Water hazard hits the millennium goal

The emerging water crisis shortage and flooding -- especially in Bangladesh, India, Pakistan in the Asia region other than Africa, Latin America and the Caribbean is the most worrying problem for the new millennium. To achieve the 2015 targets for freshwater provision, water supplies will have to reach an additional 1.5 billion people in these regions... writes Md. Asadullah Khan.

EVEN after the passage of 30 years since the first Summit on World Environment was held in Stockholm in 1972 charting out the first symptoms of ecological crisis the world has hardly made any headway to halt or slowdown the destruction of global environment. And the result has been catastrophic. This year's theme for the World Environment Day: "Water -- two billion people are dying for it" has awakened the conscious citizenry to look for specific solutions to meet the millennium goal. In the backdrop of critical shortage of water in Asia and Africa, the goal is to inspire political and community action and encourage greater global understanding of the need for more responsible water use and conservation.

The problem of water pollution is causing indisputable harm in poor countries. Because populations in poor countries are growing so fast that improvements on water supply have failed to keep up with the growing number of people. Worldwide two billion people still have no access to clean water and water contaminated by sewage is estimated to kill 3.4 million including two million children every year.

Water experts have sounded alarm that within next 25 years, half of the world's population could have profound trouble in finding enough fresh water for drinking and irrigation. Currently, as reports reveal, at least 80 countries representing 40 per cent of world's population, are subject to serious water shortages. Condition may get worse in the years to come as population grows and as global warming disrupts rainfall patterns.

Believably, West Asia faces the greatest threat. Over 90 per cent of the region's population is experiencing severe water stress with water consumption exceeding 10 per cent of renewable freshwater resources. Precisely speaking, human water consumption rose six fold in the past century, double the rate of population growth. People now use 54 per cent of the available fresh water and additional demand will further jeopardise all other ecosystems. That only indicates that water scarcity may soon limit economic development, particularly in parts of China, India, Bangladesh and Pakistan where supplies are already inadequate to meet the needs of agriculture and industry. Added to this is the problem of pollution caused by fertilizers, silts, sewage and other toxic effluents that have killed lakes and poisoned rivers.

The crisis did not end there. Half of the world's wetlands have been drowned through conversion, diversion and fragmentation of the system resulting into destruction of habitat. Insanitary water which provides a breeding ground for parasites, amoebas and bacteria damages the health of 1.2 billion people a year. Water borne diseases are responsible for 80 per cent of illnesses and deaths in the developing world, killing a child every eight seconds. Almost 60 per cent of the world's population lives within 60 kms of the coast lines. Disease and death related to polluted coastal waters alone cost the global economy US$ 16 billion a year.

Much of the woes and suffering to people stemming from water crisis in many parts of the world, it is now believed, has come out of dam building mentality of the developed nations. The first of the world's great dams, Hoover, built over Colorado river to support bustling modern Los Angeles inaugurated an age of dams that spanned three quarters of the last century. The dam building mentality, however, has pretty much expired in the developed world, especially in the US, -- one reason is they have run out of dam sites -- but it is still prevalent through much of the world. In China which is erecting the Three Gorges Dam, the biggest hydroelectric project in history and at $ 25 billion the most expensive one in the world, one senses outright resentment against rivers running free.

True, almost everyone appreciates how water projects have altered the course of civilization in ways we call (perhaps foolishly) benign. Dams and reservoirs permit unimaginable numbers of people to inhabit forbiddingly arid regions -- as well as flood plains where cities would be washed away without upstream protection. Dams produce more clean energy than nuclear reactors. Irrigation agriculture, largely dependent on reservoirs, grows 40 per cent of the world's food on a much smaller fraction of its farmland. Ironically true, we are now beginning to understand how water development projects, amounted to a Faustian bargain between civilization and the natural world which, as it happens, supports civilization. For example, reports have it that hydroelectricity from Grand Coulee Dam in Washington state smelted enough aluminium during world war II to build tens of thousands of warplanes with enough surplus power to make plutonium for the first atom bombs. But in the form of devastated salmon fisheries and lost farmland, worth billions of dollars Grand Coulee, along with countless other dams, is extracting an awful price for its creation.

