

Fog Collection Evaluation in the Sadaa Governorate, Yemen

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ABSTRACT

In early 2004 a fog collection evaluation project was carried out in the Sadaa Governorate, located in the northern part of the Yemen Arabic Republic. The people that live in the mountainous areas of Sadaa are basically farmers, and they get the water from wells and from rain in the summer season. The best possibility to increase, in a sustainable way, the water availability in the villages is related to atmospheric water sources, rain and fog collection, and the present evaluation opens the possibility to use a combination of both. The area studied is large and the orientation of the mountain ridges and their altitudes are also quite variable. Eight different sites were chosen and site comparisons related to the orientation of the slope and the altitude were done. Ten 1 m² Standard Fog Collectors (SFCs) were constructed and installed in December 2003 and January 2004, and data from 14 January 2004 to 31 March 2004 were obtained. The results show that the fog collectors have produced the highest water outputs in the Jabal Al Ur mountain and the Kitfah, Madak and Assaga villages. The best sites averaged 4.5 liters of water per square meter of mesh per day over the three month winter period. Measurements with the SFCs were made from 1750 m to 2700 m elevation, with the best collection rates being found from 2220 to 2680 m. The SFCs oriented to the west showed the best rates. This second study of fog collection rates in Yemen shows that the water resource is spread over a wide area of the north of the country and that it has potential to be developed to benefit the people in ways that are appropriate to their lifestyle, culture and religion.

1. INTRODUCTION

The success of the fog collection evaluation project in the Hajja governorate of Yemen in early 2003 led to conduct an evaluation of the fog collection potential in the Sadaa governorate of the Yemen Arabic Republic from January to March 2004. This is a largely arid region located in the extreme north of Yemen along the border with Saudi Arabia. The topography is a complex of mountains rising up from the flat lands near the Red Sea in the west to peaks of 2900 m.a.s.l. in the center and a large dry desert to the east. The year total average rain in the area is around 350 mm distributed mainly from April to August. The people that live in the mountainous areas of Sadaa, specially in the Munabah, Qatabir and Majz districts area basically farmers and they get the water from wells and from rain in the summer season. The best possibility to increase the water availability in the villages is related to atmospheric water sources, basically the combination of rain and fog collection. The field work was carried out using fog collection protocols and instrumentation that have been developed in Chile (Schemenauer and Cereceda, 1994a; Schemenauer and Cereceda, 1994b) and subsequently used in many other countries.

A basic need of any successful water project is the people involvement, in this way the present research was done under the framework of the ADRA Yemen Basic Health and Education Program (BHE), a multifaceted approach, which enhance the capabilities of partners in health, education and community participation at all levels, in order to improve services and living conditions, especially for girls and women. ICS project director conducted a field visit to the Sadaa area during December, in cooperation with the Yemeni NGO Jama'iyya Mustaqbal members, they choose sites that could be suitable for a fog collection evaluation. By the mid-January, with the FogQuest assessment the final locations for the 10 SFCs were chosen and the collectors were installed. The people were briefly involved on the concept of fog collection, how the collectors worked and on the benefits that the fog collectors could bring through the provision of clean water for their families. Forms were produced in Arabic and discussed with the people who would record the measurements. Each person making field measurements had the use of the fog collector demonstrated after installation. The field work went very well with the exception of one site. The results have been reported in detail by Osses and Schemenauer (2004).

2. THE SITES SELECTION AND EVALUATION

The area studied is large, with varying distances from the mountains to the Red Sea coast, the orientation of the mountain ridges and their altitudes are also quite variable. Eight different sites in three different districts were chosen and site comparisons related to the orientation of the slope and altitude were done. Ten 1m² Standard Fog Collectors (SFCs) were constructed and

installed in December 2003 and January 2004, and data from 14 January 2004 to 31 March 2004 were obtained. SFCs were preferentially located on ridges, summits and saddle points, in positions where experience has shown that there will be strong enough winds to push the fog through the mesh of the collectors. The sites were also chosen to reflect a range of altitudes and exposures. The final consideration in site selection was the ultimate point of use of the water. Table 1 gives the site details.

SFC Number	District	Village	Orientation	Elevation	Average January* (L m ⁻² day ⁻¹)	Average February (L m ⁻² day ⁻¹)	Average March (L m ⁻² day ⁻¹)	Total Average (L m ⁻² day ⁻¹)
1	Munabah	Al Butayn	250	1980	0.42	0.55	0.1	0.35
2	Munabah	Jabal Ur	260	1750	5.79	3.35	0.92	3.35
3	Munabah	Jabal Ur	230	2215	6.14	4.11	0.58	3.61
4	Munabah	Jabal Ur	315	2220	1.96	0.7	0.17	0.94
5	Munabah	S. Kamis	270	1950	0	0	0	0**
6	Qatabir	Kitfa	270	2680	12.22	2.03	0	4.75
7	Qatabir	Kitfa	180	2700	10.66	2.03	0	4.23
8	Majz	Madak	240	2615	12.08	3.06	0.92	5.35
9	Majz	Assaga	170	2620	8.0	0	0.23	2.74
10	Majz	Assaga	240	2630	20	8.4	0	9.46

Table 1. Locations of Standard Fog Collectors in the Hajja Governorate, Yemen.

