The Water Challenge

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Characteristics of the water challenge

Despite the massive investment in water resource development during the twentieth century – in recent decades also reaching the developing world – there is still what many see as a "water crisis". This has two key facets:

- Lack of access to safe and affordable domestic water supply (for over a billion people) and sanitation (for nearly half the world's population).
- Lack of access to water for productive purposes for the rural poor.

There is clearly sufficient water available in the world for all Mankind's needs: domestic, industrial and agricultural, although it is distributed very unevenly. The problem is not lack of water, but that the unserved do not have access to capital (financial or political) to make it available to them. The challenge addressed here is therefore providing access to safe water for poor people for domestic and productive purposes.

Domestic water needs are relatively small; only 20-50 litres per head each day in developing countries (although up to ten times this in the USA and Europe). In contrast, each person needs thousands of litres a day to produce their food. About 1,000 litres (one cubic metre) of water are needed to produce one kilogram of cereal grain, and meat production requires considerably higher quantities. On average, each person needs seventy times as much water to feed them as for all domestic purposes.

Water resources are subject to competition for different uses, particularly agriculture and the environment. Large development projects have, in the worst cases, led to rivers running dry and to enormous depletion of aquifers. This challenge therefore has two crucial dimensions: service delivery to those people without adequate water supplies, and sustainable resource management.

The case for government involvement in water

In both historical and modern times, water service provision has generally been seen as a government responsibility. This is largely because water is regarded as a public good and its availability as a basic human right, best administered by the public sector. However, the cost of service provision has to be borne somewhere, and an emotional argument continues as to whether individual citizens should pay at least part of the cost of providing the water they consume, whether to public or private providers.

The experience of poor returns from centralised water infrastructure projects has shown that these are best managed at local government or community level. This leads to greater involvement of the users and better accountability. There is now a general trend towards decentralisation of service provision and introduction of water charges.

There are also arguments that governments are not the best providers of services such as water supply. Experience in France and the UK, for example, shows that private

companies can also successfully carry out this role, within a government regulatory framework. Nevertheless, there is still a strong case for public investment if it can be better targeted at poor communities to reduce poverty and hunger and improve public health rather than just being a narrow, technology-based approach to water provision.

The costs of managing water badly

What costs does the current water crisis impose on society? The 2003 report from the United Nations (UN) Task Force on Water and Sanitation gives some sense of the scale of the problem, for example

- Nearly half the population of the developing world is suffering at any given time from diseases related to poor access to clean water and sanitation, ranging from diarrhoea to a number of parasitic illnesses.
- Over two billion people are infected with water- or soil-borne parasitic diseases (bilharzias and helminthes), with 300 million suffering serious illness.
- Well designed water and sanitation infrastructure reduces the incidence of bilharzias by more than three-quarters.
- A range of pollutants also affects health: high arsenic levels in water from deep wells affects 50 million people in Asia.

Diarrhoeal diseases are the greatest health problem, with more than four billion cases and between one and two million deaths each year. The total burden of diseases associated with poor quality water, sanitation and hygiene has been assessed as 82 million Disability Adjusted Life Years (DALYs) annually. Taking a low valuation of $500 per DALY, the economic cost amounts to $40 billion (considerably more if the higher DALY valuations used by authors of other challenge papers are used).

Moving on to water for agricultural use, it is found that there is a strong correlation between rural poverty and low levels of irrigated land. Irrigation is clearly an important tool for poverty reduction. But, where land distribution is inequitable, the benefits of irrigation are also delivered unequally.

In India, irrigation has become more widely available to marginal farmers via privately pumped groundwater, made available cheaply because of current electricity subsidies. However, the lack of control of groundwater exploitation has led to severe depletion of major aquifers.

Further development of small-scale irrigation technology – drip and micro-sprinkler systems for example – can repay a small farmer's investment very quickly. This enables water resources to be used more productively.

Appropriate provision of water can be a key opportunity for reduction of rural poverty. The provision has to be done with due regard to environmental factors, to avoid potential large remedial costs in the longer term. Irrigated land is prone to water-logging and salinisation, leading to reduced productivity. It is estimated that 30% of irrigated land already suffers from reduced productivity, but no remediation opportunities have been identified yielding benefits on the scale comparable to those reviewed in this chapter.

The economic literature on the benefits of improved water management is rather sparse, with many projects in the sector based primarily on a human rights approach. Nevertheless, this chapter examines the challenge from an economic perspective.

Water opportunities

Two key opportunities to meet the challenge are discussed more fully below, but there are several others which should also be noted:

- *Re-using waste water for peri-urban agriculture.* Installation of low-cost sewerage in medium to large cities in developing countries could provide biologically safe irrigation water for poor farmers living in the slums and shanty towns at the city's margins. This would not only have a direct benefit for the farmers, but also prevent pollution from untreated waste water.
- *Developing sustainable smallholder agriculture in wetlands.* As an alternative to complete reclamation, some wetlands (for example "dambos" in Africa) can be adapted for agriculture while maintaining the existing ecosystem. Only a relatively small number of farmers would be directly affected, but there would be significant benefits associated with maintenance of the environmental services of the wetlands.
- *Research to increase the productivity of water for food production.* More efficient water use can meet the rapid increase in urban and industrial water demands without further environmental impact. Investment costs are relatively low, at $300-400 billion over 10-15 years, and expected benefits are high; benefit/cost ratios of 15-20 have been estimated.

Although presented as discrete options, these can also be components of an integrated approach to water supply, together with the two options explored in more detail below.

