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Water management: some personal reflections

Asit K. Biswas*

Third World Centre for Water Management, Atizapán, Mexico; Lee Kuan Yew School of Public Policy, Singapore

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In recent years, books, papers and media coverage of the global water crisis due to physical scarcities of water have become a growth industry. Is this widely accepted hypothesis correct? It is argued in this paper that the world is not facing a water crisis because of physical scarcities of water, as people with linear and compartmentalized thinking are forecasting, but is facing a crisis because of the inefficient way water has been managed in the past and is being managed in nearly all countries of the world. There is at present enough knowledge, experience, technology and even funds to solve the world's water problems for all uses. In addition, the world's future water problems will be very different compared to past and current problems. A new mindset is needed, first to identify the emerging water and water-related problems of the world, and then to find and implement appropriate solutions. Based on the current evidence, there is every reason to be cautiously optimistic of the world's water future.

Keywords: water crisis; agricultural water use; domestic water use; industrial water use; future water problems

When I was invited to write a piece reflecting upon the current status of water management by the President of IWRA, I promptly agreed. In this present-day world, where most water professionals are forced to react immediately to day-to-day water issues, serious reflections on the state of water management have already become a neglected, or even a lost, art.

One of the most important questions at present in the water profession is whether the world is facing a water crisis because of the physical scarcity of water. Over the past several years, much has been written and said on this fundamental question. If one reads the relevant literature and believes media reports, the answer appears to be overwhelmingly yes. The argument goes along the following lines. World population is increasing and will continue to increase till at least 2050. In order to survive, people need food and water. Since globally agriculture accounts for nearly 70% of the total water consumption, producing extra food for the additional 3.5 billion people will need considerably more water than what is being used at present. In addition, as people in the developing countries become increasingly more affluent, their dietary habits will change as well. They would prefer more and more animal products such as meat, milk and milk-based products. Even in a country like India, where the number of vegetarians constitute a significant proportion of the population, consumption of milk products such as cheese or ice cream has skyrocketed in recent decades with increasing affluence. Since animal products require far more

*Email: akbiswas@thirdworldcentre.org; sppab@nus.edu.sg

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water than conventional agricultural production, the world will not have enough water to feed an increasingly larger number of people, and to satisfy their changing dietary habits.

Is this linear thinking valid? The answer has to be no. In the water profession, we preach ad nauseam the importance of, and the need for, integration, but I regret to say that, because we continue to inhabit our watertight intellectual compartments, our thinking is still far too linear. We need to climb down from our pulpits and start thinking outside the box. For example, food availability to consumers depends on many factors. If countries like China and India want to increase the food availability per person, they have better, cheaper and quicker options available than to increase food production. Yet, in the water profession, it is now assumed axiomatically that increase in food availability for the people will require more and more water and, of course, more land. The terminology used here is "increase in food availability" rather than "increase in food production". These two imply fundamentally different options. Increasing food production will have land, water, energy and other resource implications, such as use of more fertilizers, pesticides and better-quality seeds. On the other hand, increasing food availability does not necessarily mean increasing food production but ensuring that the food currently produced actually reaches the consumers.

A few examples are in order. India produces nearly 15% of the world's fruits and vegetables, second only to China. According to the former Indian Minister of Agriculture, Sharad Pawar, nearly 40% of this production was lost in 2007 due to various pre-harvest and post-harvest losses. This loss could satisfy the demands for fruits and vegetables of the United Kingdom. India currently processes only 2% of its fruits and vegetables, compared to 65% by the United States, 70% by Brazil and 80% by South Africa and by Malaysia. Similarly, the country loses nearly 25–30% of its cereal production before it can reach the consumers. All these very high food losses are due to many reasons, among which are significant post-harvest losses due to inadequate and insufficient storage practices, poor transportation infrastructure and overall fragmentation and mismanagement of production and supply chain logistics.

Thus, proper storage, distribution and management of the food that is already being produced should be the main concern of countries such as India and China, if increasing the availability of food to consumers is the main objective. Consumers can then use this extra food that is already being produced but that is now being lost. Instead, as a result of linear thinking, the water profession is focusing exclusively on additional production of food to meet future demands. Better distribution of the food already produced will be a far simpler and more economic alternative for the countries concerned. This option has the potential to increase the current food availability of the world by about 30–45%, without any additional water, land or energy.

