Local Solutions in the Global Water Crisis

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Water, covering 71 percent of Earth's surface, gives our planet its distinctive blue hue when seen from space. Yet for all that water, an astonishing small amount is available for human use. If we were to imagine all the Earth's water in a 1000-litre bucket filled to brimming, the fraction that is freshwater and not locked in ice is a mere 25 mL. Rough estimates place South America's share of that total at about half. Asia gets almost 6.25 mL, leaving the remainder — another 6.25 mL — for everyone living in North and Central America, Europe, Australia, Africa, and the Middle East.

The lion's share of the water we use goes to growing our food: irrigation siphons off roughly two-thirds of all the water we consume. Industrial and other economic activities draw somewhat less than a third. The trickle that is left — or about five percent of the total — accounts for all common household uses, most of which are low quality uses, such as watering lawns and flushing toilets.

Over the past 70 years, human numbers have tripled but our thirst for water has surged six-fold. To keep pace, we have diverted rivers, tapped lakes, and pumped aquifers. Everywhere, the best and cheapest sources of water are now being used. In some regions, we are approaching the limits: in the Middle East, 58 percent of all reasonably available fresh water is already being withdrawn. In Eastern Europe, the figure stands at 41 percent. While strategies to increase water supply by desalinating seawater or by shipping large volumes by pipeline or sea are technically feasible, they will be neither cheap nor easy, and they will likely incur severe ecological and political costs.

Supply is only one part of the growing water crisis. For an increasing number of people, water quality is every bit as threatening. Population growth, industrialization, and urbanization are not only depleting lakes, rivers, and aquifers, they are polluting them as well. Already more than 1 billion people lack access to safe drinking water; 3 billion lack access to basic sewage systems. For millions, life-sustaining water is now a deadly menace. Water- and sanitation-related diseases will rob many more of their health and a productive future.

So what are the options? The answer is deceptively simple: we must manage our current supplies better. Past approaches, enthusiastically endorsed by development banks and agencies, favoured large-scale, capital-intensive projects. While they did deliver water to many households and many farms, most fell short of their original promise. Thirty years of applied research supported by the International Development Research Centre (IDRC) offers a new focus for global efforts to curb water demand and alleviate poverty: community-based or local water management. It is at this level that the effects of water scarcity are most keenly felt and it is here that solutions must be implemented.

As the examples that follow demonstrate, some of the most powerful responses to water scarcity are already being mounted in households, farmers' fields, villages, and city neighbourhoods across the developing world. If these efforts are to continue and to expand, local people will need ongoing support from their governments. In some cases, this will include delegating power to make decisions about which options to pursue and which techniques to employ.

For those who wish to pursue the promise and confront the problems of local water management, this brief can serve as a useful reference. Highlighted blocks throughout the document underscore some of the key lessons gleaned from IDRC's three decades of support for water-related research. They can serve as starting points or notions to consider in developing new community-based initiatives or in improving those currently under way.
Harvesting rain

The history of rain harvesting is rich in technique and innovation. The Greeks, the Mayans, and island peoples around the world all developed ways of harvesting or holding back rain as it cascaded from their roofs or flowed across their fields. IDRC-supported researchers tapped into this broad base of traditional knowledge and used the tools of modern science to improve water-harvesting techniques and safeguard water quality.

In the crowded settlements of the Gaza Strip and the dusty villages of the Jordan Valley, for example, “textbook” rooftop rainwater-collection systems were adapted to local circumstances. The main technical hurdles were in keeping the water clean and engineering cost-effective storage. The principal obstacles to deploying the rooftop systems were partly organizational: inhabitants not only had to be shown how to build and maintain the systems, they also had to be convinced that the technology was effective and durable.

There was an economic hurdle as well: the ferrocement holding tank—priced at US $200—was beyond the means of most households in the Gaza Strip. Two policy options presented themselves: a subsidy or alternative pricing scheme; or scaling-up to serve several families or a city block, thereby producing economies of scale and cutting unit costs. This second option also required some system of fair distribution and ongoing maintenance.

A benefit–cost analysis found rainwater harvesting to be economical where rainfall averages between 100 to 500 millimetres per year. More rain than that and costs exceed benefits; less, and benefits fail to cover costs.

Lesson: Scaling-up from households to villages or neighbourhoods is a common solution for improving the cost efficiency of traditional techniques. However, scaling-up requires capital or large tracts of land. These factors favour the well-to-do. Research and policies that fail to account for these unequal effects can make a difficult situation worse for the poor or disadvantaged.

Aquifer protection and recharge

In Mexico City, overpumping of the underlying aquifer has dropped the water table 20 metres in only 50 years. This situation is not unusual. Research in Latin America has shown that overuse and pollution are common threats to urban water supplies. The same body of research also offers solutions: vigorous programs of aquifer protection and recharge. Recharge techniques can be as simple as digging pits or trenches to gather rainy-season water, or as technically challenging as injecting clean water under pressure into fissures or fractures in the surrounding bedrock.

