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# Water from Thin Air

Fog catcher in the Atacama Desert of Chile with the *camanchaca* fog sweeping in from the Pacific.

Credit: Pontificia Universidad Católica de Chile (Flickr: Rector Ignacio Sánchez visita Alto Patache; CC BY-SA 2.0 [http://creativecommons.org/licenses/by-sa/2.0]), via Wikimedia Commons

Imagine you're in Chile's Atacama Desert, the driest nonpolar desert in the world. Understandably, you're parched. So you head to the local watering hole…where you're surprised to find a craft beer—made from fog. What?

Deserts have little rain, but if they're near the coast, they can have fog—which you may remember is just a cloud on the ground, water vapor condensing around particles in the air.

In the Atacama, fogs often roll in from the Pacific, but the water droplets are too small to produce rain. So in the 1950's, a professor began experimenting with ways to extract water from the cloud.

Following his lead, the villagers of Peña Blanca have strung a series of nets in the mountains. Together, they condense more than 2,000 gallons of water from the fog each day, which is carried by aqueducts into the village.

This water serves people, livestock, vegetable gardens—and an award-winning microbrewery. Their beers are famed for their light body, which some attribute to the lack of minerals in the cloud-borne water.

Chilean researchers estimate that collecting just 4 percent of the water from the Atacama fog would meet the needs of all the communities in the desert, and that a 3-ft by 5-ft net could provide enough water for one person per day.

For these reasons, villages in many countries are now building fog nets, and they could be an important source of water—and beer—in coastal deserts around the world.

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# Background: Water from Thin Air

**Synopsis:** In many deserts of the world, rain may be scarce but fog is common, so villagers are collecting water from the air.

- The Atacama Desert in Chile is the driest nonpolar desert on Earth. This region has places that have not seen rain in a decade, but large banks of fog known as *camanchacas* rise as they roll inland from the cold currents of the Pacific each day.
  - Plants and animals in the region have adapted to use the fog as a water source.
  - To feed more than a million people who call the Atacama home, farmers use drip irrigation from aquifers and snowmelt streams for crops and livestock.
    - As population grew and water resources dwindled, some communities had to truck water in, which was very expensive. In the 1950's, a physics professor observed native fauna and flora and started local experiments with nets.
  - Villagers from numerous communities like Chungungo and Peña Blanca have benefited for many years from *atrapa niebla* ("collectors of fog").
    - Fog (*niebla*) condenses on nets placed in the mountains and drains into gutters and pipes that carry the water downhill to villages.
    - In Chungungo, nets provide the village with about 10,000 liters of water a day for homes, gardens, and livestock.
    - In smaller Peña Blanca, nets provide each of the 85 landowners with 100 liters of water per day from about 140 sq meters of mesh.
    - Chilean researchers estimate that collecting just 4% of the water contained in the *camanchacas* would meet the needs of communities across the entire Atacama Desert.
  - Alongside the nets of the village of Peña Blanca are nets of an improbable business in the high desert—a brewery! The Atrapaniebla (Fog Collector) Brewery produces award-winning beers from water collected from the *camanchacas*.
    - Their Scottish Ale and American Brown Ale are famed for their unique lightness, which some attribute to the lack of minerals in the cloud-borne water.
- Many of the world's deserts are coastal, which means that they may almost never see rain but may regularly see fog and dew—especially where moist air from cold ocean currents blows onshore along their coasts.
  - Fog develops when air temperature drops below its dew point, which is the temperature at which air becomes saturated by the water vapor it contains.
    - Tiny water droplets (less than 40 microns) condense and accumulate on cooler surfaces into larger droplets of liquid water known as *dew*.
    - Water-vapor droplets in the fog are too small to produce rain.
  - Even if rainfall is less than 1 mm per year, fog may be abundant—and where there is fog, it can be harvested through condensation from the air using fog collectors.
    - Each cubic meter of desert fog contains 0.05 to 0.5 grams of water; 1 gram of water is 1/1,000th of a liter, so it would take at least 2,000 cubic meters of fog to produce a liter of water.
    - Water production from netting varies depending on location. In California, it ranges up to 40 liters a day per square meter of netting, but in the Atlas Mountains, production can range up to 65 liters a day.
- The World Health Organization estimates that communities need about 75 liters of potable water per person per day to cover the needs of their people, crops, and livestock.
  - Americans use 300–400 liters per day on average—our water is plentiful and many of us take it for granted.
  - Many communities in deserts subsist on as little as 8 liters per person per day.
  - Water from fog collecting is usually good quality and meets World Health Organization drinking standards, so further processing is unnecessary.

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**References: Water from Thin Air**


Fog Collection | Wikipedia
This Device Collects Water from the Clouds | Smithsonian
Harvesting Fog to Solve a Water Crisis | CNN
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- Where water is scarce, people schedule their day around searching for sources of water.
  - Collecting water is an essential task that normally falls to women and girls, who may be pulled out of school in the never-ending quest for each day's water.
  - Families in arid regions may spend 3–4 hours per day walking to and from working wells, carrying 50-lb barrels on their heads if they don't have pack animals.
  - The search for water is becoming increasingly difficult in these areas because of climate change; rising temperatures and desertification mean that water sources are dwindling and increasingly contaminated.
  - In these areas, poverty is widespread, and expensive desalination or drilling for deeper aquifers is prohibitively expensive.
- Originally described in the sixteenth century, the earliest fog collectors mimicked the Ferro tree in the Canary Islands that collected fog or mist on its leaves.
  - The fog collectors of today are increasingly efficient. They look like volleyball nets stretched between tall poles and are usually made of polypropylene mesh that traps water droplets, which drip into a gutter that feeds a water tank.
    - Some designs are simple to enable easy repair, and some use state-of-the-art materials and design. By customizing the size of the holes and the size, composition, and coatings on the fibers, efficiency has increased about 500% compared to devices deployed in Chile in the late 1980's.
  - Over the past 30 years, fog-collection projects have also been constructed in Peru, Ecuador, Guatemala, Cape Verde Islands, Namibia, Eritrea, South Africa, Yemen, Oman, Ethiopia, Israel, Nepal, Tanzania, and Morocco.
- Additional amazing fog-collection strategies come from biomimicry.
  - California's redwoods use this process to harvest fog from the cool Pacific.
  - In the Namib Desert, fog sweeps in from the Atlantic's cool Benguela Current. The *Stenocara* beetle (fogstand beetle) raises its back into the fog to use the combination of hydrophilic (water-attracting) ridges and hydrophobic (water-repelling) furrows to direct the water straight into its mouth.
    - Australian scientists have produced *Stenocara*-inspired surfaces that combine hydrophilic layers with hydrophobic layers to efficiently trap and produce water; such surfaces may soon be used to harvest dew, as well as rainfall, from the roofs of houses.
  - Chinese scientists are studying spider silk because it is known to be very effective at collecting water vapor from air. The silk fibers change structure when they come into contact with water. Smooth segments allow tiny drops to slide along them and collect at hydrophilic knots that accumulate larger drops. Scientists hope to develop synthetic materials that can direct and control these water droplets.


Atrapaniebla (Fog Collector) beer.

Credit: lordsofthedrinks.com

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