Quarterly news bulletin – June 2019

The rainy season – possibilities amidst problems

This season is associated with waterlogging after heavy showers. Hence, sadly enough, flooding is not "news". But as usually done in these newsletters, we take a look at innovative ways of improving the quality of life, by circumventing the problems. First, we describe the use of boats as both classrooms and ferries in Bangladesh. Second, despite the rains, the supply of accessible water at home, and in particular, clean drinking water continues to be inadequate. But here again, the innovative combination of renewable energy, appropriate technology, and traditional practices has enabled water purification locally; two methods devised in India are being described – one already proven and the other being tested. As an end-note there is a quaint arrangement for washing hands independently, even without pipeline-enabled faucets.

Going to school – whatever the weather: The combined delta of the huge rivers Brahmaputra (called Tsangpo in Tibet), Ganga, and Meghna occupies much of Bangladesh (earlier East-Bengal) and southern West Bengal of India. Hence, lands are liberally interspersed with distributaries of the rivers, and travel necessitates crossing in boats. During the rains, low-lying lands are flooded for long periods. This renders it very difficult for children to commute between home and school (even if schools had already been established).

But *Shidhulai Swanirvar Sangstha* (www.shidhulai.org) in Bangladesh is implementing an innovative idea of its founder Md. Rezwan: boats have been fitted out to double as school-rooms and buses/ferries!

While the movement of the boats is powered by diesel-engines, there are solar panels on each cabin roof to power essential energy needs like a computer and lighting.

Inside the boat cabin, there are the conventional school supplies – desks, books, a blackboard, and so on, with some boats serving mainly as libraries. The first such school-boat began plying in the year 2002, but the organisation now has 23 school/library boats, each serving a particular locality, collecting teachers and students, and returning them as close to home as possible. Children who would be cut off from school during several months of the year are now able to continue their studies; their safety during commuting is also greatly improved by the ferry service.

Training sessions for adults, for example, for appropriately growing plants, are also conducted on such boats. There are an additional five floating clinics that ply along rivers, docking at different points. This innovative (and partly renewably-powered) system

addresses the climatic and situational barriers to basic needs and assists people in staying afloat - literally!

Clean (potable) water: Despite the rains, the availability of clean water continues to be difficult[1]. About 12% of India's estimated current population, or 163 million people, do not have access to clean water[2], with "access" defined as less than 30 minutes travelling to procure water. This is the highest in the world[3], according to WaterAid, a global advocacy group on water and sanitation, in its report *The Water Gap - WaterAid's State of the World's Water 2018*. India is followed by Ethiopia with over 60 million people, and Nigeria with over 59 million people, without safe water. Globally, the number without access to clean water has risen to 844 million, or about 11% of the total population.

Contaminated water results in suffering from water-borne diseases; around the world, an estimated 289,000 children under five die each year (WaterAid, 2018) of diarrhoeal illness directly linked to dirty water (as well as inadequate toilets and poor hygiene). Without safe drinking water, none of a person's other basic needs can properly be met. Water purification, to the best extent possible, is therefore essential. This includes processes by which undesirable chemical compounds, organic and inorganic materials, and biological contaminants are removed from water. There is a range of processes that achieve partial to complete removal of contaminants -- simple filtering of particles by straining, boiling, sedimentation, membrane filtering such as reverse osmosis (RO), granular activated-carbon filtering, distillation (the conversion of a liquid into vapour to condense it back to liquid form), and deionization (ion removal through the extraction of dissolved salts).

Cloth-filtering and boiling water are the simplest methods that people usually employ in homes, to make water fit for drinking. But filtering alone is inadequate, and boiling necessitates the additional purchase of fuel. Purification systems that use reverse osmosis (RO) have been advertised aggressively and have become commonplace in upper-income urban homes. RO uses a partially-permeable (or selective) membrane to remove many types of dissolved and suspended chemical species as well as biological ones (principally bacteria), that are flushed down the drain along with the water in which they are mixed. But this results in water wastage; what is more, simpler methods could suffice.

Here are two methods that combine modern technology and traditional practices, while avoiding the need for fuel purchase and water wastage.

Cloth filter + solar-powered heating: A solar-powered water purifier has been developed at the Nimbkar Agriculture Research Institute (NARI, www.nariphaltan.org) in Phaltan (Maharashtra state, western India).

