Arsenic disaster and water supply: An overview

REZAUL KABIR CHOWDHURY

NINETEEN rural districts covering an area over 500 square kilometers near the border of Bangladesh with India have arsenic-contaminated wells. Many villages adjacent to the capital Dhaka are also affected. This paper gives just an idea about the solutions of getting safe drinking/domestic water.

Urban and Rural water supply in Bangladesh is primarily based on Ground Water (GW). Another major source is surface water (SW) like river, pond, dighi, lakes, haor, baor and beels etc. Since GW is free from suspended particulate matter (SSP) and pathogens, it is common practice to withdraw GW by deep tube wells, shallow wells and by hand tubewells. Furthermore GW contains some minerals that are good for health.

Arsenic disaster comes from underground tube wells introduced widely over the last 20 years as a cheap alternative source of water supply to prevent outbreaks of deadly diseases such as diarrhoea and cholera. Tube wells are steel cylinders sunk into the aquifer to varying depths to provide underground water for irrigation and drinking purposes. No testing was done, however, for potential dangers such as arsenic (or other heavy metals), which is colourless, tasteless and soluble. The United Nations International Children's Emergency Fund (UNICEF) initiated well drilling as a means of providing what was thought to be clean water in rural areas in Bangladesh. When the programme began no water or soil tests were carried out.

As recently as six months ago tube wells were being installed without testing. Of the 20,000 tubewells tested by the government and non-government organisations, 25 per cent had dangerous levels of arsenic, 40 per cent had unsafe levels and only 35 per cent were below 0.01 mg/L (ppm) of arsenic. The World Health Organisation (WHO) recommends a level of 0.01mg/L of arsenic but the government of Bangladesh regards 0.05 m/L -- a level five times higher than WHO -- as acceptable.

In the village of Jessore, 92 per cent of 282 tubewells tested were found to be contaminated by extremely high levels of arsenic. In Hajiganj of Chandpur district, which includes over 157 villages, 93 per cent of all wells were also found to be contaminated.

The treatment of arsenic poisoning is straight forward: provision of arsenic-free water will halt any further physical deterioration in all but the most advanced cases. But access to this basic necessity of life -- clean water -- is precisely what is lacking. Neither the government nor the various international agencies have any remedies to propose. In a number of cases, the government has tested and sealed dangerous wells only.

All funds and loans from international agencies (WHO, UNICEF, World Bank and others) to conduct more research and attempt to find alternative supply of safe drinking water have been used to re-test the tube wells. Now-a-days in rural areas, arsenic disaster has come as a sign of "Red" and "Green". Rural people again go back to the ponds and other contaminated surface water sources. Despite mounting evidence of widespread water contamination, little has been done to identify the extent of the problem, let alone provide any solutions.

It is generally considered that GW is the gift of God and is renewable, obviously GW is renewable but as long as the rate of recharge is grater than the rate of extraction by pumps. Otherwise GW table will be depleted. In our country during dry season, GW can't be extracted by many tubewells due to depletion.

Sources of potable water:

λ Back to surface water
λ Rain water
λ Treatment of Arsenic Polluted water
λ Related Technologies:

1. **Surface water** (characteristics: colour, odor, SSP, micro organism etc.)
λ Sedimentation with Coagulation
λ Filtration
λ Disinfections
λ Establishment of Surface Water Treatment Plant (SWTP) is costly. Rural people can collect pond/ river water, add some Aluminum Sulphate (*Fitkiri*) for coagulation and pass the clean water through some filter beds (sand, coal, gravel, pebble etc.). Finally to disinfect the clean water they have to add some Calcium hypo chloride (Bleaching Powder). It is recommended to boil the filtered water prior to drinking.

λ 2. **Rainwater** (characteristics: pure, NOx and SOx and particulates matters from atmosphere, no mineral contents)
λ Filtration
λ Disinfections if polluted by birds or other animals

Rainwater is pure. As it contains impurities from the atmosphere, it is recommended to collect rainwater after 10 minutes from the beginning of rain. Rainwater can be collected from the pipe networks of building's roof (structured method). Rural people can also collect from their roof (tin) by providing gutter. People without roof can collect by providing polythene (with a hole) on bamboo holds during the rainfall. Collected rainwater should be filtered and disinfected prior to use. Rainwater does not contain any mineral, but we don't have water as a source of mineral, we have food for minerals. Another drawback of rainwater is its seasonal variability.

3. **Treatment of Arsenic Polluted ground water**

λ Adsorption, Absorption and Co-precipitation
λ Filtration

Treatment of arsenic polluted water is not fully discovered. However, it can be seen from many research works that arsenic is generally found with iron and manganese. During oxidation, flocculation and filtration of iron, arsenic is removed by the method of absorption, adsorption and/or co-precipitation. Treatment of arsenic polluted ground water is not a sustainable solution because of the sludge disposal problem. If not carried out carefully it could lead to soil, pond and river contamination.

