5.2 Fog harvesting in Chile

The far north of Chile, between the cities of Arica (latitude 18° S) and La Serena (latitude 29° S), is classified as an arid or semi-arid zone, depending on the rainfall. The Antofagasta area (latitude 23° S), on the eastern edge of the Pacific Anticline, is a desert climate with virtually no rainfall. In these areas, natural watercourses are few and highly seasonal. Hence, alternative sources of freshwater are required.

Special atmospheric conditions occur along the arid coast of Chile and southern Peru, where clouds settling on the Andean slopes produce what is known locally as *camanchacas* (thick fog). The clouds that touch the land surface can be "milked" or "harvested" to obtain water. This technology is described in Part B, Chapter 1, "Freshwater Augmentation Technologies."

Technical Description

To capture the water from fog, rectangular obstacles constructed of polypropylene mesh are employed. These are usually placed perpendicular to the prevailing flow of the clouds. The "fog harvesters" are positioned 1.5 m above the ground, and are supported on vertical posts. The size of the harvesters depends on the topographical conditions and the purpose for which the water is to be used.

Drops of water collect on the mesh, coalesce, and flow by gravity along a plastic conduit at the bottom of the mesh to a receptacle for later treatment (if required) and distribution.

This technology is being used in the area of Paposo (latitude 25 °S), 180 km south of the city of Antofagasta, in the Paposo Protected Forest Area administered by the National Forestal Corporation (CONAF). The site is 750 m above sea level. In this area, CONAF is operating a Research and Development Center for the Study of Flora, Fauna, and Human Activities. A research facility has been built, housing two park rangers. This facility is supplied with water by a fog harvester, which is described in detail below.

Type and design a/harvester. The harvester is a multiple (three) screen type, forming a single structure with a useful surface area of 144 m^2 (see Figure 6). It is composed of two independent structures, one holding the posts upright and the other supporting the mesh. Each of the structures has its own separate anchoring system. The mesh employed is the Raschel 35% shade-type.

Post supports. The structure is supported by eucalyptus posts impregnated with copper sulfate and creosote, 7 m long, with diameters tapering from 30 cm to 15 cm. The base of each post rests in a hole 0.80 m x 0.80 m x 1.0 m filled with rounded stones of approximately 20 cm diameter and sand. The posts are further supported by a system of cables held in place by cone-shaped anchors. Four posts supported by ten anchors are provided for the installation. The holes for the post anchors are excavated at a linear distance of 5.75 m from the base of the posts, or at the end of a cable describing an angle of 45° relative to the posts. Galvanized steel cables connect the anchors and the posts (all cables are 6 x 7, 3/16-inch k-stem steel, shark type). The cables are attached to the buried cone-shaped anchors by means of a 1.8 m, 5/8-inch diameter bar extending from the anchor to the point of cable attachment immediately above the soil surface. The posts are installed 10m apart, and are also interconnected with the 3/16-inch cable. These cables are attached to the posts by means of 5/8-inch diameter, 7-inch-long eye bolts using 5/8-inch coupling flanges.

Mesh supports. The mesh is supported by cables at the top and bottom of each panel. These cables are fixed to two cone-shaped anchors which are independent of those supporting the posts. Two intermediate 1/8-inch-diameter plastic-coated cables pass through the center and are interwoven with the mesh thread.

Mesh attachment. The mesh is attached to the posts with two moisture-treated smooth-planed boards, 4.3 m long x 7 cm x 3.5 cm. The mesh is wrapped very tightly between the two boards and held with galvanized bolts, 5/8-inch in diameter and 15 inches long, which pass through the post, the boards and the mesh. The cable that supports the mesh from the top passes through two pulleys mounted on the end posts, which provide the structure with a measure of flexibility vis-a-vis the force of the wind. For its entire length, the lower cable is encased in a high-density polyethylene tube which passes through a gap between the two boards holding the mesh onto the posts. This cable is extremely important as it supports not only the mesh but also the channel that collects the water.

Water channel attachment. The channel is made of 110 mm diameter PVC pipe, from which one-quarter of the circumference has been removed along the entire length. The tube is suspended, cut side uppermost, from the lower cable using 2.16 mm galvanized wire, attached at various points to provide increased strength. At each end, the PVC tube is fitted with a 110 mm x 40 mm cap. The water flows out of the tube, via a T-junction and a 3/4-inch polyethylene pipe, to a storage tank (cistern).

Storage lank. The storage tank used with this system is a 30 m^3 closed cistern, built of waterproofed reinforced concrete, and equipped with flow control and cleaning valves. The cistern also has a hermetically sealed inspection hatch, and is built entirely below grade.

Extent of Use

This technology is of relatively limited applicability. While it lends itself to use along the coastal zone of northern Chile and southern Peru, wherever the hills are higher than the base of the cloud layer, it requires a specific combination of climatic and topographical conditions for best results. Such combinations of climate and topography are uncommon, but do exist outside of this region, as is shown in Figure 7.

Operation and Maintenance

Operation is simple, requiring only periodic inspection of the collection channels and the water supply lines to prevent blockages. Few other difficulties are experienced in the operation of this technology, the most common being that strong winds may cause the mesh to come loose. This problem can be easily resolved provided it is detected in a timely manner. Problems with the support structure are unlikely if it is properly constructed. There is generally no difficulty in obtaining replacement parts if needed. The operation and maintenance of this technology do not require any specific level of training unless it is necessary to purify the water, but even then this is usually a simple process.

Level of Involvement

Depending on the proposed use of the water, government organizations may be directly involved in implementation and maintenance of the technology. Nevertheless, this technology may be easily constructed and installed by individuals using readily available materials.

Costs

The cost of the fog harvesting system was as follows:

Post support structure	$3020
Mesh support structure	$2089
Storage tank	$5710

For purely reference purposes, the initial capital cost per m^2 of mesh installed was $90, with maintenance and operation costing approximately $600/year. The resulting unit cost of production is $1.4 l/m^3.

Effectiveness of the Technology

The average annual volume of water harvested was 2.5 l/m^3/day in the Antofagasta area.

Advantages

- · The system requires a low level of investment, and is inexpensive to operate and maintain;
- · It is modular in construction, allowing production to be increased incrementally as funds become available or as demand grows.
- · It has no significant impact on the environment.

Disadvantages

- · The availability of sites at which to install the fog harvesting system is limited.
- · While the technology has few environmental impacts, the harvesting structures may be visually intrusive.

Future Development of the Technology

While the technology meets the need for small volumes of water, future development work should be directed toward increasing the yield from the harvesters for larger-scale applications. In particular, if this goal is to be achieved, studies need to be aimed at designing spatial distribution systems that will increase the flow of fog into the collection area. Also, it is important to bear in mind that, while the technology has proved satisfactory, its successful implementation depends on the existence of the correct combination of geographical and meteorological conditions. Thus, a study of ambient meteorological parameters must precede any proposed application of this technology, not only to determine if the correct combination of topography and climate exists but also to contribute to the understanding of these factors so that their occurrence may be predicted.

A sociocultural development project should also be conducted at the same time to ensure that an appropriate organization exists to manage the system in an appropriate and efficient manner.

Information Sources

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