Fog-harvesting for water - clouds on tap

Water-wheel, WRC

The Namib fog beetle is a feisty little creature. Every morning he makes an arduous journey to the top of a sand dune, where he turns his body into the wind, straightens out his rear legs and lowers his head. The fog rolling in from the sea gradually collects on his back, forming droplets of water, which glide downwards and hang from the insect's mouthparts. In this way, the *Onymacris unguicularis* is always assured of a healthy morning drink, despite being miles from the nearest fresh water.

Previous experiments have shown that other sites in South African could yield more than four times the volumes of water recorded at Tshanowa.

It's an innovative solution to the problem of water shortage - one that researchers have been quick to latch onto, but which many countries have been surprisingly slow to implement.

Professor Jana Olivier of the University of South Africa's Department of Anthropology, Archaeology, Geography and Environmental Studies, explains that the idea of harnessing fog as a source of drinking water has been studied for decades.

"The first experiments were conducted in 1901, on Table Mountain. But it was only in 1987, in the arid coastal desert of northern Chile, that it was implemented on a large scale."

For years the remote fishing village of Chungungo relied solely on trucked-in water. In 1987 it was transformed by the installation of a fog collecting system. With a dependable and affordable water supply, not only did the growing population have domestic water, they were also able to cultivate commercial crops and plant trees.

Although unconventional, the technology behind fog collection is amazingly simple: massive vertical shade nets are erected in high-lying areas close to water-short communities. As fog blows through these structures, tiny water droplets are deposited onto the net. As the droplets become larger, they run down the net into gutters attached at the bottom. From there, water is channeled into reservoirs, and then to individual homes.

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In Chungungo, this system saw water flowing from local taps for the first time ever, in 1992, providing more than 40l of water per person, per day.

Like Chile, South Africa is an arid country in which large sections of the population have inadequate water supply. Only 35 per cent of the country gets more than 500mm of annual rain, and - with few unpolluted surface water sources, many contaminated ground water supplies and water tables that drop out of reach during drought - the advantages of an effective alternative water source are obvious.

Professor Olivier, who has been involved in fog collection research since 1995, says the potential for fog collection in South Africa is clearly shown by what has already been achieved at two fully operational sites - one in the Limpopo Province and the other on the West Coast.

Water for Thought

Tshanowa Junior Primary School in Limpopo is frequently shrouded in dense mist and rain, but the nearest water sources are a non-perennial spring located 2km away, and a dam, 5km away. Since most water sources in the province are contaminated, the quality of the dam water is suspect. The 130 school children rely on what water they can carry with them to school each day.

The school is located at the crest of one of the easternmost promontories of the Soutpansberg, at 1 004m above sea level. Despite its relatively low elevation, this region is ideal for fog collection in that moist maritime air from the Indian Ocean moves over the escarpment and against the mountains during the night and early morning. This cloudiness sometimes persists throughout the day.

Permission was obtained from the relevant local and tribal leaders to erect a fog water collection system on vacant land adjacent to the school. Construction commenced in 1999 and local inhabitants were employed to assist.

Each fog collector consists of three 6m-high wooden poles, mounted 9m apart. Steel cables stretch horizontally between the poles, and from each pole to the ground. A double layer of 30 per cent shade cloth is draped over the cables, and fixed to the poles on each side. Water dripping from the net into the gutter runs through a sand filter and is then emptied into a tipping bucket. From there, it flows into a 10kl storage tank further down the slope. Two additional tanks were erected at the school to collect the overflow from the first. An automatic weather station was also installed to record rainfall, wind speed and wind direction.

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Within four days of completion, school children and members of the local community were drinking water collected by the fog screen. Although weather conditions have made accurate data collection difficult, daily yields of as much as 3 800 l of rain and fog combined, have been recorded. The average collection rate from March 1999 to April 2001 is over 2,5 l per square metre of fog screen.