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.Bangladesh is one of the most densely populated countries in the world, and one of the poorest. About 80 per cent of the population is rural and 60 per cent landless peasants. Safe water is the basic necessity for a man. We must look forward for providing safe water to the rural as well as urban dwellers.

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Kuzurdia--an arsenic-free village

DR JAMAL ANWAR

MY niece Ana, a 17-year girl who studies at Oxford was thinking on her way back home during Easter holidays, what should she do with the money that she saved during the term from her pocket money. When she arrived at Dhaka airport, she told her mother that she wanted to donate that money for the poor. She knew that her uncle was engaged in Bangladesh with a determination to make arsenic free water available to the poor and affected people.

After some thinking she chose that her savings of 280 English Pounds should be of some help towards providing arsenic free safe water for the poor.

Background

Millions of school children (5-17 years old) in Bangladesh are drinking arsenic contaminated water. Almost 80 per cent of rural population is analphabetic. Arsenic mitigation can be highly successful, if school students and teachers are educated and transfer their knowledge to their parents and neighbours. Bangladesh is facing the largest mass poisoning in history because of arsenic contamination in the drinking water supplies. Previously Bangladesh used to be proud that 60-70 per cent its population have access to tube well. Most of the tube wells are now contaminated.

Prof. Richard Wilson of Harvard University, USA describes: "In Bangladesh 30 million people are exposed to arsenic at levels higher than EPA presently permits (>50 ppb in the water). I have been quoted many times, without ever being contested, that the Bangladesh catastrophe makes Chernobyl look like a Sunday school picnic. Some thousands have already died from secondary effects of the skin lesions and there are estimates by responsible scientists that a million people will die eventually." (2001)

The research by Allan H Smith, professor of epidemiology at the University of California at Berkeley said that between 33 and 77 millions of Bangladesh's 125 million population was at risk. Smith predicted a bigger increase over the coming years in the number of cases of diseases caused by arsenic.

These ranged from skin lesions to cancers of the bladder, kidney, lung and cardiovascular problems. The scale of this environmental disaster is greater than any seen before.

Cardma decided to take up the challenge and has come forward to solving the problem by identification of facies-change within contaminated area and located and construct arsenic free wells. A few wells show ground water arsenic concentration is far below Bangladesh standard. Based on an understanding of the geological origins of contamination, it may be possible to identify areas or strata that are at relatively low risk of arsenic contamination. In some areas arsenic contamination is confined to highly localised sedimentary deposits.

Kazurdia

Like all villages in Bangladesh, Kazurdia is a small beautiful village in Tanbul Kana, Faridpur but one of the worst arsenic affected areas of Bangladesh. There were several deaths in the village. The entire village population was affected by arsenic contamination. We selected this village for using Ana's small donation for obtaining arsenic free water on the basis of geological information.

After digging we found an arsenic free layer (aquifer) but not continuous. We set seven arsenic free wells within one and a half month.

Today about 100-2000 villagers are drinking arsenic free water. This is a cheap method. A sound knowledge of ground water hydrology can be applied to many worst affected areas of Bangladesh. It is not explainable why many NGOs and different organisations are depending on advice of expensive foreign consultants and experts, spending taxpayer's money for deep tube wells and expensive unworkable filters.

Thanks to Ana, a great donation and a big impact!

Dr Jamal Anwar is Vice President of CARDMA.

Party is over but degradation of Everest persists

RON CHEPESIUK *writes from Kathmandu*

THE party is over and Sir Edmund Hillary has left for England, hauling a load of honorary medals and awards, but the country is still savouring the commemoration of one of the greatest occasions in its history. On May 29, 1953, Hillary and Tenzing Norgay Sherpa stood atop the seemingly unconquerable 8,850 meter high Mount Everest and changed Nepal forever. Five decades later, the world's highest and most famous mountain has been conquered nearly 1700 times.

For the poor country of Nepal, the last several months have been a time to bask in the glare of Mount Everest coverage. For those involved in ecology, high altitude mountain climbing and Nepal's tourism industry, however, it has been time to take stock of what the booming tourist trade is doing to Nepal's fragile environment. The party may be over, but the serious environmental problems and challenges persist.

As an environmental journalist I have been intrigued by reports of Mount Everest's environmental degradation, so last May 23 I trekked the winding and steep road from Lukla to Namche Bazaar to attend a historic three-day conference on ecotourism that focused principally on Nepal. More than 55 academics, conservationists, tourism industry officials from 15 countries, as well as members of the local community, attended.

Nepal's mountains are an attraction not just for climbers but also ecologists, anthropologists, development workers and many others who are attracted by the exciting research opportunities.

One of those researchers is Dinesh R. Bhuju, an ecologist with the Royal Nepal Academy of Sciences and Technology in Kathmandu. Bhuju explained to me his fascinating work at the Pyramid International Laboratory-Observatory, a three-story high permanent structure of glass and aluminum located in the Sagamartha National Park, which at an altitude of 5050 meters, is the world's highest scientific laboratory.