Even in a developed country like the United States, according to the Economic Research Service of the US Department of Agriculture, the country loses nearly 27% of its food during retailing and food services and at household levels. In other words, more than one quarter of the food produced in the United States is not used by consumers. Nestlé estimates that food wastage in developed countries currently is about 30%.

Thus, if increasing food availability to people is our concern, the best alternatives would be to see how the pre- and post-harvest losses in developing countries, and food wastages in developed countries, can best be reduced significantly in the coming years.

However, serious consideration of this non-traditional option will require a major change in the current mindsets of water and development professionals. The main objective should be enabling people in the developing world to have access to proper and adequate food without additional water and land requirements.

For the developed world, the focus has to be on how to seriously reduce the current level of food wastage and over-consumption, much of which is due to the current level of affluence of the population. Thus, water requirements for increasing food availability can be managed, based on holistic and out-of-the-box thinking.

In addition, water requirements for producing a unit of any agricultural product vary widely across the world. For nearly all agricultural products, water requirements for producing a unit of any product is 50–200% more for non-efficient farms as compared to their more efficient counterparts. If these non-efficient farms can become as good as their more efficient counterparts, it would be possible to produce significantly more food globally with the current level of water consumption.

The above discussion does not include advances in biotechnology, which are likely to help, most likely within the next decade in terms of developments of pest-resistant crops, drought-resistant crops and flood-resistant rice crops. In addition, much progress has been made in recent years on the cultivation of crops with marginal quality water, especially saline water. Biotechnology and innovative agricultural management techniques are likely to contribute to major advances in food production during the next 10–20 years.

If these and other related likely developments are considered, one can be cautiously optimistic about the agricultural water requirements for the future, which will assure the world of adequate water availability to meet the food needs of the projected hypothetically stationary population of 9–10 billion people of the world by 2050 and beyond.

In quantitative terms, after agriculture, industry is the next major user of water. There are many signs of very significant improvements in this sector as well. For example, Nestlé, a major multinational company, has reduced its freshwater requirements from 5 litres per dollar of sales to less than 1.8 litres per dollar of sales at present. Nestlé expects that even this low figure will decline progressively in the future with the use of better technology and management practices. Many other major industries can boast similar advances in the efficiency of water use. For example, a ton of steel can be produced by the most water-efficient steel plant at present with only 4% of the water requirements of the least efficient plants by using improved designs, good technology and better management practices, including extensive recycling of water. The overall picture from all over the world is very similar. As industrial water use is being priced at higher and more realistic levels, industry is finding numerous ways to conserve water significantly. With enlightened policies, proper water pricing and good and implementable water laws and regulations, industrial water requirements can be managed in the future as well.

The number one priority of water all over the world is domestic use. While the total global water use for domestic purposes is less than 10%, the services are mostly dismal in the developing world in terms of quantity and quality, as well as the reliability of the service received. However, at present, the necessary knowledge, experience and technology are available to ensure that each person in urban areas has access to clean and drinkable water. The fact that they do not is an indictment on the poor governance in nearly all urban centres of the developing world. The poor supply is alleged to be due to physical scarcity of water, lack of investment funds and a variety of similar reasons. Any serious, objective review will indicate that these are not the real reasons! With our present knowledge base, water availability and economic alternatives available, there is absolutely no reason why any city of more than 200,000 people, anywhere in the world, should not be able to provide a 24-hour uninterrupted supply of drinkable water by significantly improving its governance practices. The excuses offered may be many, but they do not stand any serious and objective scrutiny. All the constraints can be overcome.

Take the case of Phnom Penh, Cambodia. In 1993, the Phnom Penh Water Supply Authority (PPWSA) was flat broke. It needed heavy governmental subsidies to run a very inefficient operation. The institution was badly managed and corrupt to the core, and lost 72% of its water due to unaccounted for losses; even the rich and the powerful people, let alone the poor, did not have access to drinkable water. By improving governance practices, it started to supply drinkable water on a 24-hour uninterrupted basis. Since 1997, this public sector company has been making steadily increasing profits through its operation. The poor receive clean drinkable water through house connections, and pay 70–80% less than they used to hand over to private water vendors for poor quality, often untreated, water. In addition, the unaccounted for water in Phnom Penh is now only 6.19%, less than one-fourth that in London, and also very significantly less than that in Paris, New York or Los Angeles. Contrary to the claims of many urban centres of the developing world that external investment funds are not available, the donors are now fighting with each other to provide PPWSA with whatever investment funds it requires. This has enabled the institution to negotiate the loan conditions that are most suitable and favourable for the city.

