow grains. If the objective is to feed a given population, then use of water to irrigate or the use of money to buy food are equivalent. Obviously, however, the two options are anything but equivalent in terms of socio-economic and environmental effects.

A related lesson is to look beyond the immediate end-use of water to ask about demand management in a larger sense. Drip irrigation may get 90 percent or more of the water supplied to the plants, but the larger question is whether the water should be used for irrigation at all. One can install low-flow toilets in an isolated village, but the larger question is whether water-based sanitation should be used at all.
Another lesson is that it is almost as important to conserve the quality of water as to conserve its quantity. High-quality water can be used for many purposes; low-quality water for only a few. On the other hand, the volume of high-quality water used is rather small, whereas the volume of use that can accept low-quality water is very large. Concretely, we need relatively small amounts of potable water for drinking but large quantities of more or less dirty water for growing food. The importance of quality may also change with technology; turbid water may be perfectly acceptable for flood irrigation, but, its clogs the holes in drip irrigation.

A final lesson is that lines between demand management and supply management are blurred. Is water harvesting a supply or a demand technology? Most analysts have found it convenient to include local sources of supply as part of demand management.

TOOLS FOR DEMAND MANAGEMENT

Tools and techniques to promote demand management can be classified in many ways but the following four categories are convenient (Rosegrant, 1997). None of the measures is as simple as will appear in the list below. Even for surface water let alone underground water, there are complexities.

**Institutions and Laws:** Supply and demand systems for water always exist within a set of water rights, land rights, social and civil institutions, and legal regimes. Some are formal and others informal; some modern and others traditional; some international and others local. They all play a role — more accurately, as great a role as granted to them — as do both modern and traditional institutions for conflict resolution. Few indeed are the societies that do not have some system for granting permanent or temporary rights to use water.

**Market-Based Measures:** The market is the world of water prices and tariffs and of water subsidies, both of which appear in a variety of forms. Although pricing is currently widely touted, careful analysts see it as a necessary but insufficient incentive for achieving efficiency, equity and sustainability. Most would argue that subsidies should be explicitly justified; that water tariffs should be designed to encourage conservation, not just to recover costs (which implies that pricing should be high enough to move into the elastic portion of the demand curve); and that some form of lifeline pricing should be adopted to provide water
for the basic needs of even the poorest households. Of course, any of these measures depends upon the existence of a more or less sophisticated system for water metering.

**Non-Market Measures:** An enormous variety of non-financial measures can be considered to promote water demand management (Brooks and Peters, 1988). Information and consulting services can be provided; social pressure can be applied; regulations can limit the time or quantity of use; and so on. Although regulations have a bad name, they are often both appropriate and efficient for managing water demand. Exhortation is also more effective than generally believed, particularly in times of drought. The range of options is so wide as to preclude generalisation, but one can say that they should be chosen so as to support and, if possible, reinforce the effects of market-based measures.

**Direct Intervention:** Governments and water suppliers can, of course, intervene directly by providing services, installing consuming or conserving equipment, fixing leaks, adjusting pressure, providing sewerage, and so on. Publicly funded water and sanitation utilities typically undertake many of these functions. More fundamentally, they can also affect, if not control, land use by their decisions on the location and quality of water and sanitation services, which is, of course, why these decisions are so politically sensitive.

**SOME THINGS TO DO AND NOT TO DO**

There are several tasks in water demand management, so it may be of help to suggest a few things not to do, or at least to place well down in a list of priorities for action and a few things to consider seriously.

**Don't Worry About:**

- what will happen in the middle of the next century: If one projects supply and demand curves far enough, the world seems to run out of fresh water (Raskin et al, 1996). The relevant time period for water planning is, however, the next two to twenty years, and in that time frame, water demand management has a lot to offer.
- the advent of high-capital solutions: Desalination, water pipelines and great canals are all on the horizon – which is exactly where they have been for the last 20
years! With the possible exception of some international transport by water and desalination plants in petroleum-producing countries with a lot of residual oil, all of these techniques are too expensive for extensive use in most parts of the world.

