Fog on the brine — Fog-catching systems for arid lands

by Cristobal Pinche and Loren Ruiz

Along Peru's coastline, rain is a rarity, but fog is never far away. For ten years, a team of engineers developed a system to capture this free water supply. Did they succeed — and who stood to benefit?

PERU'S COASTLINE IS almost total desert, with only 10mm of rainfall per year. A thick belt of fog covers the area from April to November. It arises from the cold, northerly, flowing current, and south-westerly winds continually blow the fog masses over the land. These rise over the coastal hills and maintain a band of fog measuring between 600 and 800m, enabling lomas (coastal hill) areas to form, where plants and animal have evolved to absorb the fog. This article looks specifically at the area of coastline to the north and south of Lima, where *lomas* vegetation forms frequently between the rivers (see Figure 1).

Seven million people live in Lima, and most of them are poor. Inappropriate water-resource management has caused rapid deterioration of the *lomas* vegetation and pollution of the rivers; severe droughts every few years compound the problem. Traditional water supplies are inadequate for a population which grows by 3 per cent every year. Currently, only 15.3 per cent of the total water resources are used.

Tackling water scarcity

Large-scale projects The Government of Peru has poured money into large projects for the people of Lima, ithe rural poor. These are long-term schemes, taking around 30 years to complete. The people's daily needs are not being met; those in low-income settlements, for example, have to rely on poor-quality water sold from trucks.

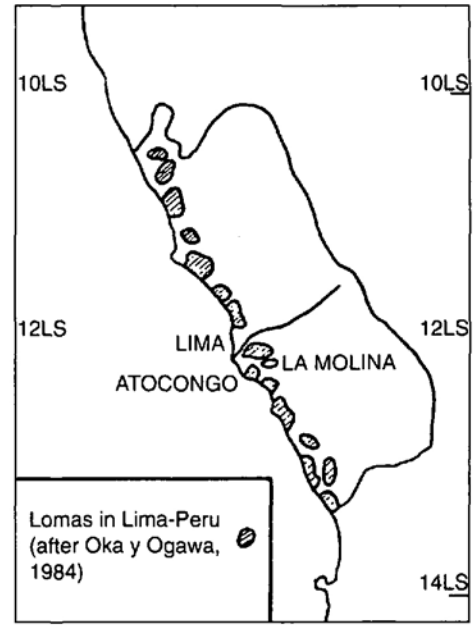


Figure 1. The Peruvian coastline north and south of Lima where lomas *forms between rivers.*

Yolanda Crucinta/Panos Pictures

People collect water — probably of poor quality — from a battered truck in one of Lima's many crowded slum areas.

An appropriate initiative Over the last decade, the idea of catching fog has been explored as a short-term, water-supply solution. Sufficient, good-quality water can be collected, using appropriate, small-scale technology. To pursue this further, in 1990 Grupo de Trabajo Nieblas (GTN), or 'Fog Working Group', was set up by the authors and four other six professional engineers and planners.

Fogwater being collected in a mining area 250km south of Lima. Pollution has affected the natural colour of the lomas, *and the fogwater shows a high concentration of iron. It can be purified by filtration.*

The fog-catching system

● *First principles* The fog droplets collide with a mesh, build up into larger drops, and collect in a PVC gutter where they run down a pipe into a storage tank or container.

● *Design* The simplest fog catcher is a m^2 of green polypropylene *mosquitero* (mosquito) mesh with 10mm-diameter holes — any larger and the droplets will fall through. The catcher is fixed to a treated tree trunk, and faces the prevailing winds. The tree trunk is supported by wire guys fixed into the rocky ground. The water is collected in a PVC gutter which leads to a $4m^3$ reservoir, illustrated in Figure 2. This method will average 5.57 litres of water per day; a collection of fog catchers can provide sufficient water for a community. The size of the catcher varies from 1 to 4m high, and between 5 and 30m long.

● *Installation* Weather conditions, such as wind direction, the amount of fog per year, and when it occurs, must be taken into account, together with the area's geographical position, slope, and altitude. The planners then assess the potential amount of water that can be 'caught' each day, and how many catchers are needed. Finally, the quality of the water must be tested, both at the initial catching stage, and in storage. The materials must be cheap, and available locally.

Initially, one 'trial-run' fog catcher, measuring $1m^2$ is put into position. If it works, stage 2 goes into action, with up to 20 m^2 catchers. By the final project stage, as many as 300 may be incorporated.

● *Maintenance* To prevent moss clogging up the holes in the mesh, the catchers must be cleaned at least once a year. The storage tank should be kept clean and, where possible, covered, to prevent birds fouling the water.

