ALLEVIATING WATER-PROBLEMS : MARRYING OLD AND NEW IDEAS

*Q. Isa Daudpota**

ABSTRACT

Water-scarcity presents exciting challenges to all. It invites – rather forces -- an attitudinal change. This change should accompany economic, social and political incentives for conservation. There is also a need for introduction of appropriate new technologies and for reviving long-forgotten old ones. Our traditions teach us respect, and offer lessons, for water- harvesting of rainwater. Sewage and solid-waste management are shown to be linked to the solution of the water-resource problem. Ultraviolet purification is described; it can provide clean water cheaply to every citizen in the South, and can be introduced widely in Pakistan at minimal cost, thereby offering each citizen clean water. These and similar techniques introduced by national experts, working alongside common people, can solve many water and related developmental issues

INTRODUCTION

Our world is full of water – two third of it is covered with it. Despite this, expert forecasters predict shortages of water, leading to major tension that would lead to military conflagration. The earth's reserve of fresh water adds up to more than 37 million cubic kilometers. The ice-caps bind more than three-fourth of this water, which is therefore inaccessible with current technology. The rest, nearly 9 million cubic kilometer, is in aquifers, and hence not easily exploitable.

The ultimate source of fresh water is the distillation of the oceans by solar radiation. The annual rate of evaporation is roughly 500,000 cubic kilometer, of which 430,000 comes from the oceans and the remaining 70,000 from waters on the continents. Fortunately, the continents receive 110,000 cubic kilometer from precipitation, so that the net effect of the hydrological cycle is to transfer some 40,000 cubic kilometer of fresh water each year from the oceans to the continents.

The maximum water that can be available for use by humans is about 14,000 cubic kilometers per year – this is the water flowing in all rivers and streams, excluding floodwaters. Of this, 5000 cubic kilometers flow in regions that are not inhabited. This leaves 9000 cubic kilometers per year, from which all human needs will have to be met. Is this going to be adequate? A simple analysis of the per capita needs could help. For this, it is convenient to work in smaller units, i.e. cubic meters (1 cubic kilometers is made up of a billion cubic meters). An acceptable quality of life can be maintained with 30 cubic meters per capita. Of this allocation, less than one cubic meter is for drinking, which needs to be of a higher quality -- chemically and biologically safe.

Other than in the most industrialized countries, industry takes 20 cubic meters of water per person. This is swamped by the requirements of agriculture. For a diet of 2500 calories per day, food-production requires 300 cubic meters per person per year. In wealthier countries, where input requirement is 3,000 calories per day, the water needed is 400 cubic meters per year per person. Adding all the requirements, it is fair to estimate the water requirement as 350 to 450 cubic meters per person per year. Given that the global water supply is 9,000 cubic kilometers per year, one may be led to assume that a world population of 20 to 25 billion can be adequately supported by the water that is available annually.

This simple calculation clearly has a flaw and it hinges on the assumption that the water is distributed around the globe in the same way as humans are. This is not so. For example, in some parts of the world, people have to make do with just 2 cubic meter of water per year, which is the bare biological minimum. For this low supply, they can pay as much as $20 per cubic meter. In the U.S. and other developed countries, where an average urban user consumes 180 cubic meters for domestic purposes, the cost is one hundredth or less of what the poor person in the developing country

* Consultant, Institute of Business Administration & Technology, China Chowk, Islamabad, Pakistan

pays! For sustainable development, such inequities should be removed.

Agriculture uses the largest amount of fresh-water resources. More than 85% of cultivated land is watered exclusively by rainfall. If not used, this water would be wasted. In 1970, rain-fed agriculture consumed 11,500 cubic kilometers of water; in comparison irrigated agriculture employed 2,600 cubic kilometers on 12% of the cultivated land. This should suggest that a major effort should go into optimized extraction and usage of the free rainwater that is spread widely and does not require transportation-cost to move it to places where people live and grow crops.

RAINWATER HARVESTING

In Pakistan, and elsewhere generally, rain-fed areas were considered high-risk for agriculture. This meant that almost all resources were put into irrigation, thereby depriving ourselves of improving the enormous potential of our rain-fed (*barani*) areas. These *barani* areas cannot be ignored, as they nurture 80% of the country's livestock, grow 12% of wheat, over 50% barley, 65% of gram and 89% of groundnut production. Surface run-off, if stored in reservoirs, could help achieve the goal of food-sufficiency. Many of the problems of irrigation, such as water-logging and salinity, could have been avoided if we had been aware of the advantages of rainwater harvesting, a traditional method which can now be taught to the developed countries by countries in the South.

The use of rain-water harvesting has existed for 4,000 years. In Negev desert of Israel, which receives less than 15 cm of annual rainfall, hillsides were cleared to increase runoff, which was led into contour ditches. Underground storage of volume up to 300 cubic meters have been reported. In the Mediterranean region, rainwater collected from roofs, and stored in cisterns, constituted the principal source of water from the sixth century BC until today.