The two most important factors that have made this miracle possible in Phnom Penh are leadership and political non-interference in its work. A competent and charismatic leader has managed to root out corruption, which is still endemic in all other public sector companies in Cambodia and most of the developing world. The staff of the PPWSA are very proud to work for an institution that is now respected not only in Cambodia but also in the rest of the world. With a good leader and political non-interference, all the major governance problems were solved within a brief 4–5-year period. It has now become an institution that is the envy of the urban centres of the developed as well as of the developing world.

The question that can be legitimately asked is that if a city like Phnom Penh can do it with its traumatic political history, and develop its in-house personnel and expertise to run the institution properly, why can similar results not be achieved by Delhi, Jakarta, Cairo or Buenos Aires? The water profession must stop offering flimsy excuses. It must show leadership and innovative thinking to solve the urban water problems of the world within the next decade.

Providing water to an urban metropolis is not rocket science. There is absolutely no reason as to why other Asian, African or Latin American cities cannot replicate the Phnom Penh example, especially as many cities have more managerial and technical expertise than Phnom Penh. Conceptually, there is absolutely no reason why the political leaders of urban metropoles of the developing world cannot provide clean drinkable water to all their residents by 2015 if they are serious about it. They could even leave the Millennium Development Goals far behind! However, to achieve this, rhetoric has to be sacrificed on the altar of performance.

Another factor should also be noted regarding domestic urban water use. During the past two decades, growth rates of population and economic activities in the coastal areas of the world have been 2–3 times higher than in the inland regions. As a result, there is a massive global migration taking place towards the coastal areas. According to the World Bank, nearly 55–60% of the global population now live within 100 km of the coast. The cost of seawater desalination has come down by one-third during the past decade, to around USD 0.55 per m^3. This cost is likely to fall further as technology and management techniques improve. Desalination of brackish water costs even less.

With these types of technological and management breakthroughs, there is no reason as to why everyone in the world cannot have access to clean and safe drinking water within one decade.

There is absolutely no reason as to why water problems of the world for the agricultural, industrial and domestic sectors cannot be solved with existing knowledge, technology,

experience and availability of investment funds. While one can easily provide numerous excuses as to why these objectives cannot be achieved, this should be possible with a new mindset and a "can do" attitude from the water profession and strong political support, both of which are basically missing at present. The fact that we have failed to achieve this in spite of the global commitments made during the International Water Supply and Sanitation Decade of the 1980s is truly regrettable.

While one can be cautiously optimistic about the future of the world's water problems, there are indeed many problems we have to wrestle with. Take, for example, the Millennium Development Goals, which stipulate that the number of people not having access to clean water should be reduced by half between 1990 and 2015. Instead of fulfilling this goal, which, as argued earlier, is eminently possible, we are playing with the definition of the word "access" to water. Every individual in the world has access to water. If they did not have access, they would have been dead long time ago!

When I proposed the idea of an International Water Supply and Sanitation Decade as a senior advisor to the Secretary General of the United Nations Water Conference in 1976, our thinking was clear and unambiguous. We believed, and I continue to believe, that when we mention access to clean water, it means that the water that is received from the tap, or other sources, can be drunk without any adverse health implications. This, regrettably, is not the case at present. From Delhi to Cairo, and Lagos to Mexico City, the water that comes out from the tap is neither safe nor directly drinkable. People must treat it, sometimes even through a membrane, a process used extensively for desalination, so that water becomes safe to drink. Yet, if one looks at the progress of reaching the water target of the MDGs, it is assumed that cities like Delhi, Cairo, Lagos or Mexico have already reached this goal, even though the water the people receive is undrinkable.

By manipulating definitions and using unreliable and erroneous statistics, countries and international institutions may claim that they have reached the MDGs for water. These may score some political points, but the inhabitants of the developing countries will continue to suffer. Take the case of Mexico, which is now the leading country in the world in per capita bottled water consumption. Its GDP per capita is about one-sixth that of USA, yet the average Mexican consumes twice the bottled water as his/her northern neighbour. The reason for this is very simple. People have no faith in the quality of water they receive in their houses. Thus, they buy bottled water for drinking purposes because of health considerations. This unsatisfactory situation is not what we had in mind when we proposed the International Water Supply and Sanitation Decade. Water being supplied in most urban centres of the developing world is a direct health hazard.