To protect aquifers, regulations are required to keep pumping rates below inflow rates. These should include measures to control competitive drilling, investment in ever-deeper wells, and careless dumping of wastes that all to often pollute groundwater stocks.

Putting proposed solutions into practice has proven difficult. The reasons, not fully understood, undoubtedly include the common practice of pricing water far below the cost of extraction and delivery. In most cases, far from benefiting ordinary people, such subsidies enrich the better-off. In developing countries as in industrialized ones, power politics and vested interests pay close attention to policies and regulations controlling access and use of water.

Lesson: Three decades of experience warn to expect the worse when managing groundwater and aquifer supplies. But even when the outcomes of research are disappointing, it can still pay rich dividends. The discovery of fresh and basic information can open new opportunities to solve old problems.

Community-based water quality monitoring

Developed-world approaches to ensuring the safety of drinking water rely on sophisticated tests carried out in expensive laboratories. Where these are duplicated in the South, they usually benefit citizens in the urban core and wealthier suburbs. In the mid–1980s, IDRC brought together a network of Southern and Northern researchers to develop low-cost, sensitive methods to test water for microbiological contaminants, such as faecal bacteria. The network proposed four methods suited to conditions in rural communities across the South: the hydrogen sulfide test, the presence–absence test, the A1 broth, and the coliphage test.

Field trials in Canada’s North and in Chile proved the tests’ effectiveness and ease of use by locally trained staff. Further efforts to broaden the scope of community-based water management activities to include remedial actions also pointed to the need for closer linkages between the communities, local institutions providing test supplies and technical advice, and state and national bodies charged with water supply and quality. Significantly, the Government of Chile is in the process of adapting its regulations and policies to include the hydrogen sulphide test as a standard procedure for monitoring drinking water quality in rural areas.

Lesson: Decision-makers frequently overlook small groups and simple solutions. Yet, seemingly humble innovations, such as check dams to slow the runoff from on farmers’ fields, can produce surprisingly powerful benefits that spread quickly through community networks.
Wastewater recycling

Reusing wastewater is an obvious response to local water shortages. But recycled wastewater can pose a threat to public health, soil, and water if wastewater is not reused carefully. Because of the technical difficulty in safely treating "black water" from toilets, much of the IDRC-supported research at the household and village level dealt with recycling "gray water" from showers, kitchens, and laundry facilities.

In the poorer communities surrounding the Senegalese capital of Dakar, researchers tested the technical and socioeconomic feasibility of exploiting aquatic plants, like water lettuce, to convert household wastewater into water fit for irrigating small market gardens. Results here, and from a similar project in Peru, found no significant health problems. Risks in consuming crops raised on recycled waste gray water, where measured, also appeared negligible.

In Cambodia’s second largest city, Battambang, IDRC also supported an evaluation of an engineered wetland to treat all of the city’s wastewater. Comparative economic analysis of small-scale gray water recycling systems and large-scale systems show many of the benefits in keeping things small.

From a cost viewpoint, large-scale systems, as with Battambang, will not pay for themselves. Selling the water (and fish) may cover the operational costs, but not capital costs. Smaller household and village gray water systems, on the other hand, can generate enough income to cover building and maintenance costs. The revenue gained from selling additional produce is often enough to encourage local participation. And where these systems replace septic tanks, households further save on the cost of pumping them out.

To operate effectively in the long-term, large-scale operations also require that governments develop means of allocating costs and revenues, encourage or oblige those used to disposing of wastewater for free to use the new system, and reform building codes or land-use regulations to permit and encourage wastewater recycling.

In small-scale systems, skills gained through training and in running the system stay in the community and with local authorities and nongovernmental organizations that frequently act as executing agencies. This capacity-building feature of small-scale systems frequently favours women, as they play leadership roles in financing, operating, and managing both water treatment systems and market gardens.

Lesson: Social and economic factors are always important in local water management. Gender issues are particularly pertinent, as women bear the burden of providing water for domestic use. Changing water-management practices, even for the better, is rarely gender-neutral. Researchers and policymakers looking to improve water management ignore this aspect of program or project implementation at their peril.

Watershed management and irrigation

Irrigation is vital to our survival. Some 40 percent of all the food we eat is grown on irrigated land. But irrigated agriculture has not kept pace with population growth. Moreover, irrigated farmland is steadily removed from production because of soil salinity and contamination, and because of urban encroachment.