The giant fog screens at Tshanowa Junior Primary School in Limpopo province are providing pupils and members of the community an average of between 150l and 250l of water per day.

Heavy clouds, no rain

The same system was also set up at Lepelfontein, a small missionary station about 400km from Cape Town, and about 5km inland of the West Coast. Although ground water here is abundant, it is of such bad quality that it is considered a health risk. A small solar distillation plant was installed in 1998 to provide limited drinking water, but most water is still transported to the village from elsewhere.

The fog screens were installed in 1999, and the overflow from one of the 10 kl tanks is now being used to supplement the water from the desalination plant. At least 80 per cent of the water collected at this site is from fog alone, as the region receives very little rain. Fog conditions are mostly associated with onshore breezes originating either from the South Atlantic anticyclone to the south of the continent, or from north westerly and westerly winds on the northern perimeter of a coastal low.

Again, daily yields of over 3 000 l have been recorded, with a daily average of about 5 l of water collected per square metre of fog screen.

While Lepelfontein's water initially showed high levels of sodium - possibly due to the proximity of the ocean and wind-blown spray - Professor Olivier says that water quality at both sites is good, with no disease-forming organisms present in samples.

"In fact, at Tshanowa, water was rated as Class 0 - ideal quality," she says. "Since the water is used for drinking purposes, quality is tested regularly." She adds that experiments conducted at other high elevation sites around the country have yielded more than 10 l per square meter of collecting surface per day. "This shows that in terms of quality and magnitude of yield, fog harvesting could go a long way to alleviating water shortage problems in the fog-prone mountainous regions of the country. "The costs are low, the technology is simple and the source is sustainable for hundreds, even thousands of years."

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Where fog harvesting could work in Southern Africa

- For fog collection to be effective, the site must be in an area where fog occurs frequently throughout the year, and lasts for a few hours at a time. The water content of the fog should be high, and the fog must be accompanied by wind to ensure that a large enough volume of moist air is blown through the collecting screens.
- South African Weather Bureau records show that a number of places in South Africa have over 90 days of fog per annum. These are mostly located along the West Coast of southern Africa and in mountainous regions.
- Rain clouds have the highest water content, followed by advection sea fog. Radiation fog has too little water to be successfully collected.
- Ideally, sites should also be more than 1 000m above sea level. Sites in many parts of South African have elevations of more than 2 000m, and according to previous experiments, these sites could yield more than four times the volumes recorded at Tshanowa in the Soutpansberg.

An age-old practice

In ancient times, fog water was often collected for domestic and agricultural use.

- The inhabitants of what is now Israel used to build small, low, circular honeycombed walls around their vines, so that the mist and dew could precipitate in the immediate vicinity of the plants.
- Historically, in the Atacama, both dew and fog were collected by means of a pile of stones, arranged so that the condensation would drip to the inside of the base of the pile, where it was shielded from the day's sunshine. The same technique was employed in Egypt, with the collected water stored underground in aqueducts.
- In Gibraltar, a similar technique is used: a large area on the slope of the rock has been covered with cement blocks. Fog and rainwater runs downwards and is collected underground where evaporation is minimised.
- On a smaller scale, rain, fog and dew are collected on enormous granite rocks at Cape Columbine lighthouse, on the West Coast. Low retaining walls have been cemented onto the sloping rock surface to channel the water into a reservoir at the base of the outcrop.
- The first fog collection installation in South Africa - prior to the Chilean project - was at Mariepskop in Mpumalanga, in 1969/70. It was used as an interim measure to supply water to the South African Air Force personnel manning the Mariepskop radar station. Two large fog screens, constructed from plastic mesh and measuring about 28m x 3,5 m each, were erected at right angles to each other and to the fog

and cloud-bearing winds. These yielded more than 11 l of water per square meter of collecting surface, per day. Unfortunately, the project was terminated once an alternative water source was found.

Source: Fog harvesting for water – clouds on tap.