The situation is even worse with regard to sanitation. When the decade was promoted, the idea was very clear. By sanitation, it was meant that wastewater would be collected from the houses, treated properly and then discharged in an environmentally friendly way. Sadly, the MDGs did not even include a sanitation target, the rationale of which is hard to understand or appreciate. The sanitation target was subsequently agreed to at the Johannesburg Summit of 2002. To meet the target, the manipulation of definition and data is even worse than that of water supply.

In most urban centres of developing countries, wastewater is evacuated from the houses, but then discharged to rivers, lakes, oceans or land, with inadequate or no treatment at all. Consequently, water bodies in and around urban centres of the developing world are now highly contaminated, with increasingly higher health and environmental costs. Delhi is now discharging its wastewater to the river Yamuna, and Ahmedabad to the river Sabarmati without any treatment, or with minimal treatment. The wastewater from Mexico City is discharged to the Mezquital Valley without any treatment. These cases are

far from exceptional. The practice is widespread in the developing world. In my view, such practices should not be condoned; this also means that such cities are not meeting the Johannesburg target.

The research done at our Third World Centre for Water Management indicates that only about 10% of the point sources of Latin America are properly treated and then discharged to the environment. We believe the situation is somewhat similar in Asia but worse in Africa. And yet, if the UN figures for sanitation achievement targets in Latin America are to be believed, they are well over 3 times our estimate! Again, statistics and definitions are being manipulated to paint a far rosier picture so that the 2015 targets can be met on paper. While the goals may be closer to fulfilment in terms of access to water supply and sanitation based on official national and international statistics, the situation still remains grim and most certainly far worse than these numbers indicate.

Water is a renewable resource, and thus it can be used and then reused numerous times. In fact, as the world reuses more and more water, both formally and informally, how much freshwater the world has becomes an increasingly meaningless indicator of water availability. In fact, the current concept of using the indicator of per capita national freshwater availability is not very useful. As the population of a country has increased from prehistoric times, per capita fresh water availability has steadily declined. Taking a biblical approach, with Adam and Eve, each of them had 50% of the share of the world's water. If they had had three children, per capita water availability would have declined to only 20%! Water is not like oil, which once used breaks down into different components and cannot be used again. With good management techniques, as well as proper treatment of used water, the same quantum of water can be used and then reused several times. With better management techniques, water can be reused repeatedly, thus increasing its availability. We thus need to look at water availability from a different mindset and a scientific perspective. The widely used current concept of defining water scarcity as having access to less than 1000 m^3/person/year of freshwater is increasingly becoming meaningless, as formal and informal water reuse increases.

In the final analysis, the water problems of the world can be solved. However, the water profession will have to reflect upon the problems of a future that will be very different from what we are observing at present or have experienced in the past. In my view, water management during the next 20 years will change more than that during the past 2000 years. Many of the drivers of these changes will be new to the water sector, such as globalization, free trade, migration between countries and within countries, technological advances and the information and communication revolution. These new drivers and the changing nature of the existing drivers will mean that tomorrow's water and water-related problems cannot even be properly identified, let alone be solved, by today's knowledge, yesterday's experience and day-before-yesterday's mindset.

The emerging water problem will be increasingly related to the management of other sectors such as agriculture, energy, environment and health. Solutions to the many water problems of the future will move away from the water sector to other sectors. The water sector may have to anticipate and react to these changes coming from other sectors, since they would have very limited control over them. Equally, their solutions may have to come from other sectors. Thus, unlike in the past, the long-term solutions for water and water-related problems will depend upon the interactions between water, land, energy, agriculture and environmental issues. The solutions have to be found within the interactions and interrelations between these sectors, rather than within any one single sector. Each will affect the other, and will in turn be affected by the others. It will require a new

mindset, new institutional arrangements and a new way of approaching the problems and finding the appropriate solutions.

Water management will become increasingly complex in the future. Current popular paradigms like integrated water resources management or integrated river basin management, which are not working even now, will become increasingly irrelevant and ineffectual. New paradigms which will work in a real and rapidly changing world will have to be formulated, rather than the current practice where the situations are changed to fit the paradigms! The solution-in-search-of-a-problem approach, as is widely practised and promoted at present, cannot continue. One prediction can be made with complete certainty: well within the next two decades, our existing textbooks on water management would have to be substantially rewritten because of the rapid changes and the challenges the water profession will face during this period.