

The Atacama Desert Fog Collection Project at Falda Verde, Chile

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ABSTRACT

Desertification has had an enormous impact on the coastal zone of northern Chile (Regions I to IV) and it has been classed as one of the major socioeconomic problems of the country. One of the most innovative ideas used to fight this problem is the installation of Large Fog Collectors (LFCs) for the production of water and the irrigation of plants. The Falda Verde project illustrates the experience that a group of 18 fishermen, with 70 family members, had in installing a fog water collection system in the coastal zone of the Atacama Desert. It was done with the technical help of experts from FogQuest, which is a charity dedicated to helping rural communities in arid lands.

1. INTRODUCTION

The project began in 2001 with the objective of providing water to the coastal settlement of Falda Verde. With the help of eleven fog water collectors, an average of 600 L of water per day is now being produced, and used, in the driest place on earth. A pipeline takes the water down to a greenhouse 2,300 m from the coast and to a plantation in the desert sand.

2. EVALUATION OF FOG AS A WATER RESOURCE

In the northern zone of Chile, there are different factors that determine the general presence of fog and the extremely arid conditions. Aridity results from a combination of subsidence generated by a permanent high-pressure area over the Pacific Ocean and the atmospheric stability induced by the cold northward-flowing Humboldt Current (Larraín *et al.*, 2002). These conditions lead to low cloud decks over the ocean and frequent fogs on the coastal mountains. In this zone, we have advection and orographic fogs. In the case of advection fog, the presence of the Humboldt

Current cools the warm and humid air that it comes from the Pacific Ocean down to the dew point, forming low cloud and fog. In the case of orographic fog, the presence of mountains and the action of the predominant wind that pushes the air, allows the ascent of the air over the mountain, where the air expands and cools down forming fog.

The specific factors that determine the presence of the fog in the study area are the following ones (FogQuest Fog Water Collection Manual, 2005):

- a) *Mountain ranges*: The Falda Verde mountain.
- b) *Altitude*: This Mountain rises to 600 m.a.s.l.
- c) *Distance to the sea*: 1,5 Kilometers to the coast line.
- d) *Corridors of fog penetration*: Falda Verde is located at the border of the northern margin of Salado Valley, faced directly to the coast line.
- e) *Wind*: The predominant wind of the area is from the SW. This is considered to be the most positive for the arrival and reception of fog on the north coast of Chile. This SW wind forms

fog on the upslope side of the hill, which is near the coastline defined as an open bay that allows the easy arrival of the marine stratocumulus cloud.

f) *Relief and slope orientations:* The orientation of the mountain is NW - SE in relation to the coast line. Also, the mountain has a windward hillside, which is exposed directly to the predominant wind in the area.

g) *Vegetation:* The vegetation in this case is not an indicator of the presence of fog, due to the arid condition of the environment,.

h) *Accessibility:* The Mountain has a small footpath up which it is possible to climb. It takes approximately 2 hours to slowly walk to the collectors.



Photograph 1: Chañaral's bay viewed from the top of Falda Verde Mountain, near the fog collectors.

3. THE BEGINNING OF THE FOG COLLECTION PROJECT: EVALUATION OF POTENTIAL IN THE AREA

The first contact between the group of fishermen and the experts on fog studies in the north of Chile was made in 1988. The group had the dream to create another economic activity to increase their possibilities for income. The main idea was based on fog water collection for the irrigation of plants and vegetables but also on a growing tourism opportunity for Falda Verde. One proof of the enormous water supply problem in Chañaral is the existence of a pipeline that brings water from Copiapó, located 180 kilometers to the south.

