Managing water quality is more complex than quantity

By Asit Biswas and Cecilia Tortajada

Much has been said about how the world is facing a water crisis because of physical scarcity of this resource, which can only get worse in the coming years. The media regularly carries frightening stories about "running out of water" and the consequent "water wars" as if water was a non-renewable resource like oil.

The water crisis has captured the attention of the media and a good section of the general public, as well as water professionals. Fortunately, scientific analyses of all the available data indicate that the world is not facing a crisis because of physical scarcities of water. However, it is indeed facing a crisis because of continued poor management of its water resources.

From the US to the UAE, and in the entire continents of Asia, Africa and Latin America, water management practices and processes leave much to be desired and can be improved significantly. If this can be achieved, the world's water needs for all activities can be successfully met on a long-term basis. We already have enough knowledge, technology, management expertise and capacity to ensure that water crisis can be significantly improved. However, continuation of the current business-as-usual management practices will undoubtedly give rise to serious water problems in different parts of the world. Implementation of new, innovative and business unusual practices, which are already known and are being used in some areas, can ensure that the world will not face a water crisis in the foreseeable future.

While much of the global attention has been focused primarily on water quantity and allocation issues, poor water management has created a serious problem in terms of quality. Developed countries have made much progress in controlling point sources of pollution, but this is not so in the case of developing countries. Consequently, most water bodies within and around the urban centres of Asian, African and Latin American developing counties are already heavily contaminated.

Unfortunately, there are no signs that governments and people are aware of the seriousness of this problem and the dangers they pose to human health and ecosystems. If there is a water crisis in the future, it will not be due to physical lack of this resource but because of its quality which is deteriorating continuously in nearly all developing countries. Anecdotal evidence indicates that the health and the environmental costs of such deterioration are already in billions of dollars each year. These costs will continue to rise significantly.

Furthermore, all over the world, in terms of non-point sources of pollution, the situation is significantly worse when compared to point sources. One would indeed be hard-pressed to find even a single developing country which has an implementable plan for managing non-point sources of pollution. Consequently, nitrogen (N), phosphorous (P), and potassium (K) contamination of rivers, lakes and aquifers are increasing all over the world, albeit at a much higher rate in developing countries compared to industrialised nations. Not surprisingly, most water bodies in and around areas where agriculture and animal husbandry are practiced at intensive scales in developing countries already show serious signs of contamination and eutrophication.

Even in developed countries, limited progress has been made in controlling NPK contamination. Without effective control of non-point sources, it would not be possible to ensure good ambient water quality conditions. In general, developed countries have not regulated non-point sources with the same zeal as for point sources. There are two main reasons for this. Conceptually and technically, it is far more complex to regulate non-point sources compared to point sources.

For example, at present, there is simply no technology available which can measure pollutant discharges from a single farm unit with any degree of confidence. Accordingly, concepts like effluent charges or tradable discharge permits, which may work quite well with point sources, can at best be of limited value for managing non-point sources. Equally, defining upper limits of contamination per unit of time has not been of much help. Thus, effective and usable policy instruments to regulate non-point sources that applied cost-effectively simply do not exist at present. Thus, not surprisingly, the main causes of contamination of surface water in the developed world at present are from non-point sources.

Even though developing countries have given more attention to managing point sources of water contamination compared to non-point sources, the current situation even in terms of point sources is very grim. For example, assess-

ments done by the Third World Centre for Water Management indicate that at present no more than about 12–14% of point sources of wastewater in Latin America are collected, adequately treated and then discharged to the environment in a safe manner. In other words, even in 2010, more than 85% of wastewater in Latin America is being inadequately treated. Such an independent and objective assessment simply does not exist for Africa and Asia at present, but it can be said with some degree of confidence that the situation in Asian developing countries is probably similar to Latin America, and it is probably somewhat worse for Africa. Even for an Asian developed country like Japan, according to Japan Sewage Works Association (2010), the percentage of population of Japan that has access to sewerage services increased from 8.3% in 1965 to 72.7% in 2008. This means that more than 27% of the Japanese population did not have access to wastewater treatment.

The current global water quality situation raises some serious questions with respect to the Millennium Development Goals (MDGs) for water and wastewater management in the developing world.

There are some fundamental problems with the current wastewater goal, especially in terms of how it is being defined at present and also how it is being monitored and interpreted. During the run up to the United Nations Water Conference, which was held in Mar del Plata, Argentina, in 1977, and which was instrumental in proposing the 1980s as the International Water Supply and Sanitation Decade, the word "sanitation" meant that wastewater would be collected from households, taken to a wastewater treatment plant where they would be properly treated, and thereafter discharged to the environment in safe manner. However, this simple idea was subsequently corrupted very significantly so that in its current interpretation it bypasses any serious water quality management considerations.

At present, under the MDG interpretations, it is assumed that people have access to sanitation as long as wastewater is collected from their houses. Thus, inhabitants of cities like Delhi or Mexico are supposed to have near total sanitation since the wastewater is taken away from their houses.