In India, as early as the third millenium BC, farming communities in Baluchistan impounded water and used it for irrigation. Dams, built from stone rubble, have been found in Baluchistan and Kutch. Some of the settlements of the Indus valley civilization, dating back to 3000-1500 BC, had water-harvesting and drainage systems. The most recent to come to light is the settlement at Dholavira in Gujarat, India. The 1997 report, "Dying Wisdom" produced by the Center for Science and Environment, and dedicated to native wisdom and the rural communities of their country, looks at the "rise, fall and potential of India's traditional water-harvesting systems". This outstanding, seminal work, which took 10 years to produce, should be essential reading for our water planners.

HANDLING ORGANIC 'WASTE'

There is a fundamental connection between the present state of agricultural development, organic-waste management, sanitation and water supply. While water-supply and provision of sanitation is a big challenge for the burgeoning population, an important issue is to make organic residuals of human settlements useful in rural and urban agriculture. The content of nutrients in the excreta of one person is sufficient to produce grain, with all the nutrients, to maintain life for a single human! *This revolutionary thought provides the reason why no one needs to go hungry in this world.*

Work done in Sweden points to how agricultural production can be increased without the use of artificial fertilizers, provided that sanitation-technology could be made capable of recycling nutrients from households to agriculture. An important reason why this is needed, and is not peripheral, is that current sanitation-practices use scarce potable water to dispose off sewage, which is then difficult to manage and causes pollution of ground and surface water supplies.

The real goal is not just to recycle water and nutrients, but also all matter, and especially organic solid wastes that constitute about 85% of all 'wastes' produced in human settlements. At the moment, only 5% of the solid waste generated in the North is biologically digested to recover nutrients. Theoretically, it is possible to use up to 85% of solid waste as recyclable resource. Moving beyond composting and urine-separating toilets, workable decomposition technologies for organic wastes that produce bio-gas and bio-fertilizers are needed. Solid-waste management becomes an issue of organizing the collection, transportation and recycling of waste. Instead of problems and pollution, the end-products may feed the growing population and be a source of clean energy. One can then move from thinking about isolated technologies to totally new system-solutions.

This is an area where our agriculturists and other scientists could valuably spend their effort and come up with profitable solutions, with wide-ranging impact on the health and economy of the country.

CHEAP CLEAN WATER WITH ULTRAVIOLET LIGHT

Poor water-supply and lack of proper sanitation condemns half the population of the developing world, at any given time, to suffer from one of six main diseases associated with water-supply and sanitation. About 400 children below the age of 5 die every hour, in developing countries, from waterborne diseases. This comes to 3 million dying in a year! Diarrhea and associated diseases make them the biggest environmental threat to people.

Provision of plentiful and safe water and sanitation is essential for development; the benefits of these are increased labor and economic productivity. A citizen should, however, demand these as a basic civil right. What Pakistan needs is good sanitation, plentiful good-quality water and adequate disposal of human and animal excreta and waste. According to a former director-general of WHO, the number of taps per 1000 persons is a better indicator of health than the number of hospital beds.

The latest report on the quality of water in Islamabad, Pakistan's best cared-for city, shows that we are far from providing safe water in the country. Contamination of the water is due to sewage entering the leaking pipes in the supply chain, says one report. Boiling of water for ensuring safety is very expensive and environmentally harmful. Also, expensive home-filter, with or without ultraviolet, for removal of pathogens is not feasible for most homes. Again, as with the water-harvesting, a cheap reliable hundred-year-old idea comes to the rescue.

Low-pressure mercury arc (same as that used inside ordinary fluorescent lamps) puts out 95% of its energy at a wavelength of 254 nanometers, which is right in the middle of the range of wavelengths that kills bacteria. The Energy-efficiency of UV treatment is very high, as it uses one over two thousand of the energy that boiling does, using a bio-mass cook-stove of 12% efficiency. Unlike chlorine, which does provide long-term protection against re-infection by pathogens, UV does not leave a taste or odor and presents no risk of overdosing or formation of carcinogenic by-products caused by chlorine. The high sensitivity of bacteria to UV keeps the needed contact-time down to a few seconds, as compared with 30-60 minutes for chlorine.

In the mid 90s, when floods in India caused many deaths from water-borne disease, Ashok Gadgil of Lawrence Livermore Lab. in California, used a simple idea of UV's bio-active property to build a simple equipment that is now beginning to be used widely in India and other parts of the world. The beauty of it is that the assembly is simple and only local materials are needed to have a system up and running within a community, in less than a day.

A curved plate helps focus the UV lamp on to a channel, which carries flowing water that is to be made bacteria-free. By using 40 Watts, such a unit can disinfect one ton of water per hour. The cost of such a system is remarkably low. Electricity cost, using the grid or from a photo-voltaic array and amortizing over 10 years, as well as maintenance, gives the cost of annual provision of drinking water for a single individual (10 liters per day) at about Rs 6. No one in Pakistan has, as yet, set about installing such units in the country. Why?

CONCLUSION

As Pakistan's population grows, there will be increased pressure on water-resources. The lack of good sanitation, which is already rare, threatens to cause even more serious health hazards. These problems invite us to search our traditions for solutions, most important among them is respect for water. Technologies, old and new, can help us use the resource sensibly. Mere technical solutions will, however, not help. We will need to build a community with national conservation ethics, backed by an improved management-capability. The problems of water- scarcity and poor sanitation can be turned into wonderful opportunities to transform our societies. It is time to change the way we do things and think anew our relationship to natural resources!