- water demand management in the North America or Europe: The northern countries are no models of efficient, equitable or sustainable management of water. In effect, they have used their resources of capital and energy to overcome deplorably bad water management. One can learn something about process from North America, where requirements for freedom of information, public participation, and environmental assessment are more extensive than in most developing countries (Gouldman, 1996). Otherwise, conditions in the North are so different that one will have to rely on his/her own research to develop appropriate methods and measures.

Do Think About:

- the in-situ value of water: Energy analysts are fond of saying that no one wants energy for itself, but only for the services it can provide. This is not the case with water. For one thing, water provides many services, including habitats for plants and animals, dilution of wastes, flood stabilization and so on. For another, lakes and rivers are beautiful; springs and waterfalls are sometimes revered. Water has intrinsic value!

- traditional water management systems: Older systems, some of which still exist and some of which must be rediscovered, are worth studying. Traditional irrigation systems in India and Nepal, for example, depended upon a high degree or organization for the construction, maintenance and distribution of water; so too did the use of falling water in hills to run mills. The institutions on which such systems were based may have achieved a better balance among efficiency, equity and ecology than modern systems do (Agarwal and Narain, 1997). On the other hand, they may need adjustment for conditions in which farmers are growing vegetables for an urban market rather than grains for home consumption.

- how to allow for extreme events: Except for fossil aquifers, our water supply is dependent on rainfall, and rainfall is notoriously variable from place to place, from summer to winter, and especially from year to year. A sound system of water demand management must be resilient to extreme events, including both heavy floods and multi-year droughts, and to short-term events, such as the bishyari that are so common in Nepal.
A NOTE ON THE COUNTER-REVOLUTION

Today's serious efforts at water demand management is almost revolutionary. Not surprisingly, therefore, these efforts have spawned a counter-revolution. The counter-revolution is led by the International Water Management Institute (Keller et al, 1996; Seckler, 1996), and its main point is as follows: Water that is not used consumptively cycles back into a basin, and, therefore, what appears to be inefficient at a micro (individual end-use) scale may be efficient at a macro (water basin) scale. For example, irrigation water that runs off or sinks into the water table may return to the water course and then be used by farmers downstream. In effect, a water multiplier exists such that every drop of water that does not evaporate or evapo-transpire is used several times.

The analysis put forward by IWMI has considerable merit. Moreover, it is not put forward naively; they allow for various kinds of losses of water quantity and of water quality in the flow back to the river or aquifer. Nevertheless, this analysis can be seriously misleading if it is used as an excuse not to improve micro-efficiency or to neglect water demand management. Among other things:

- Effective natural recycling must be proven; it cannot be assumed. It works very well along the Nile in Egypt, which is the source of many case studies. For a variety of geographic and hydro-geological reasons, it works much less well in most other places.
- Over one-fifth of the world's population lives along a coast, so any water they use is lost directly to the sea. Moreover, this is merely a specific case of a more general effect of water flowing to an 'economic sink', from which it is simply too expensive to recover (Rosegrant, 1997).
- Water management costs are highly sensitive to the scale of the system in question. The less efficient end-use consumption is the larger both supply and effluent facilities must be which implies an inefficient use of capital.

In summary, even if basin efficiency is greater than farm efficiency in the use of water, this is only true in a physical sense. Thus, we end up where we started – water is at least as much an economic as a physical resource. Natural recycling is not an alternative to demand management. In most cases, it will save both dollars and the environment to conserve water; it may even allow for more equity as well.
CONCLUSION

The range of water-use patterns in South Asian nations is as wide as the range in their economic and ecological conditions. Nevertheless, for all nations, potential gains from attention to water demand management is far from marginal, even for domestic uses (where leakage can be higher than actual consumption). For example, a number of authors have estimated that, in higher income countries, such as Israel, 25 to 35% of current water use could be saved with cost-effective measures (Kahana, 1991). My own estimates suggest that, by including minor changes in lifestyles and in urban and industrial uses, plus some shift away from irrigated agriculture, savings would exceed half of current use. Savings in lower income countries, for example those in Nepal, would be much smaller, partly because it would be economically efficient to expand irrigated agriculture and partly because the need to provide more water for domestic, urban and industrial use will overwhelm use-by-use and sector-by-sector savings. Despite the differences in the current patterns of use, and in the prospects for growth in the near future, it would be economic, social and ecological folly for any South Asian nation to ignore the huge potential of water demand management.

REFERENCES


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