Yet, Delhi discharges almost all its wastewater to the river Yamuna virtually without any treatment, and Mexico pumps down its untreated wastewater to Mezquital Valley. In spite of these unacceptable practices, which significantly damage the quality of surface and groundwater bodies, it is claimed that the two cities have almost full access to sanitation!

Continuous discharge of untreated or partially treated wastewater has contributed to serious contamination of quality in nearly all water bodies in or around urban centres of all developing countries. Yet the inhabitants are counted as having full access to sanitation by various national and international bodies. It is a sad situation where pollution is simply transferred downstream.

Under the philosophy underpinning the MDGs, the number of people who do not have access to sanitation should be reduced by half between 1990 and 2015. If the existing situation with wastewater management is correctly and objectively interpreted over Latin America, it becomes unacceptable. In 1990, less than 10% of the Latin American population had access to proper wastewater treatment and disposal. By 2010, the overall situation had improved only incrementally to around 12–14%. In 2000, when the MDGs were proclaimed, the goal would have been that by 2015, 44% of the people in Latin America should have access to proper wastewater treatment and disposal.

But, on the basis of the current trends, significantly less than 20% of the Latin American population would have access to proper sanitation by 2015, when the Decade will end. This means that the water quality in most places of Latin America will not show any appreciable improvement. On the contrary, continued disposal of untreated and partially treated wastewater can only further aggravate water quality conditions of receiving bodies.

Continuation of the prevailing erroneous interpretation and the use of wrong statistical information, can at best solve water quality management problems in the developing world in an abstract and academic sense. In reality, the problem is likely to worsen significantly in the coming years.

In developed countries, a determined long-term effort is necessary to successfully control non-point sources in order that ambient water quality conditions can be maintained at a desired level. In developing countries, initial efforts would emphasise controlling discharges from point sources, since technically, economically, institutionally and politically they are easier to control compared to non-point sources. In addition, use of agrochemicals in developing countries per unit area is generally significantly less than in developed countries. Thus, non-point sources of contamination are often much less of a problem at present compared to industrialised countries.

No single solution would address effectively and efficiently the different water quality concerns of all counties. Equally, different countries give different priorities to water quality management. Even for a single country, there is often no one single magic bullet that could address and solve the various water quality problems faced.

Countries, and the various regions within a country, are often heterogeneous in terms of population densities, levels of industrial, agricultural and human activities, as well as physical climatic, economic, institutional and environmental conditions. Management and technical capacities may often vary significantly from one region to another, even within one specific country. Use of approaches

like command and control, public education and involvement, and use of economic and legal instruments are likely to be helpful under specific conditions. Equally, other requirements like steps that could be taken to build up social and political awareness of the problems faced because of continuing water quality deterioration, and pressure to take countermeasures to reduce the problem, could be helpful. A groundswell of public opinion that water quality is an important socio-political issue is necessary in order that country- and region-specific water quality management policies and programmes can be formulated and implemented.

What is often not realised at present is that water quality management is significantly more complex than water quantity management. In most countries, even now, institutionally and academically, water quality considerations are often significantly less than the importance accorded to water quantity issues. Technical and management capacities to control water pollution are often at a much lower level than for water quantity. Reversing these trends is likely to be difficult.

The increasing complexity of water quality management can be demonstrated by any number of issues. Only one issue will be discussed herein as an illustrative example: data requirements. For water quantity assessments only a few simple data need to be collected, like cross-sections of channels and flow velocities. The total number of parameters for which data need to be collected are few, and these parameters do not change with time. In contrast, for water quality management, the types of data that have to be collected varies with time, geographical locations, nature of pollutants that are being discharged, or likely to be discharged, and their potential impacts on the human health and the environment, and a variety of other factors.

As people, especially in some select developed countries became aware of the health and the environmental impacts of water quality deterioration, and proliferation of industrial activities which continually discharge old and new chemicals to the environment, the number of water quality parameters that need to be monitored have increased almost exponentially in recent years. In recent years, knowledge base has increased very significantly in terms of interrelationships between pollutants and human health. Also, instrument capacities to detect extremely low doses of contamination in water bodies have improved tremendously. For example, it is now possible to detect very low doses of contamination in parts per billion compared to only parts per million a few years ago. Because of these and other associated developments, more and more new and emerging pollutants are being monitored because of their real or perceived adverse health impacts.

Accordingly, the number of water quality parameters that are being monitored in drinking water supply systems of some important cities of developed countries has gone up very significantly during the past decades. Ottawa today monitors over 350 water quality parameters.

Such a significant increase in monitoring of water quality parameters is an expensive process because of the sheer volume of data that has to be collected, analysed in sophisticated laboratories having state-of-the-art instruments, and the technical, management and administrative personnel required for different stages of collection, analysis of interpretation of data collected and their effective management.

While major urban centres of developed countries can afford to establish such elaborate systems, most developing counties are finding it difficult to establish a system which can regularly handle even 25 water quality parameters. This is just one example of the complexities associated with a good water quality management system compared to having only a water quantity management system. **AW**

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