After the first observations in the study area made by the fishermen's group, they recognized the permanent existence of the stratocumulus and, after a little investigation specifically in

relation to the Operational Fog Water Collection Project in El Tofo, Chungungo, they contacted Professor Horacio Larraín. (Anthropologist and cultural ecologist specializing in fog ecosystem studies). After the visit of the expert to the study zone and his respective scientific and technical instructions, the fog water evaluation project was realized by the support of local funds. Later, the group together with IECTA, the University of Arturo Prat of Iquique, the Service País program, the Municipality of Chañaral and the Embassy of Australia, obtained the funds for the first Large Fog Collectors, and other infrastructure like water storage tanks, access route to the project site, field leveling, wood storage, greenhouse materials and the water conduction system. The funds came from private enterprises, the municipality, government institutions and local projects in the region. The first use of plant irrigation was principally for vegetables and greens like tomatoes, Italian pumpkins, potatoes, corn, carnations and olives. Actually the unique species that has been cultivated is the Aloe Vera plant. According to studies done by the group, for the cultivation of 1,000 plants of Aloe Vera it is necessary to have 4,000 liters of water, over a period of 230 days using drip irrigation.

During these formative years, FogQuest members such as Pablo Osses and Horacio Larraín provided continuous assistance and modest sustaining funding was provided by Rotary International Clubs of Southern Ontario, Canada, through FogQuest. These funds built and repaired fog collectors and improved the infrastructure of the project.

The fog potential evaluation on Falda Verde mountain was made during two consecutive years, from November 1998 to November 2000. The group first installed a locally designed fog collector (1.5 m², 1 meter above the surface) and made measurements during two weeks. Later, the FogQuest members installed an Standard Fog Collector (SFC), of 1 m² structure with raschell mesh, two meters above the surface. With this, the measurements were done simultaneously by both instruments. In both cases, the water was collected in plastic water tanks of 100 liters each (Larraín *et al.*, 2001).

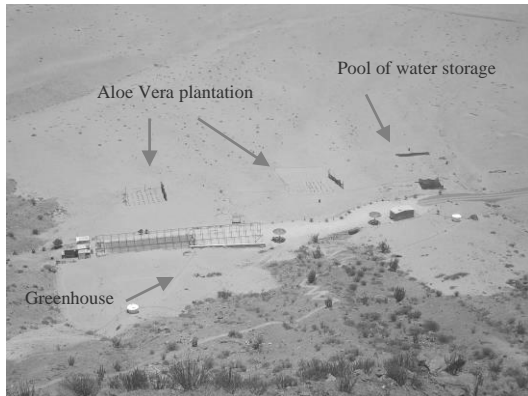


Figure 2: Actual installations in the field, view from the walking route to the Fog Collector Project.

Analysis of the measurements at the site determined there was an average of 1.46 L/m²/day, corresponding to the one of the lowest averages in the northern Chile. This is in comparison to measurements done in Falda Verde and five other locations; Alto Patache, Cerro Guatalaya, Cerro Moreno, Paposo, and El Tofo. The total period considered for the analysis went from 1987 to 2001 (Larraín *et al.*, 2002).

4. LARGE FOG COLLECTORS AND THE DREAM OF WATER IN THE DESERT

Once the evaluation of potential was done and even without high collection rates at the site, the fishermen's dreams were realized. When the comparisons between Falda Verde and Alto Patache (Iquique) were done, the data were an average of four times less for Falda Verde (1,46 l/m²/day in Falda Verde and 7,12 l/m²/day en Alto Patache). Nevertheless, due to the extreme water need identified in the study area and the enormous enthusiasm and work effort shown by the fishermen's group, the construction project was realized. In 2000, the group found finances to build six Large Fog Collectors on the top of Falda Verde Mountain. Three structures, one triple, one double and one single were constructed. The construction took 55 days and included one system of greenhouses (6 rows of 26 x 1.10 meters long) and an irrigation system.



Figure 3: Aloe Vera plantation with his respective fog water irrigation system.

In 2005 FogQuest started with further significant economic and technical contributions to this amazing project. In July, Virginia Carter, with the support of a group of geography students of the Pontifical Catholic University of Chile and also with members of the Atacama Atrapanieblas Group, started the construction of the second operational phase of the project. Four new Large Fog Collectors, with 40 m² collection area each, were built (two double structures). With these new collectors, the average water production of the project was increased, according to the data collected in the evaluation phase, from 400 to 600 liters of water per day.

