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How Singapore's NTU is helping a town in Nepal battle arsenic contamination



Rice farmers working in a paddy field in Nawalparasi, Nepal. The district, which has huge swathes of agricultural land - is known to be the country's grain bowl.
ST PHOTO: DESMOND FOO



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NAWALPARASI, NEPAL - Mr Ramprasad Yadap started developing skin lesions all around his body some 17 years ago. The 59-year-old retiree, who lives in the low-lying area of the Nawalparasi district in rural Nepal - did not think much of the little pigmented spots that started appearing.

He would learn only later that it was the hills and mountains he had been living under all his life that were slowly killing him.

The skin lesions were a telltale sign of arsenic poisoning.

The poisoning would become so severe that it turned his left foot gangrene a few years later, and he eventually had to have the leg amputated.

He now walks around his village in crutches.



Mr Ramprasad Yadap walking on crutches at his village in Nawalparasi. ST PHOTO: DESMOND FOO

Arsenic contamination is very much like "slow poison" said Dr Makhan Maharjan, a programme director of the non-profit organisation Health and Environment Development, Nepal (HEAD-Nepal), and who has spent more than 20 years working on arsenic-related projects in the area.

"For such chronic contamination, at the early stages, there are no symptoms, but infection begins from the head to the feet, and prolonged exposure at high concentrations has fatal effects," he added.



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The silent killer is colourless and odourless, and its effects are more long-term which explains why raising awareness of it has been so difficult all these years, said Dr Maharjan.

Indeed, the Nawalparasi district in Nepal's southern Terai region - which is a region which runs parallel to the outer foothills of the Himalayas - has always been an arsenic hotspot. A proportion of its water wells were found with an arsenic concentration of about 50 parts per billion - five times higher than that of the World Health Organisation's recommended limit.

"Arsenic is naturally found in rock and mineral formations; and as the water has been travelling from the Himalayan mountains to the lowlands over thousands of years, its layers of sand deposits are now rich in arsenic. And this is where people are now extracting their water from," said Dr Maharjan.

Those living at the Nawalparasi area have been drawing from shallow aquifers, or rock formations underground, through the use of hand pumps, like this one previously used in Saraswati Secondary School.



Students of the Saraswati Secondary School having their break and drinking safely straight from a designated 'clean drinking water point-of-use'. ST PHOTO: DESMOND FOO

This is where the arsenic content tends to be elevated, he added.

Now, a team from Nanyang Technological University (NTU) in Singapore is helping to provide a solution.

How NTU is helping

Dr Maharjan has been working with scientists from NTU's Nanyang Environment and Water Research Institute (Newri) to install water filtration systems at the schools in Nepal.

As part of a collaboration between the Newri's philanthropic arm, NewriComm, and Head-Nepal, the first drinking water facility was successfully installed at the Saraswati Secondary School in 2020.

The project is supported by the Lien Foundation Fellowship, a non-profit programme which empowers leading academics and researchers from Asean, South Asia, and Central Asia to tackle water and sanitation challenges in their home countries.

Principal of the Saraswati Secondary School Dayang Chuadhary, 53, said he was relieved when the school no longer had to rely on the hand pumps.

"As a principal, the children's health is my biggest responsibility, and there was nothing I could do about it," he added.



Principal of the Saraswati Secondary School Dayananda Chaudhary. ST PHOTO: DESMOND FOO

Prior to the system's installation, lab tests revealed that each litre of water extracted from the hand pump had 0.1mg of arsenic.

Conversely, the filtered water had an arsenic content of 0.01 mg per litre - which fell within the country's drinking water standards of 0.05 mg per litre.

A second pump was commissioned in end-2020 at the Shree Janta Secondary School, which is in the same district.

The completed water filtration system was officially handed over to the school management on June 15, at a ceremony attended by NTU and Head-Nepal representatives. This project will benefit more than 600 students and teachers at the school - more than double the number of the inaugural project.

How the system works

The water treatment facility comprises three 1,000 litre tanks arranged in a descending order.

Example of the filtration system at the Shree Janta Secondary School



The sedimentation tank is placed at the highest stand. Here, particles suspended in water are allowed to settle out.

Next, the water gets transferred to the middle tank, where it is filtered using a combination of iron nails, brick chips and sand. The iron nails play an important role in attracting and absorbing the arsenic particles.

This helps to filter about 85 to 95 per cent of arsenic from the water, and the clean water is stored safely in the third and lowest tank, which is connected to taps at a long sink.

Children at the Shree Janta Secondary School using the filtered water



Dr Maharjan, who was in charge of both projects, said he hopes the children and youth benefiting from these taps can become important environmental champions and changemakers.

"If we teach them, educate them in school about arsenic contamination and its health concerns, they can take this message back home and educate their families and their larger communities," he added.

Educational programmes and campaigns have also been implemented in the school with the hope of encouraging students to promote safe drinking water habits at home.

Large murals educating children on the different sources of water and the health concerns of arsenic poisoning were painted around the school's compound, and educational booklets were also given out to the students.



Murals at Saraswati Secondary School. ST PHOTO: DESMOND FOO

But the task of getting clean water to everyone remains a difficult one.

When 17-year-old student Sandip Yadav from the Saraswati Secondary School learnt about arsenic contamination in school, he felt compelled to convince his father to purchase a similar filter for their own use. This was not a simple purchase for the family.

"My father, who is a labourer, had to save up for several months, and eventually we were able to purchase the water filter which cost about 6,500 Nepali rupees (SGD \$72.50). I feel more relieved knowing that the water we consume is now a lot cleaner," he said.

Many others are unable to afford similar filters, and are still relying on untreated, contaminated water.

Ms Samjhana Chaudhary, the deputy mayor of the Ramgram Municipality in Nawalparasi, said that foreign aid will be key if the district is to build piped water systems to distribute clean water to surrounding households, as well as install more water filtration systems in public places.

Apart from NTU, there have been other institutions and non-governmental organisations in the region offering help.



Children at a popular stone water spout in Patan. ST PHOTO: DESMOND FOO

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For instance, some NGOs have provided household-level arsenic removal filters to Mr Yadap's village, and a deep tube well system was installed about two years ago, said Dr Maharjan.

Unlike the hand pumps, these deeper tube well systems - which are a lot costlier - have the ability to extract water from deeper aquifers underground which have cleaner water that is arsenic-free, he added.

Mr Yadap and his four children, who had also suffered from arsenic poisoning in the past, now have access to clean water.

"Still, I worry a lot about their future. I hope clean water for them is here to stay," he said.

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