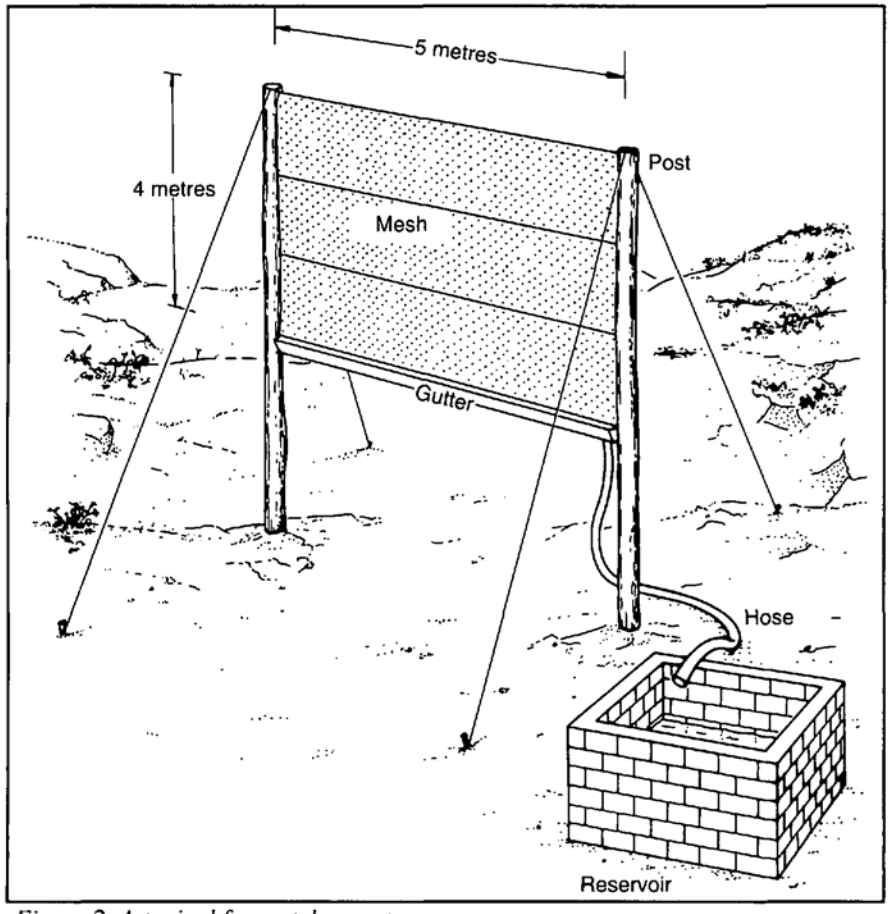
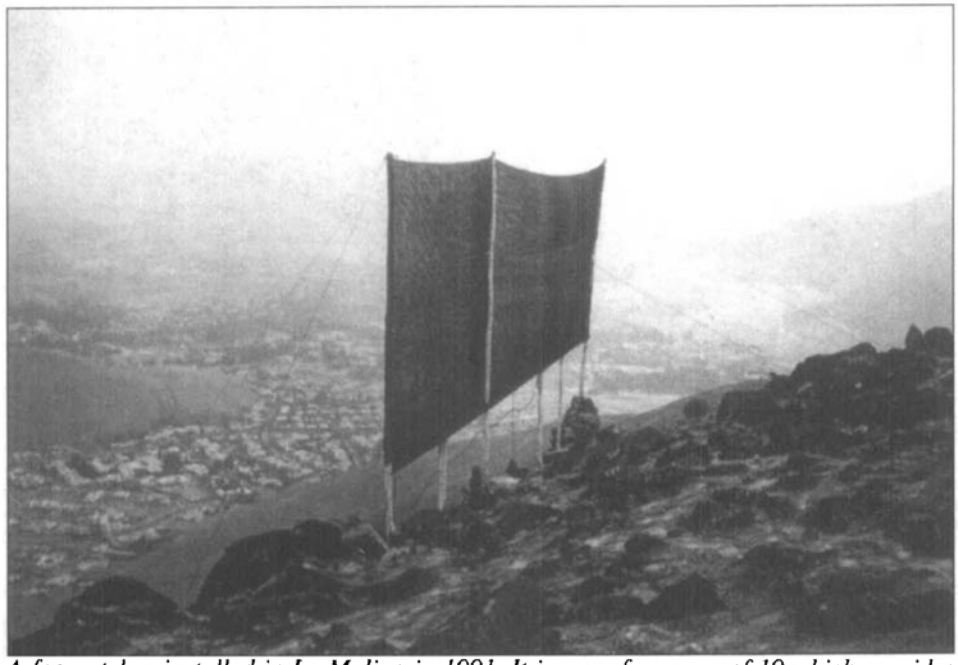


Figure 2. A typical fog-catcher system.