At the end of 2006 the group of fishermen achieved new funding through a project presented to the Angloamerican Enterprise "Mantos Blancos Division". This phase of the project consisted of funds for adjustments to the earliest fog collectors and also for the future construction of a third phase of Large Fog Collectors. These activities are underway at this moment and will probably be finished by August of the present year. The new collectors will be positioned on the same edge line of the mountain (second phase) and connected to the water storage tanks existing in the project installations. The actual water storage system is made up of two plastic tanks of 5,000 liters each and also, a pool of 30,000 liters capacity.

5. SOCIO-ECONOMIC SITUATION OF ATACAMA GROUP MEMBERS

The idea of the group is to be able to have another activity to add to fishing and other traditional works. One advantage of the project and especially of the social organization of the

group is that it mixes diverse ages and interests. The idea of the people is that the project continues growing in the number of LFCs and in cultivated land, thus being able to generate economic benefit for the families.



Figure 4: Large Fog Collectors, constructed between 2001 and 2005, on Falda Verde Mountain .

The families of the members do not take direct part in any way in the project. Only the breadwinners are members of the group. Nevertheless, if the project continues over time, clearly the children of the members of the group will be the heirs of this interesting initiative. Both the members of the group, and their families, live in the town of Chañaral, where they work in fishing and in other diverse activities. The idea of the project is not to receive fog water to supply their houses but to be able to have an initiative that is sustainable economically over time. The dream of the members of the group is to be able in the near future, especially for the majority, to leave their current activities and to live on the fog water and the respective products generated (Aloe Vera, tourism, bottled fog water).

Of the whole membership, 16 have been eight years in the group, that is, from its formation. The two remaining ones have been members for six years. This reflects a marked continuity in the structure of the group. Most of the members have a family, and almost all of them live with their children and in some cases with their grandchildren. They live with their wives who work in their houses where they do not receive any type of salary. All the members have completed secondary education (school structure of Chile). Only one of the members has completed university studies and he is the only one that has a better salary than the others (he works for a mining company). For the majority of the members, the principal work that they have is fishing in the Bay of Chañaral. The work

has a sporadic nature and they must combine it with other activities such as small agricultural projects.

In relation to the drinking water available, in the city houses belonging to the members of the group, only one of them is not provided with the typical service of municipal drinking water. The family that does not have this service uses the water that is delivered to it by truck, typical of the extreme zones of the country.

6. CONCLUSIONS AND RECOMMENDATIONS

This paper shows the development of one of the most innovative fog collection projects in the world. At present this fog collection project is the only one existing and operational in multiple phases in Chile (water collection, water storage, irrigation of plants, harvesting of plants). Through the initiative and enormous effort of the Atacama Atrapanieblas Group, the dream of collecting water for future economic and social benefits, in the middle of the Chilean desert, has begun to be realized. It is recommended that the project be continued with more phases of Large Fog Collector construction and the respective connections to the existing water storage system, to obtain a larger plantation of Aloe Vera, increasing the possibility to open another economic activity for the fishermen's group, the sale of agricultural products.

7. REFERENCES

- Schemenauer, R., Cereceda, P. and Osses, P., (2005) *FogQuest Fog Water Collection Manual*, Toronto, Canada, 100pp.
- Larraín, H., Velásquez, F., Cereceda, P., Espejo, R., Pinto, R., Osses, P., and Schemenauer, R. (2002). *Fog measurements at the site "Falda Verde" north of Chañaral compared with other fog stations of Chile*. *Atmospheric Research* 64, 273-284.
- Larraín, H., Velásquez, F., Pinto, R., Lázaro, P., Cereceda, P., Osses, P., and Schemenauer, R. (2001). *Two years of fog measurements at the site "Falda Verde", north of Chañaral (Chile)*. *Conference on Fog and Fog Collection*, St. John's, Canada, 15-20 July, 2001.