Opportunity 1: Community-managed low-cost water supply and sanitation
This option covers an integrated package of measures designed, implemented and managed with the full involvement of the community. Low-cost water supply would entail the provision of standpipes and low-cost sanitation would comprise good quality latrines in rural areas and low-cost sewerage in urban areas (septic tanks or shallow, small-bore sewerage plus low-cost treatment). These would be supplemented by hygiene education.

At the end of the twentieth century, it was estimated that 1.1 billion people did not have access to a safe water supply, and 2.4 billion people were not served by basic sanitation. One of the Millennium Development Goals (MDGs) is to halve these numbers by 2015, which means not only halving the present numbers, but also catering for a significant population increase.

To achieve this goal, just over 1.5 billion extra people would have to be supplied with safe water, about 60% of them in urban communities. In the case of sanitation, the figure is 2.1 billion people, this time split quite evenly between urban and rural dwellers. The UN World Water Development Report (2003) concluded that there was a funding gap of between $110 billion and $180 billion which had to be bridged to achieve the targets.

Conventionally, such funding shortfalls lead to calls for increased international aid. However, over 80% of water infrastructure investment at present comes from domestic (largely public) funding, and it is reasonable to assume that this will continue to be the case. Since about half of those without proper sanitation live in China and India – both with high and sustained rates of economic growth – funding in this case will very likely become available domestically.

There are still, however, countries with about 30% of the world's population which are making little or no progress towards the MDGs for water and sanitation. The great majority of these are in Africa, and there is clearly a case for targeting aid and other forms of external funding towards them.

This money could provide the necessary infrastructure, but past experience shows that this can be poorly correlated with the level of service provided. In many cases, this has been because projects have been donor-driven, top-down and technology focussed, and have failed to involve the local community.

Not only must future projects be community managed, but they must also be integrated. Analysis shows that water supply must be combined with basic sanitation and hygiene awareness campaigns if key health benefits are to be realised. Currently, improved sanitation on average accounts for only about 20% of the total spending on water infrastructure in developing countries, and there is an obvious case for this to be increased.

An economic analysis of a programme to meet the MDGs shows the total investment and recurrent costs of sanitation provision as $9.3 billion and that for water supply as $1.8 billion, a total of $11.1 billion. The benefits in terms of sanitation alone amount to over $54 billion: a benefit/cost ratio of nearly 5. Using a 5% discount rate, the project overall has a Net Present Value (NPV) of $400 billion. The major part of the benefit is accounted for by time gained: fewer days off work and school and less time spent nursing sick babies.

Halving the present numbers of people with water and sanitation would still leave large numbers unserved: 550 million people without a safe water supply and 1.2 billion with no access to basic sanitation. A simple extrapolation of the costs and benefits of meeting the MDGs suggests that the NPV of providing services to everyone increases to $600 billion. In practice, of course, things are not that simple, and implementing effective water infrastructure projects in countries which are financially unstable or engaged in civil conflict would be extremely difficult.

Opportunity 2: Small-scale water technology for livelihoods

The second option is the exploitation of appropriate low-cost, small-scale technologies which individual farmers can use to improve agricultural productivity. This is applicable to 800 million rural poor people, plus some peri-urban dwellers who depend on farming for a living. To make a real difference, these technologies have to be provided in a supportive environment, where micro-credit, training and support are available.

Recently, there has been increased focus on the provision of a range of water technologies to smallholders. These include low-cost electric or diesel pumps, a

number of manual irrigation systems and techniques for water harvesting. Such technologies offer a major opportunity to reduce poverty in rural areas.

Drip irrigation is one example of the technologies used. This can give significant yield increases (20-70%) while using less water than traditional methods. Previously the preserve of commercial farmers, the availability of cheap, small-scale equipment has made this an option also for smallholders. For example, the so-called "Pepsee" system in India costs only $93 for equipment to irrigate an acre of cotton. This gives yields almost twice as high as non-adopters, and comparable to those from conventional drip irrigation systems costing twice as much.

Another technology – the manual treadle pump to lift water from ponds and wells – is improving livelihoods in the poorest parts of southern Asia. Costing only $12-30, these pumps have been found to increase farmers' income by an average of $100 a year. Assuming a typical cost of $20 for a pump, replaced every three years, the Net Present Value for an adopter is $1,900. The total NPV for the 1½ million current users is $2.8 billion, and there are believed to be 10 million potential users in the region in total.

Small-scale rainwater harvesting technologies (to conserve rainfall in the field or by storage) have been actively promoted by NGOs and have been a conspicuous success, particularly in parts of India. In the Gujarat region, tens of thousands of small check dams have already been built. It is estimated that the value of the main monsoon crop across the whole of India could be increased from about $36-54 billion to $180 billion by building two million small check dams at a total cost of $7 billion.

Overall, some 100 million farming families in Asia and Africa could benefit by an average of $100 per year by using small-scale water technology. This yields an NPV of $200 billion in direct benefits. Indirect effects on the overall economy could increase this significantly. Taking the multiplier effect into account, an investment of $100 billion over the MDG timescale would give benefits of $700 billion; a benefit/cost ratio of 7.

Conclusions

The two opportunities discussed above (and the others for which too little information is available to do a proper analysis) rely not just on delivering appropriate technologies, but doing so in an integrated way which focuses on end results. Providing access to clean water and basic sanitation, plus options to improve the productivity of small-scale farming, would have large welfare benefits and help to lift people out of poverty.