Evaluating fog water

The success or failure of the system can only be assessed if careful records are kept for at least a year. To measure fog water, the daily volume of water in the container must be recorded as litres of water per m^2 of mesh per day ($l/m^2/d$).

Evaporation from the storage tank is negligible during fog periods. The purity of the water should be tested every month especially if it is to be used for drinking.



A fog catcher installed in La Molina in 1991. It is one of a group of 19 which provides water for the staff and pupils of the high school below, near an urban area.

Trials

- *La Molina.* The first project was carried out in 1991, in a rocky area at La Molina, 790 m.a.s.l (metres above sea level), 15km south of Lima. This was specifically to provide sufficient water for a high-school garden. Initially, two catchers were installed and, once they had proved successful, the school decided to invest in a scheme incorporating 19 fog catchers. The result was 12 000 litres of water per day.
- *Lachay.* Lachay National Reserve, 350 m.a.s.l and 105km north of Lima, was the site of the second fog-catching project, in 1992 . The main objective was to regenerate a deteriorating *lomas* oasis. ECCO (Ecology and Conservation) provided funding for GTN to carry out the work. Five fog catchers were installed, producing 10 000 l/d. The better result, proportionately, was a result of more fog.
- *Atocongo.* In Atocongo, 25km south of Lima, and 252 m.a.s.l, a mothers' association was working with the Llanavilla Farmers' Community to supply water to small rural settlements. The 'experimental' fog catcher produced 5.57 litres per day — a good result — so two bigger fog catchers were installed, giving a total area of 80m^2. The women were able to irrigate their land and grow vegetables. Atocongo has becomea pilot project of fog-water management for small coastal communities (see Figure 3 below).

Costs and funding

An effective fog-catcher system, incorporating 1000m^2 of mesh, costs US$14 000. For this, communities can expect to collect 20 000 l/d over a ten-year period, with maintenance carried out once a year.

Up to now, fog-catcher systems have been funded mainly by outside agencies. If the initial system is judged successful, private organizations, such as schools, may be prepared to pay for the full system. Otherwise, other agencies should be approached.

In areas like Atocongo, the water supplied by the government costs US$2 per 1000 litres, while the same amount of trucked-in water costs $1.5. Fog-catcher systems can produce 1000 litres for $1 are is, therefore, very competitive.