Undoubtedly true, nature can take some blame for the tribulations of river life in China, India and Bangladesh. As for China, the devastation wrought upon over the years owes much to the policies of its great leader, Mao Zedong. Mao ordered Peasant communities to "plant grain everywhere". In the 1950s, work brigades drained the lakes along the Yangtze and its tributaries and seeded them with crops. Families settled on flood plains. The enormous Dongting lake once a catch basin during the years the Yangtze swelled was now half the size it was when Chairman Mao came to power in 1949. And the results were predictably disastrous. The surrounding countryside lost its ability to absorb water from the Yangtze as it flowed from the Tibetan plateu downwards. To ward off the crisis, even when the government tried to build dikes and sluices, as the ultimate solution, such attempts have been of very little help. The Three Gorges Dam is now under construction upriver in Sichuan province. Yet even that grand ambition turning the upper Yangtze into the world's greatest reservoir probably won't stop downstream flooding. Water shortage in India caused water hazard in Bangladesh, its lower riparian country. As for instance, India receives an annual precipitation of around 4000 bcm (billion cubic metre) including rain and snowfall. Of this the runoff -- accessible water -- is 1869 bcm of which barely 690 bcm is used. Nearly 1179 bcm water is drained into the sea. Not only water is drained into the sea, along with it are transported silts and sediment that eventually raises the river bed causing the rivers to overflow its banks. This ultimately means watery death to humans, animals and total destruction of farm crops.

In most parts of the world including India and Bangladesh pipelines are there but these often turn dry because the crux of the problem -- supply has not been addressed. Most cities and towns are not based on river banks and the rapid pace of urbanisation has led to the drying up of the traditional water sources like tanks and lakes. With water sources shrinking day by day and population pressure increasing water stress has become visible. Most municipalities and corporations especially in the towns and cities have gone for the immediate, tapping ground water resources. In the countryside, as well, to meet the drought like situation and to pursue agricultural activities, people have joined the rush to bore wells. Expectedly, the pressure on groundwater has shown up. Tubewells are now routinely dug at higher and higher depths.

Against the backdrop of severe water crisis hitting almost two thirds of the global population, Bangladesh, once considered a country of abundant water resources or otherwise known as a country of rivers, haors and baors -- is now facing an acute water crisis and also seasonal flooding. This is due to several factors : Rivers and lakes are drying up due to siltation, most rivers have changed their original course because of obstruction raised here and there with unplanned dikes and sluices, no new tanks, lakes and reservoirs in any part of Bangladesh have been excavated during the last one century and lastly the river water has been dangerously polluted. Because of careless and senseless human activities, rivers now contain many bacteria from human waste and other harmful effluents thrown in the rivers. Noticeably, an estimated 90 per cent of sewage in our part of the world is discharged into rivers, lakes and seas without any treatment. To make things worse as already mentioned supplies of fresh water that might dilute the sewage are dwindling in many areas. Almost 90 per cent of the populations of Bangladesh has now become victim of river pollution. Cities, towns and villages stand by the river, but the population cannot use river water for indiscriminate disposal of pollutants there. Most shocking, even if the alarm bells are ringing governments in Asian countries and the public in general are apathetic to the problem.

The emerging water crisis shortage and flooding -- especially in Bangladesh, India, Pakistan in the Asia region other than Africa, Latin America and the Caribbean is the most worrying problem for the new millennium. To achieve the 2015 targets for freshwater provision, water supplies will have to reach an additional 1.5 billion people in these regions. But water problems, as experts indicate, are more related to mismanagement than scarcity. Upto 50 percent of urban water and 60 percent of water used in agriculture is wasted through leaks and evaporation. Besides, logging and land conversion to accommodate human demand has shrunk the world's forests by half contributing to increased erosion and water scarcity. Between 300 and 400 million people worldwide live close to and depend on wetlands. Strikingly, wetlands act as highly efficient sewage treatment works, absorbing chemicals and filtering pollutants and sediments. Paradoxically, urban and industrial development has claimed half the world's wetlands. Undeniably true, sustainable development and poverty alleviation will only be achieved through better management of and investment in rivers and wetlands.