The available water has to be filled through a piece of ordinary cotton cloth folded into four-layers. Earlier tests by NARI had indicated that filtration of water through four-layered cotton sari cloth itself reduced the coliform count, as many impurities such as *Escherichia*

[1] One is reminded of "Water, water everywhere, nor any drop to drink!" (Coleridge).
[2] Details about the sources of water for domestic use around the country are available at https://data.gov.in/catalog/households-access-safe-drinking-water
[3] India is also one of the world's most-improved nations for reaching the most people with clean water. However, India faces challenges with falling groundwater levels, drought, increasing population and corresponding demand for domestic, agricultural and industrial needs, pollution and poor water resource management – challenges that will intensify as climate change contributes to more extreme weather shocks.

coli (or *E.coli*) are attached to dirt particles. Since the cotton cloth can be washed daily, this filter does not get clogged.

The solar-powered water-purifier is an evacuated tube collector[4] comprising four tubes fitted in a stainless-steel manifold, as shown alongside. The main criterion followed when designing this solar water purifier was that it would work even under cloudy conditions and diffused solar radiation. According to the Director of NARI, Dr Anil Rajvanshi, laboratory tests have shown that filtered water, heated to 60 degrees for 15 minutes, or as low as 45 degrees for three hours, inactivated all coliform. Hence, water heated in the solar collector system is made potable. However, this system does not remove or reduce dissolved solids like arsenic.

The tubes, imported from China, are available in the Indian market for Rs 150 - Rs 200 (US$ 2.14 – 2.86) each. The frame can easily be fabricated in any metal-workshop. For large scale production, a light weight frame could be shipped with the tubes, so that each unit can be assembled with just a spanner. The present design is based on this ease of assembly and costs about Rs 3,000 (US$ 42.86). The total volume of each four-tube-collector system is about 15 litres (with the capacity of each tube being 2.7 litres, and the manifold of 4.18 litres). Two purifiers installed at the NARI campus have been working for two years. Details regarding the effective operation of the systems are provided in their manual, available at https://nariphaltan.org/swpmanual.pdf

Baked clay/husk + nano-particle silver-disk filter: Nano Cera Enviro India, a new firm, is developing a water-purifier made of clay and rice-husk, with a silver-coated nano-particle disc or coin (that has to be replaced periodically). This "Swach neer Ag-Mittifil" (clean water silver-clay-filter) is designed to treat biologically-contaminated water, removing almost all impurities.

The water-filtering container or jar is being

[4] An evacuated tube solar collector consists of transparent glass tubes connected to a header pipe. Each tube consists of a thick glass outer tube and a thinner glass inner tube, which is covered with a special coating that absorbs solar energy but inhibits heat loss. Air is removed or evacuated from the space between the two tubes, forming a vacuum (hence, the term evacuated). As in a thermos flask, this vacuum acts as an insulator. Further, since the glass tubes are cylindrical in shape, the angle of sunlight is always perpendicular to the heat absorbing tubes, enabling the collector to perform relatively well even early in the morning or late in the afternoon, or when shaded by clouds.

made in Nagercoil (Tamil Nadu state, in south-east India), from locally-sourced clay and rice husk. During firing in a kiln, the husk burns down, leaving behind tiny holes. When water is filled in the filtering-container, it seeps through the holes into the lower collection jar, while contaminant particles are trapped above. With the present specifications, each purifier has the potential to treat about 25 litres of water per day.

Device facilitating hand-washing: While potable water is essential, facilities for cleansing one's hands are also required in order to control the spread of communicable diseases. With infant- and child-mortality continuing to be high, the need for better hygiene is acute.

In this context, a simple device deserves mention. It has been developed by NB Institute for Rural Technology (NBIRT, www.nbirt.org.in)[5], working in the north-eastern states of India.

This device, shown alongside, can be very easily fabricated by rural artisans. Bamboo-stems are used to build the framework. A container for water is hung from the top of the frame by a rope; the other end of the rope is attached to a flap at the base that can be depressed with one's foot. When the flap is pressed, the container is tilted, allowing water to flow out. This arrangement enables one to have both hands free for washing. The materials cost a total of Rs 80-90 (US$ 1.14 – 1.29). People could also earn by constructing such devices for a fee.

The model has been adopted by *anganwadi* (primary schools) in the region. Children now conveniently wash their hands, as shown here.

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[5] NBIRT is a non-profit organization (supported by the Ministry of Science and Technology, Government of India) has been engaged in innovative adaptation of technology for use in rural regions.