EVERY CLOUD HAS A SILVER LINING

Photos: R.S. Schemenauer

Giant nylon nets are being used experimentally to extract drinking water from the daily fog that shrouds the otherwise arid mountain slopes of the Chilean coast. Preliminary tests suggest that such a system can provide small communities with an adequate supply of drinking water at a fraction of the cost of trucked-in spring water.

DANILO ANTON

For the numerous fishing communities along the desert coast of Chile and Peru, drinking water is a precious resource.

In the case of the Chilean village of Caleta Chungungo, its inhabitants depend almost entirely on natural spring water delivered by an old truck once a week from about 50 kilometres away. This water isn't necessarily safe and, at a cost of CA$10 per 1000 litres, is very expensive. To make matters worse, the weekly 10 000-litre water supply — about three litres per person per day — simply isn't enough to meet people's needs.

Families with higher incomes can buy more water than others. Some of the water is used to wash fishing equipment, reducing its availability to the poorest families. In fact, in some homes daily water consumption hardly exceeds one litre per person.

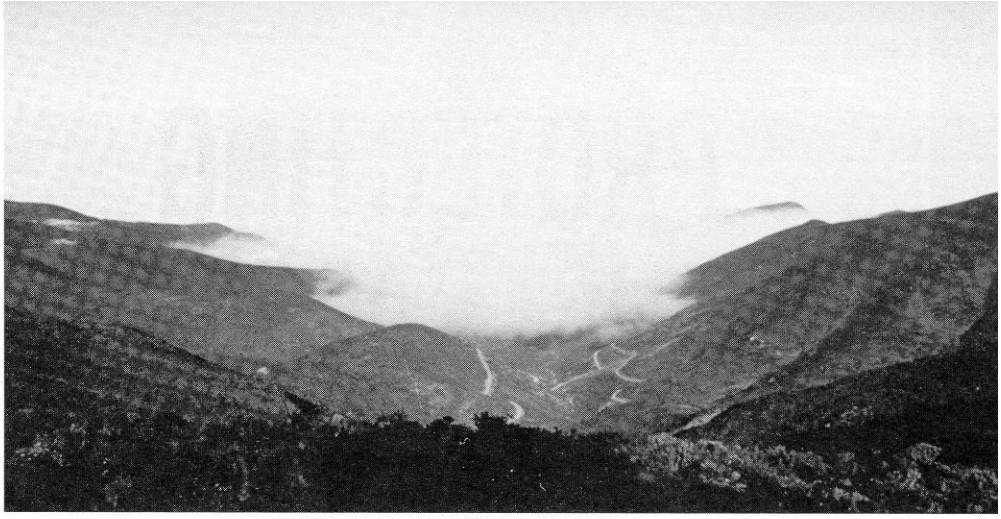
Besides water, the tanker truck is also sometimes used to carry fuel and other cargo — even people! Naturally, there are health problems associated with the use of this water. And when delivery is interrupted — for example, if roads become impassable after one of the region's rare rainfalls, or the truck breaks down — families must obtain water from local sources which are often inadequate and polluted.

Unfortunately, natural sources of safe water do not exist near the village of Caleta Chungungo. At 100 millimetres per annum, rainfall is scarce and there are no streams that run all year round. As a result, only poor-quality brackish water, which is inadequate for most domestic uses, is obtained from a few nearby springs, and water-borne diseases are therefore widespread.

Despite these difficulties, there is hope for the small communities along the coast of Chile and Peru. Like other coastal deserts on the western side of the main continental land masses in the tropics and subtropics, these areas are subject to three particular climatic phenomena: cold ocean currents flow north past them to lower latitudes, masses of cool air move in from the antarctic, and there is an upwelling of deep ocean water.

The combined effect of these phenomena is a general cooling of the ocean surface and the lower layers of the atmosphere, as well as reduced evaporation. Contact between the top part of this cold air mass and the warmer air above it produces a relatively uniform condensation of atmospheric water vapour.

Huge nylon nets are used to trap water at El Tofo where it almost never rains. Right, the clouds that provide the village with potable water.



The condensation takes the form of a more or less permanent cover of low, thin clouds which give rise to the typical features of coastal desert climates: cool temperatures, low rainfall and, of special importance, frequent fog. The desert coast of Chile and Peru experiences this apparently paradoxical climate in which there are clouds without rain and drought in a humid atmospheric environment.

The border region between Peru and Chile, near Arica, is inhospitable. Rainfall is as little as 0.7 millimetres per year, sources of drinking water are scarce, soils are rocky or sandy, and there is little vegetation.