For a country like Bangladesh that wants to achieve 5 plus percent GDP growth and where 80 per cent of the population is dependent on agriculture, investment in rural infrastructure has been pitiful. Besides the management of water supply, there is an increasing need for technology to increase efficiency. This water-starved region must shift from the concept of yield per acre to yield per cubic metre of water, emphasizing equally on the need to adopt micro and drip irrigation methods practised in many water scarce countries of the world. As urban demands for water increase, supply for the developing world's already water-starved agricultural areas will be further affected thereby creating a potentially monumental food security crisis.

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Combating arsenic hazard

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THE health problem due to arsenic contamination in groundwater was detected during mid 1990's in Bangladesh. These health problems arose from drinking water of mainly shallow rural supply wells. However, these health problems were scattered and did not occur in all arsenic contaminated areas. Meanwhile it was also observed that no cases of health hazard were found from some highly contaminated arsenic affected areas. Most urban water supplies are also from groundwater source, but arsenic health hazard had not been reported from urban areas as yet. People are known to have lived more than 90 years or so without any health problem due to arsenic in such areas by drinking tubewell water. Therefore the real cause of this health hazard needs to be determined carefully and properly.

Arsenic contamination in water supply wells is certainly not a crisis but a serious problem that arose due to human mistakes. This issue can be addressed by providing safe drinking water and medical care in the affected areas.

There are at present over six million private and government rural water supply wells. The Department of Public Health Engineering (DPHE) is the government agency in Bangladesh responsible for drilling these wells. The major donors have been the Danida, SDC and DFID through the UNICEF. Recent donors are IDB, JICA and Danida. Columbia University of the USA has also been doing a research project on arsenic problem in Bangladesh.

Most rural water supply wells, excepting the coastal belt, are shallow and called shallow tubewells (STW) as per DPHE definition with depth ranging from 30 to 250 ft -- the overall average could be 100 ft. In the coastal belt, shallow wells of depth 30 to 50 ft do exist in considerable numbers. Chloride content in most of these wells are generally between 1000 and 1500 mg/l, which is in excess of WHO desirable limit. As there is groundwater salinity in the upper aquifer system, which is within about 400 ft from the ground surface, wells are generally drilled deeper between 400 and 1200 ft (overall average is perhaps at 800 ft) in confined fresh water aquifers. The wells are drilled wherever the fresh aquifers are available in the coastal belt. These wells are known as Deep Tubewells (DTW). Perhaps 1200 ft is the maximum depth achievable by hand drilling method. A DTW generally costs 15 times more than an STW and therefore beyond the capacity of private ownership. It must be noted that the DTWs in the coastal belt generally have excellent water quality.

The water quality of these rural water supply wells is generally checked for iron and chloride only. Water containing excessive iron/chloride/hardness tastes bad. However, this is not true for arsenic contaminated water. Therefore the only way to know arsenic contamination in tubewell water is to test the water by a field kit or in the laboratory. During the very early 1990's the writer suggested to approve a programme to conduct full chemical analysis of tubewell water of at least three wells per Thana per year in order to ascertain the overall water quality of these wells, but the recommendation was not implemented. (It is worth mentioning here that full chemical analysis of water in all town water supply wells is done on completion of the production wells). Had this been done the arsenic contamination in rural water supply wells would have surfaced much earlier. A World Bank project is currently underway to determine arsenic content of every rural water supply well.

The presence of arsenic in aquifers is from hydrogeological times, in terms of millions of years. It could not be detected earlier because analysis for this element was not carried out for water supply wells as mentioned above. The writer has worked in several countries with alluvial deposits and it has been found that a good aquifer has better water quality than a poor aquifer. Good aquifer generally contains homogenous sand layer and, therefore, its permeability is high and allows water to flow through it at a much higher velocity than the poor aquifer. A poor aquifer is a heterogeneous mixture of sand and clay, such as clayey sand / sandy clay, whose permeability is relatively very low and, therefore, the groundwater flow through it is also very slow. Consequently, the flushing of the dissolved minerals from these formations has either not taken place or has been very slow. The writer's experience in well design in many water quality problem areas revealed that screening of poor aquifers/clayey aquifers was the cause for bad water quality, if any. The flow rates in these poor aquifers are low but sufficient for a hand tubewell. A hand tubewell in Bangladesh produces 3-6 gpm (gallons per minute), depending on the aquifer quality.