* Data from January 15 to 31

** No data records available

3. RESULTS OF THE EVALUATION

The results show that the fog collectors have produced the highest water outputs in the Madak, Assaga and Kitfa villages and in the west side of the Jabal Ur mountain. The best sites have averaged 4.5 L m⁻² day⁻¹ (considering SFCs 3,6,7 and 8) over the two and a half month winter period. This is a very good water production rate. There are better results in Assaga (SFC 10) but the quality of the data is not very trustworthy. The collection rates are highest for the sites located above 2200 m.a.s.l. and the best production rate is above 2600 m.a.s.l. in the Qatabir and Majz district. The orientation of the collector plays an important role, specially those instruments located in the same site but facing different ways, for example SFCs 9 and 10 are very close but with different orientation and the results are consequently different, same situation is possible to observe in the SFCs 3 and 4 were the orientation is southwest and northwest. Southwest and west oriented instruments are the most productive. This humid air comes from the Red Sea and the Sadaa highlands are the first mountain range encountered on the way inland. The data show that water is produced from the collectors at the best sites, especially in Jabal Al Ur

western side, Kitfah, Madak and Assaga villages, on a good percentage of days and thus there is considerable promise for the use of fog collectors as a means to provide clean water during the dry winter months at this site. The results of march are slightly lower than January and February but there is still some water collected and from the end of march to the beginning of the rainy season there is no long time. The results should be used to plan for an operational project using large (40 m²) fog collectors (LFC) there. These LFCs can be grouped in arrays to provide water for concentrations of houses, also the possibility of constructing medium size collectors on the houses should be explored and the combination of LFC and rain water collection systems. We can use single LFCs to provide water for an individual home, which could be stored in the rainwater cisterns, which are empty at this time of the year. The fog collection sites in these three villages can produce from 3.3 L to 9.4 L of water per square meter of mesh per day (in the fog season) based on the data collected. This is an average of 130 L to 375 L of water per day per collector, which is enough water to sustain a family of seven people. Presently there are LFCs producing water in the Hajja governorate in the Mabyan area near the city of Hajja.

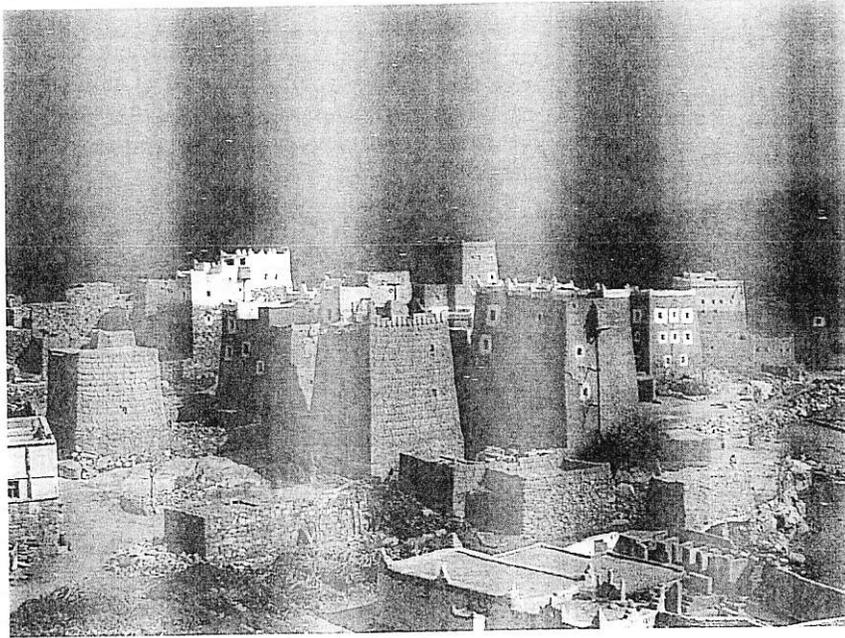


Figure 1. The village of Assaga in Majz district, Yemen.

5. CONCLUSIONS

There are many locations in the world where the fog fluxes are sufficient to produce water in substantial quantities for people. However, to have a successful project the users must accept this novel water supply and participate in its construction and operation. Cereceda and Schemenauer (1993) showed the results of an extensive survey taken in a desert community in Chile. The fog water supply was well accepted by the people and was preferred to the water that they had been purchasing from a truck.

In Yemen the economic comparison with water trucks is very difficult, because the government subsidizes diesel. Furthermore the investment into pumps is encouraged by lowering import taxes. If a comparison is made, one should also include the costs for pumping the water and building and maintaining the roads and bridges. In addition to this, the environmental aspects of building roads to villages on the mountains, which causes problems of erosion should be considered. Additional factors to consider are that ground water in the wadis may not meet future water demands as populations rise and demands for water increase, plus water quality may suffer over time as populations grow and clean water may not always be available from the wells. The weather patterns that produce fog in the hills

will be persistent for periods of hundreds and likely thousands of years, leading to the ability for the people living in the hills to have a water supply that is sustainable and under their control.

Unquestionably, good water collection rates in the dry winter period have been documented at some sites, this is an important starting point to consider seriously the use of water from fog and rain as a real water resource for the people of the Yemeni mountains, specially in the Qatabir, Munabah and Majz district in the Sadaa governorate, although because of the complex topography, the results can strongly differ between sites located closely, serious evaluations must be done to avoid wrong results because of bad locations, and not because of there is no potential to collect water.

Some considerations appear to be important for the use of water from fog and rain as a resource able to alleviate the lack of water in the area. To combine fog water collection with roof water collection from rain in order to get higher amounts of clean and cheap water. To utilize the knowledge gained from the initial Large Fog Collector arrays in Hajja governorate to strengthen the anchor points for the collectors and increase the community instruction related to protecting and maintaining the fog collectors. To work on a strong involvement of women in the fog and rain collection systems.

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