Despite the harsh climate, the region still manages to retain a sizable population. The reason is simple: the same conditions that prevent rain also make this one of the best fishing regions in the world.

Moreover, the hinterland of the coastal desert possesses considerable mining resources. Deposits of copper, tin, silver, lead, and iron, for example, could be more fully exploited if the water resources necessary to support a larger number of workers were available. Such development would bring new wealth to this historically poor area.

Nevertheless, the lack of water resources is more apparent than real. The quasipermanent cloud cover contains a substantial amount of water which, if tapped, could provide a significant source of drinking water for the local population.

"Camanchacas" is the local name given to the coastal fog that occurs when thin "stratocumulus" clouds hit the slopes of the coastal mountain range. This is an almost daily occurrence during most of the year and affects a 200- to 300-metre vertical stretch of the mountain slope.

Although the altitude of the clouds varies from almost sea level to a little more than 1000 metres, they normally remain between 400 and 900 metres. Slopes within this elevation range are often covered with fog. Every afternoon sea breezes push the fog inland and at night land breezes sweep it back out to sea.

Some natural forests (as in the area south of La Serena, Chile) have developed and survive in low rainfall areas, mainly due to the supply of water from the Camanchacas. It is widely believed that such forests at one time covered most of the sea-facing slopes of the coastal range.

A number of imaginative researchers have proposed that the Camanchacas be tapped as an alternative source of fresh water for coastal communities. As far as anyone knew, such fog collection had never before been attempted for the purposes of communal water supply. The idea therefore met with some skepticism and financial support was slow to come.

In the late 1970s, several experimental fog collectors were tested near La Serena with funding from Unesco. But to no avail. The tests were not conducted in light of the local population's needs.

In 1984, however, Chile's two main universities, the Universidad de Chile and the Pontifica Universidad Catolica de Chile (PUCC), collaborated with the Regional Planning Secretariat (SERPLAC) and the National Forestry Corporation (CONAF) in asking IDRC support to continue the research. The Atmospheric Environment Service of Canada's Ministry of the Environment was asked to collaborate on the project.

Two parallel studies have been carried out. One was under the supervision of Ms Pilar Cereceda from the geography department of PUCC. It focused on the geographical distribution of fog occurrence, at both the regional and local scales, in relation to the potential water requirements of coastal communities. To this end, the study team surveyed 45 coastal settlements in the Atacama region.

Subsequently, several dozen small fog collectors called "neblinometros" were installed in various locations to estimate the quantity of available water. This was compared with community demand. The field data were correlated and interpreted on a regional basis. At El Tofo, 6 kilometres from Caleta Chungungo, more precise studies were carried out using both meteorological instruments and the neblinometros.

The first large-scale fog collectors ("atrapanieblas") were also installed at El Tofo. Made of a double layer of locally available nylon mesh, each of these fence-like structures measures 12 metres long by 4 metres high and is suspended one metre off the ground on poles. Fifty atrapanieblas have already been installed. The output from the collectors, which is stored in a large tank, is measured with a new low-cost flowmeter designed by Canada's Atmospheric Environment Service.

Preliminary figures indicate an average output of 237 litres per day per atrapeniebla collector — or about 5 litres per square metre per day. Although the 14-day test period is probably not representative of the whole year, it gives a close approximation of the collector's potential.

Even if each collector were to produce only 4 litres per square metre per day, the daily total for the planned 60 collectors would be more than 11 500 litres — or eight times the current fresh water supply to Caleta Chungungo. It is expected that some design improvements, introduced as a result of the first tests, will make the collectors more efficient, perhaps increasing the water yield by 10 to 20 percent. This would translate into a total gain of up to 2300 litres per day for the overall system.

During the testing, a large number of studies were carried out by Dr Robert Schemenauer of the Atmospheric Environment Service and Drs Humberto Fuenzalida and José Rutlland of the University of Chile. Included in this work was the use of an airborne meteorological system to periodically record temperature, relative humidity, pressure, and wind speed from ground level to an altitude of several thousand metres. The researchers also measured the density and size of water drops (both upwind and downwind of the collectors), as well as the volume of water produced.

At the same time, samples of the water taken from the system's outlet were analyzed to ensure it is safe for drinking and other household uses.

If these encouraging preliminary results are confirmed, the people of Caleta Chungungo will finally have access to an adequate and inexpensive supply of drinking water thanks to this unique fog-harvesting system. It is estimated that the cost of Camanchacas water could end up being as little as one-fifth that of trucked-in spring water. If so, the technology could be successfully applied at other locations along the coast of Chile and Peru, and probably at other similar sites in the world. ■

Danilo Anton is a program officer in IDRC's Earth and Engineering Sciences Division.