by Sasha Henriques

too little, too hard to find

Addressing the Global Water Crisis

(L.Potterton/IAEA)

Only 2.5% of the earth's water is fresh, not salty. Less than 1% of that tiny fraction is available for us to use. The rest is frozen in ice caps and glaciers, or occurs as soil and atmospheric moisture.

Almost all of that precious resource, the earth's accessible fresh water, is located underground — water that is hidden in the earth's crust and is often hard to access. This vital resource is poorly understood and poorly managed.

Water Crisis

This issue of management—understanding where water is available, who needs it, how to get it to them, and water's equitable and responsible distribution—is the crux of the problem.

When asked if there is a water crisis, Pradeep Aggarwal, head of the IAEA's Isotope Hydrology Section, said 'yes and no'.

Understanding where water is available, who needs it and how to get it to them is the crux of the problem.

(Photo: N.Ahmed/BAEC)

In high demand places, like urban areas and the arid and semi-arid areas of Asia and Africa, there often isn't enough water. But many low demand places have quite a lot.

"If we all begin to use water more conservatively however, there will be enough for everyone," he said.

Cities, Farms and Climate Change

"Nearly half of the world is going to be living in urban settlements in the next decade or so. Because a lot of people are living in a relatively small area, we need to provide water, all of which may not be available from nearby rivers or aquifers. Therefore, the urban water crisis results from the inability to provide a lot of water in a small area," said Aggarwal.

Freshwater's use in agriculture is also a major contributor to the problem.

"Agriculture uses almost 75% of all fresh water, most of which comes from groundwater systems and aquifers," he said. "If agricultural demand for water continues to grow at the rate at which it has grown in the past several decades, it will be difficult for us to provide enough water."

But there are technological developments which are leading to less water consumption, while maintaining or improving crop yields. These developments include genetic and non-genetic crop modification and drip irrigation.

"If there were to be further developments in agricultural technology, and if these were to be adopted more quickly, there might just be enough water to grow food to feed a growing world population."

Beyond expanding urban populations and more demand for food, there is the issue of climate change, which leads to too much rain at one time, causing flooding, rather than sufficient water going into the ground to recharge aquifers.

"Also, poor distribution mechanisms; inadequate protection of water sources to ensure they remain clean; and financial strain all conspire to increase governments' inability to provide sufficient potable water to their populations," said Aggarwal.

The need to understand and manage water is becoming more urgent for many countries. The IAEA, knowing how much water matters, is helping them do just that, using isotope hydrology.

Detective Work

Isotope hydrology helps scientists and governments get a handle on just how much water is in a particular location, where it's coming from and where it goes, what it picks up along the way and how it changes from liquid to gas, pristine to polluted.

Using its experience in nuclear technology, the IAEA has been involved in this type of research for more than 40 years. The Agency helps scores of Member States better understand their water resources.

Pollution

Essentially, isotopic techniques are used to understand how water moves. So countries also use isotopes to find out the source of water pollution.

Pollutants in water come from three main sources: agriculture, industry and human waste. A community might think its problems stem from lack of proper sanitation, when the real trouble lies with agricultural runoff into streams and rivers. Isotope hydrology helps them pinpoint and eventually solve their problems.

Let's Take Nitrogen as an Example

Nitrate is a common pollutant. Nitrogen has two isotopes: N-14 which is lighter than N-15. The ratio of N-15 to N-14 in fertilizers is different from the ratio in human or animal waste. Many fertilizers are made using nitrogen from the air, while humans and animals absorb nitrogen and change its isotopic ratio, through a biological process. By looking at the N-15 to N-14 ratio, a scientist can tell the source of the pollution.

Movement

Other pressing problems countries face include understanding where fresh water comes from, how much there is at any given time, and sometimes, most importantly, will this source continue to provide freshwater. Isotopes are used as tracers, providing the answers to these questions.

Radioactive isotopes such as tritium, carbon-14, and krypton-81 can be used to figure out how old groundwater is.

Because these isotopes decay over time, their concentrations decrease as the years go by. Higher concentrations mean "younger" water and lower concentrations mean "older" water. For example, groundwater with lots of tritium may be less than 50 years old, whereas groundwater with no tritium must be older.

Tritium works for groundwater younger than about 50 years, carbon-14 for waters up to several tens of thousands years old, and krypton-81 identifies waters that can be a million years old.

Understanding water's age gives scientists and governments a good idea of how quickly new water is getting into aquifers.

Knowing if one's water source is being replenished, and how quickly, helps governments plan how best to use the water that is now, and will be, available in the future.

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Assessing Water Needs

by Sasha Henriques

IAEA Water Availability Enhancement Project to Assess Global Water Management and Resources

As industrialisation and urbanisation increase, and the demand for food rises, fresh water stores are being depleted more quickly. Comprehensive information about water quality, how much there is, where it's located, as well as how this water is replenished, will prove invaluable when determining how best to allocate water resources to meet the needs of city dwellers, farmers and industry.

The IAEA Water Availability Enhancement Project (IWAVE) will help Member States identify and fill gaps in existing hydrological information, enabling national experts to conduct independent assessments, as well as continually update hydrological information.

IWAVE will also help countries interpret water resources data, and use advanced techniques to simulate hydrological systems for resource management.

Oman, the Philippines and Costa Rica are now participating in the pilot phase of the IWAVE project, which should build on, and complement, other international, regional, and national initiatives to provide decision makers with reliable tools for better management of their water resources.

"By becoming more knowledgeable about your own resources, not only do you improve your water use and availability, but you are also better able to deal with and cooperate with your neighbours who share your resources," said Charles Dunning, Water Resources Advisor in the IAEA's Isotope Hydrology Section.

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(Photo: P.Pavlicek/IAEA)