The Pyramid's geometric form offers the advantage of high stability with a natural resistance to research harsh atmospheric conditions like wind, snow and rain. The laboratory uses only renewable power sources -- water, sun and wind.

The researchers at the Pyramid are particularly interested in studying how humans can adapt and survive at high altitudes. " Medical science tells us that people can't live at the 7000 to 8000 meter level, but Sherpas (Nepali mountain guides) do it without the use of oxygen," Bhuju told me. "The challenge to modern science is to find out why."

Many other conference sessions were focused on a more basic concern -- how can pollution and commercialisation that is rapidly destroying the attraction of Everest be checked. Tourism is vital to Nepal for earning foreign exchange. No country is more blessed with as many majestic mountains, and this rugged terrain holds a huge attraction for the adventurous from all over the world.

With the crowds swarming into the Everest region, the deforestation has continued at a steady pace. In 2001, the number of mountaineers made 28 percent of Nepal's total tourist population, a significant increase from the 15 percent in 1988.

As the total number of tourists continues to decline, Nepal is becoming increasingly dependent on the adventurous trekkers and mountaineers. That's understandable, given the economic impact. In 2002 Nepal opened up six districts for trekking and gave out more than 125 permits for climbing. In 2002 alone, the country made 128 million Rupees as royalty from the issuing of permits for more than 900 expeditions.

The current cost of climbing Mount Everest for a seven-member team is U.S $70,000, and for a single individual, $25,000. It's almost reached the point where a person with the money and time can hire a team of Sherpas who will gladly push them to the top.

Speaking at a press conference organised by the British Embassy last May 28, Sir Edmund Hillary said that the Mount Everest climb had lost some of its adventure and challenge and that it was time for the Nepal government to put restrictions on expeditions to the world's highest peak. But for others it's not the loss of the sense of adventure that concerns them. It's the rapidly deteriorating environment that threatens the eco-system in the Everest region. Ken Noguchi, the youngest mountaineer to climb the tallest peaks on all seven continents said it was time for Nepal to make an effort to clean up Everest.

Naguchi himself led four clean up expeditions of Mount Everest. Remarkably, during the last four years, Noguchi and his climbing team have brought down 37 tons of garbage from Mount Everest, including 430 empty oxygen cylinders and four dead bodies. Noguchi wants Nepal's authorities to stiffen the regulations and to get liaison officers to properly monitor the expedition teams. "Failure to do that would demean all our efforts," he says.

But if only the solution to problem was that simple, The trail leading to the Everest summit is still littered with more than 200 tons of garbage. Moreover, the increased regulations and restrictions could have a devastating impact on the poor rural people of Nepal's Himalayas. In the past half century, Nepal's tourist trade has made the Sherpa population in the Himalayas much better off economically. The U.S. National Geographic Society estimates that the Sherpas working in tourism now have an average income of $7,000, about six times Nepal's average. Sherpas run more than 300 lodges and hotels serving climbers and other tourists in the Everest region.

In an article in *Kathmandu Post* last month (May), journalist Saytandra Timilsin pointed out that each mountain climber who wants to scale a peak more than 6,500 meters requires the services of four lower altitude porters, as well as additional porters for carrying equipment and supplies in high altitudes. By Timilsin's calculations, this means more than 4,500 people were engaged as porters in expedition during 2002. This number does not include the climbing Sherpas who are hired for a minimum of one month with each expedition.

In addition, trekking agencies, hotels, teahouses, pubs, provision suppliers and other businesses all profit from the numerous expeditions that head to the Everest region.

Those at the Namche Bazaar conference, of course, are aware of the dilemma -- economic benefit versus environmental degradation. "For years, the Nepal tourist industry has been comfortable in its hypothesis that increasing local incomes through tourism would lead to a greater conservation success," explained Dr. Alton C Byers, Senior Conservationist at the International Centre for Integrated Mountain Research (ICIMOD) in Kathmandu.

Byers' research shows that 50 percent of the juniper shrub, which takes 100 years to reach a diameter of four centimeters, has been removed from the hill tops in the Everest region during the past ten years to heat the trekkers' meals and drinks.

But it was obvious form the discussions and debates at the conference that the consensus of delegates agreed everybody involved in the climbing experience bears some of the responsibility for the acute environmental crisis in the Everest region.

One of the major resolutions passed at the conference called for planning within the Everest region that aims for an integrated approach to the management of land, water and living resources so that conservation and equitable sustainable use be promoted. And with the integrated approach should come more education.

Again Dr. Byers: "I don't think the average tourist and trekking and climbing firm is really aware of the impacts they are having since it often takes a trained eye to see them. When the average trekker is interviewed, he or she expresses a strong desire to contribute to the well being of the local people and the environment. But they don't know the issues."

Byers' solution is practical: "Let's foster increased awareness first, then build in mechanism where the tourist industry is actively and financially contributing to sound local management in perpetuity of the mountain landscapes."

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