The upper aquifers in Bangladesh (except in the North West), particularly those within 100 ft from the surface, are generally clayey sand and/or sandy clay with low transmission capacity and, as such, the natural flow of groundwater has been unable to flush the aquifer. Consequently, the undesirable dissolved minerals, such as arsenic, still remain in these aquifers. To the contrary the upper aquifers in most North West Bangladesh (Bogra, Rangpur and Dinajpur) are generally sand with high permeability and the water quality of the STWs in these areas are also quite good with no arsenic hazard.

Since the arsenic problem surfaced, many national and international seminars/workshops have taken place on this subject but things have not changed for the better technically. Do we really need so many seminars on this issue? What we need is to ascertain the real medical cause behind this arsenic health hazard and offer our rural people safe and potable drinking water in the affected areas.

Bangladesh is a delta with thick alluvial deposits. Good quality aquifers are available in the depth zone 200 - 500 ft. Therefore if rural water supply wells are properly designed and drilled in these aquifers, good quality water is obtainable in most places. The urban water supply wells are drilled in this zone and there are few reports of excessive (more than the allowable limit) arsenic contamination in these wells.

The rural water supply hand tubewells use only 10 ft of strainer to produce 3-6 gpm. The use of short well intake offers the opportunity to design a better water quality tubewell by placing the screen in the most permeable aquifer. Also the small discharge generally causes a very insignificant drawdown, thus minimizing the risk of inducing leakage from the overlying/underlying any contaminant aquifers. The urban water wells are large capacity wells of discharges 15 - 60 l/s (liters per second) with well intake of (the strainer/screen) 60 - 100 ft. These wells were drilled well below the upper heterogeneous aquifers and have not yet exhibited any arsenic hazard in most cases. Although the relatively high drawdown can induce leakage from contaminant overlying/underlying layers, their contributions, due to very low vertical permeability, remain within the contaminant limit in most cases.

More than 600 large capacity Dhaka WASA wells plus many private water wells have been operating in Dhaka city for many years which already created an overdraft. These wells have been drilled in the permeable sand aquifers, available between 100 and 400 ft. Although this over development and continuous heavy pumping stressed the underlying aquifer system and caused the groundwater level to drop from 20 ft to over 150 ft, it has not yet caused any noticeable arsenic contamination from nearby arsenic hot spot, if any. The heavy pumping by the irrigation wells and the town water wells screening permeable sand aquifers between 60 and 250 ft in North West Bangladesh has yet to cause any noticeable arsenic contamination. Therefore, it is not true that heavy withdrawal of groundwater has caused any noticeable arsenic contamination as of yet. A model study has indicated that it might take many more decades to do so under these circumstances.

Therefore, water from arsenic contaminated wells, whose concentration are not too high, can be used for drinking purpose by using simple treatment such as three *kolsi* filtration method, etc. until a new safe water supply is established. These new techniques for providing safer water can be implemented either by drilling a new well in the available deeper safe aquifer or using treated surface water. In highly concentrated arsenic areas, new safe water supply source has to be established in the same way.

In Bangladesh, it is cheaper to develop safe groundwater for water supply in rural areas by hand tubewells as daily per capita water demand is very low as compared to urban areas. Treated surface water is the alternative where safe groundwater is not available. More than 80 per cent of people live in rural areas of Bangladesh.

The above has been prepared to demonstrate the real technical picture on the occurrence of arsenic hazard in many areas of Bangladesh. Groundwater is not only the most economic but also the safest and easily manageable source of water supply in Bangladesh as well as in most other countries of the world. What is important is to manage these groundwater resources properly and to design wells by positioning the screen/strainer in the right aquifer as described above. It is also essential to establish a network of tubewells to monitor groundwater quality in order to ascertain any changes over time.

Since the arsenic problem surfaced, many national and international seminars/workshops have taken place on this subject but things have not changed for the better technically. Do we really need so many seminars on this issue? What we need is to ascertain the real medical cause behind this arsenic health hazard and offer our rural people safe and potable drinking water in the affected areas. All agencies and donors need to be focused and strict during the project formulation and implementation phases in order to achieve the desired goal.

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