In the developing world, huge gains in water supply can be achieved simply by reducing the waste in irrigated agriculture. As much as 75 percent of water diverted or pumped on to fields is lost to evaporation, leakage, seepage, or just bad management. However, changes to irrigation practices must take into account two other factors. First, water in irrigation canals is used for more than growing crops. It is also used to raise fish, wash clothes, water animals, flush away wastes, and, sadly, as drinking water. Conserving water for these uses would contribute to productivity and public health. Second, some of the water apparently lost to leakage and seepage goes back to groundwater and appears in the next field lower in the watercourse.

For these and other reasons, improving the management of watersheds and irrigation raises difficult issues of equity and efficiency. Large-scale irrigation is capital intensive and so favours those with money and influence. For poor farmers, remote communities, and indigenous communities, securing a say in such arrangements is often difficult. In arid and semi-arid regions, these communities rely upon surface water sources, often seasonal; groundwater, often from hand-dug wells; or a combination of both. The local environment has shaped water-management practices for centuries, so that many of these communities are experts in dealing with water scarcity.

On India’s Deccan Plateau, for example, researchers relied on local expertise to help the tribal people of the Akole Taluka region improve their
crop yields and their year-round access to water. The strategies put in place to improve the water supply were simple. Gullies were plugged and water was diverted, thus slowing down runoff and reducing erosion. Water pooled and seeped into the soil. This increased crop yields and served to replenish groundwater supplies. Later, rooftop harvesting and storage tanks were built, filled first by rains each year and later, in the dry season, by bullock-cart deliveries. The outcome: healthier people; higher food production; rising incomes; stocks of water that last virtually all year. And villagers are embracing the new strategies.

Lesson: Scarcity forces trade-offs. To determine fairly who gets what, when, and for how much requires institutional capacity. That is the ability to gather and assess information, to deliberate, to execute policies, and to answer responsibly to community members. Building this capacity is necessary for local water management and for other sustainable resource-management decisions.

A path forward
The merits of local water management speak for themselves in the examples shown here and in research conducted across the developing world. Approaches that engage local users in water management are simply more efficient, more effective, more equitable, and more environmentally sustainable than the usual top-down practices. They are not panaceas, but must complement wider reaching water-management approaches. Local water management, however, does offer an immediate path forward in divining solutions to growing water scarcity.

Building the Foundation for Success

Community-based water management strategies can play a critical role in solving water scarcity problems. The following elements should be considered in developing any new local water-management initiatives or in improving current programs.

Up, down, and sideways, get the big picture with a three-part economic analysis.
Benefit–cost analysis is a top-down approach for determining whether using a particular technique or technology makes economic sense. While this can be revealing, it fails to identify why local communities choose not to adopt promising research. A bottom-up analysis, looking at the community level, will often reveal the value individuals or communities place on a particular solution. It should also reveal how women and men will be affected differently. A sideways perspective examines how economic and noneconomic values interact. Noneconomic values, such as maternal-health benefits from having more clean water or the gains from a healthy ecosystem, are difficult to measure, but should be included nevertheless. Together, these three elements provide a complete economic analysis of local water management.

Accept social custom and cultural norms as a given, but not sacrosanct.
Traditional practices and local knowledge are not static collections of beliefs and practices. But they will change only when people see the value in change. The role of research is to convince people of the need for change, then design and test remedies that are socially and culturally acceptable, and that fit well with local tradition. It is as wrong to romanticize tradition as it is to exalt science.

Conduct evaluation that is transparent, participatory, and continuous.
The key to deciding how well a particular solution works is to monitor it over time. Yet taking time to conduct a thorough evaluation is frequently neglected. This is dangerous, wasteful, and undemocratic. Dangerous because it can allow problems to accumulate or go undetected. Wasteful because costs and benefits go untold. Undemocratic because evaluation is a central element to transparency and accountability.

Include water rights in any analysis.
In rural areas and in developing countries tradition often rules access to water. Having a “right to water,” however, does necessarily determine who gets what, when, and for what purpose. When water is scarce, for example, women will typically demand a greater share for household uses, whereas men will want to use as much as possible for cash crops. Whatever the local situation, the management of water rights is a crucial element of policy-making.
Resources

Publications
- Water, Marq de Villiers, Stoddard Press, 1999; revised edition, 2000

Web sites
- International Water Management Institute: www.cgiar.org/iwmi/index.htm
- Water at IDRC: www.idrc.ca/water
- Water Demand Management Forum: www.idrc.ca/waterdemand
- World Resources Institute: www.wri.org
- World Water Commission: www.worldwatercommission.org
- World Water Council: www.worldwatercouncil.org

Essential Information

What Is IDRC?
The International Development Research Centre is a public corporation created by the Parliament of Canada in 1970 to help developing countries use science and technology to find practical, long-term solutions to the social, economic, and environmental problems they face. Support is directed toward developing an indigenous research capacity to sustain policies and technologies developing countries need to build healthier, more equitable, and more prosperous societies.

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