The system should last for 10 to 15 years. With a small-scale system, it is

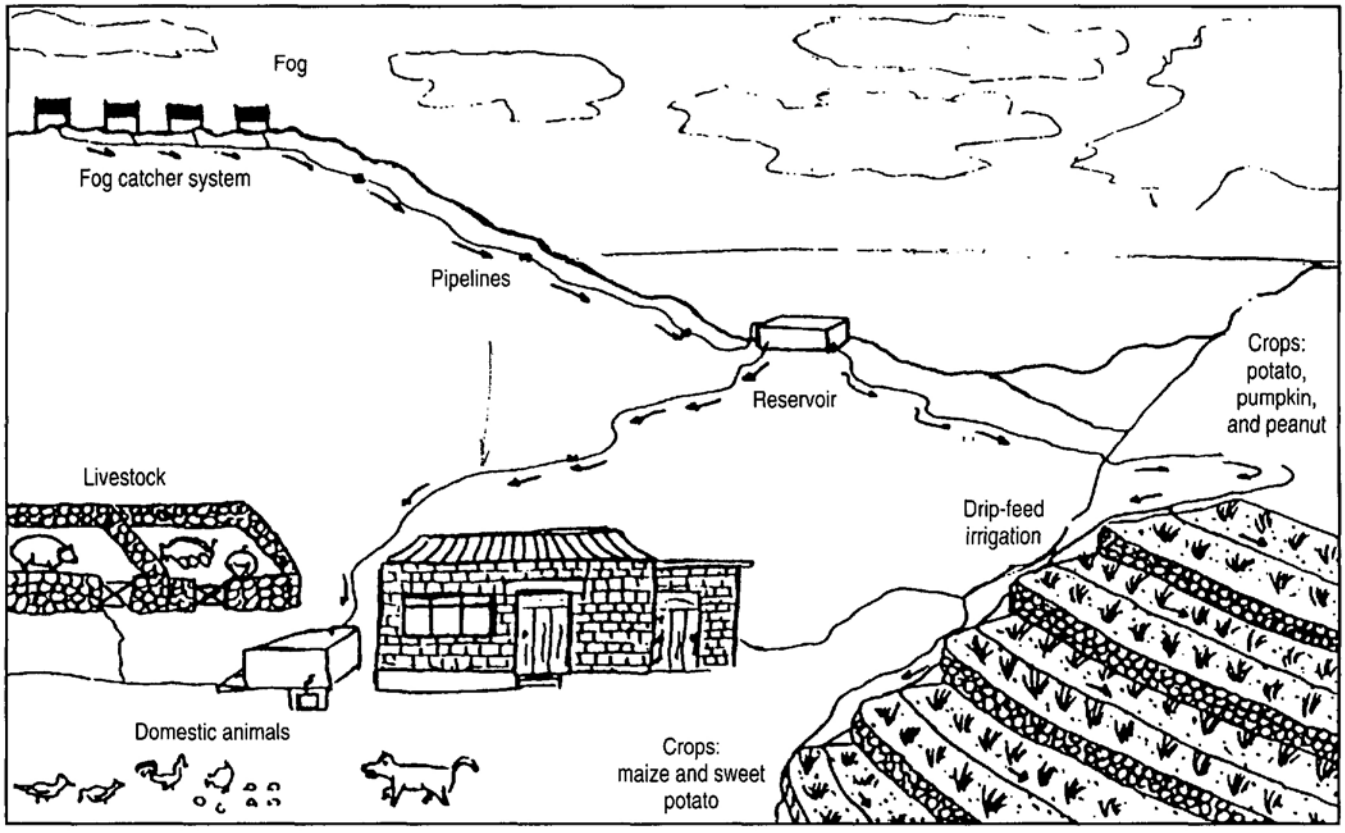


Figure 3. Grupo de Trabajo Nieblas' proposal for sustainable fogwater management in Peru.

Rearing pigs with fog water from the Atocongo project. The fog catchers can just be seen on the hilltop (above). The mothers' association helped the Llanavilla farmers to establish small horticultural plots with crops such as potatoes and maize (right).

essential that the users, such as the Llanavilla farmers, can take over the maintenance.

Problems

Fog-catching systems are not indestructible. They are sometimes vandalized and the materials sold off. This can only be prevented by strengthening the construction, and applying security measures; security fencing would be very expensive.

Goats pose another challenge: they devour both the natural vegetation and the crops being irrigated by the fog-catcher system. Initially, fences should be placed around the crops at least and, ideally, around the whole project.

The future is foggy

The fog-catcher system has proved itself to be an appropriate, small-scale method of obtaining water in the poor rural areas along the coast of Peru. Experience shows that the water is good quality and, therefore, can be used for drinking, horticulture, and livestock. With external funding and adequate community management the fog-catching will benefit not only the people living near Lima, but could be effectively replicated in such areas as the coastal areas of Chile's Atacama Desert, lower California, Mexico, N.W. Australia, Western Sahara, Morocco, Namibia, Somalia, Oman, and Yemen.

Cristobal Pinche works in water supply for coastal rural communities. In 1994 he received a medal for the best national research in technological innovation 1991-3. Loren Ruiz is a geographical engineer who worked for SENAMHI for five years. Contact them both at: Grupo de Trabajo Nieblas (GTN), Apartado Postal 055 - SMP - Lima 31, Peru.

Fog as a water resource

A small fog catcher was designed: a plastic mesh held up towards the prevailing winds by a post, a PVC gutter to collect the water, and a hose connected to a reservoir.

The experiments shown in Table 1 proved that, under specific geographical and meteorological conditions, fog could provide between 1.7 and 32 litres of water per m^2 mesh exposure per day ($l/m^2/d$).

Table 1. Locations and yields of fog water along the Peruvian coastline

Place	*Altitude data (m.a.s.l)*	*Period*	*Yield (l/m2/d)*
L* Pasamayo	450	Apr-Oct.'84	7.83
L* Lachay	350	Jun-Oct.'84	12.90
L* Atiquipa	650	May-Aug.'88	1.72
C* Campana	530	Jan. '88 - Jan. '89	8.46
C* Orara	435	Jul-Dec. '90	7.57
C* La Molina	790	Nov. '90	3.60
L* Marcona	920	Nov. '91	4.40
L* Tacna	765	Nov-Dec.'92	3.30
L* Atocongo	535	Nov.'92 - May '93	5.57

Key — L: Lomas C*: Hill*

The results were technically successful, although most of the experiments lasted only a few months. No significant differences in fog-water yield resulted from using the Chilean plastic mesh *racshell* instead of Peru's *mosquitero* mesh.