NOTES AND RECORDS

FOG WATER HARVESTING ON THE VERGE OF ECONOMIC COMPETITIVENESS

Anne Lummerich and Kai J. Tiedemann

With 1 figure and 2 tables

Fog water harvesting has proven to be a successful means to provide water in dry regions for decades. So far, economic considerations have been focused on the sheer construction cost of a fog collector, and the idea of fog water harvesting as a business model has largely been neglected. However, paying attention to this aspect could be a further step to the sustainability of fog harvesting projects. This short report is dedicated to two crucial elements of economic competitiveness of fog water harvesting: (i) maximizing the efficiency of fog water collectors and (ii) the development of a simple business model that introduces fog water harvesting as an economically competitive investment as an alternative to centralized water delivery.

For the first part (i), a field study was conducted in the outskirts of Lima (Peru). In preparation of the subsequent constructive upscaling of new fog collector prototypes, a design study was performed to find the most effective fog collector structure. Five prototypes of collectors with different shapes and collecting materials were tested at a small scale, followed by an upscaling of the three most promising setups to full scale fog collector devices (Fig. 1, No. 1–3). Additionally, a three-winged screener called *Astropod* (No. 4 in Fig. 1) was introduced as an improved instrument for the evaluation of water yield by fog water harvesting. The *Astropod* permits measurements of the favourable wind directions for fog water collection and the absolute amount of collected fog water at the same time.

The results of the efficiency study (Tab. 1) revealed that the *Eiffel* device is the most suitable fog water collection system, reaching the maximum absolute yield of up to 2,650 litres per day during the peak fog season. Therefore, it was chosen for the follow-up projects, also due to its robustness and comparative simplicity.

The successful implementation of the first set of fog collectors caused an increased awareness among local communities in the project area about using these systems. Joint efforts, including substantial financial contributions of the community members allowed for two follow-up projects, each one largely performed

Fig. 1: Compared full scale fog water collection devices as developed from the design study (see also Tab. 1): (1) "*Eiffel*" collector – 4x8x0.3 m metal frame, two separated layers of Raschel 50% net with 10 additional stripes in between; (2) "*Harp*" collector – 2x4x0.3 m metal frame, 2,256 m of 1.5 mm rubber string vertically installed; (3) "*Diagonal Harp*" collector – 2x4x0.3 m metal frame, 1,520 m of 1.5 mm rubber string diagonally installed; (4) The *Astropod* screener with star-shaped screening wings

DOI: 10.3112/erdkunde.2011.03.07 ISSN 0014-0015 http://www.erdkunde.uni-bonn.de

by the villagers themselves. Two years after the first collectors were installed, fog harvesting became more widely known and the authors were contacted by a real estate developer who builds condominiums in a part of the Lima Metropolitan Area that is not yet connected to any water supply grid. Thus, water is delivered by trucks to this luxurious country house resort, just like to the poorest suburbs. The estate developer was hence vitally interested in the economic competitiveness between truck deliveries and the installation of a large battery of *Eiffel* fog collectors.

The results of a simple investment model in table 2 shows that the initial investment of 35,000 for 100 collector modules can be fully reimbursed after 8 years. This model is based on the assumption that the money that is not spent on water purchase minus the annual maintenance cost is entirely used for loan payback. The residual loan of each year *t* is calculated as its value of the previous year *t-1* plus the capital interest rate *r* = 6% minus annual payback. The capital interest rate and the water price increase are based on the authors' market observations between 2006 and 2009.

Tab. 1: Results of water production measurements of tested fog collectors; mean, maximum and minimum value with standard deviation (measurement period in brackets). SFC is the hitherto widely used Standard Fog Collector after Schemenauer and Cereceda (1994)

SFC (19.09.07-13.01.08)	mean	28.7	L/d
	max	598.7	L/d
	min	0.0	L/d
	std dev.	82.4	L/d
Eiffel (19.09.07-13.01.08)	mean	281.2	L/d
	max	2,651.6	L/d
	min	0.0	L/d
	std dev.	487.1	L/d
Harp (21.10.07-13.01.08)	mean	62.7	L/d
	max	200.0	L/d
	min	0.0	L/d
	std dev.	52.2	L/d
Diagonal Harp (20.10.07-13.01.08)	mean	28.6	L/d
	max	94.2	L/d
	min	0.0	L/d
	std dev.	24.1	L/d

References

Schemenauer, R. S. and Cereceda, P. (1994): A proposed standard fog collector for use in high elevation regions. In: J. Applied Meteorology 33, 1313–1322. DOI: 10.1175/1520-0450(1994)033<1313:APSFCF>2.0.CO;2

Authors

Anne Lummerich
Kai J. Tiedemann
Alimón e.V.
Tittardsfeld 102
52072 Aachen
Germany
alummerich@alimon.org

Tab. 2: Input data and payback scheme for investment model

Example: 100 Modules   Price per Module: 350 USD   Initial Investment: 35000 USD

Input data		Savings [USD]	maintenance costs [USD]	Loan value[1] [USD]	Annual payback [USD]	Residual loan[2] [USD]	Cum. capital cost [USD]
Water Production Lima	after 1a	5,660.38	500.00	37,100.00	5,160.38	31,939.62	2,100.00
150 d/a (fog)	after 2a	5,943.40	500.00	33,856.00	5,443.40	28,412.60	4,016.38
150 Ltr/(module*d)	after 3a	6,240.57	500.00	30,117.36	5,740.57	24,376.79	5,721.13
2,250.0 m³/a	after 4a	6,552.59	500.00	25,839.40	6,052.59	19,786.81	7,183.74
Water Price 2009	after 5a	6,880.22	500.00	20,974.02	6,380.22	14,593.79	8,370.95
2.52 USD/m³	after 6a	7,224.24	500.00	15,469.42	6,724.24	8,745.18	9,246.58
Assumed Water Price Increase	after 7a	7,585.45	500.00	9,269.89	7,085.45	2,184.45	9,771.29
5.0 %	**after 8a**	**7,964.72**	**500.00**	**2,315.51**	**7,464.72**	**-5,149.20**	9,902.36
Assumed Capital Interest Rate	after 9a	8,362.96	500.00		7,862.96	-13,012.16	**10,041.29**
6.0 %	after 10a	8,781.10	500.00		8,281.10	-21,293.26	

[1] Calculated as (residual loan in t-1) * 1.06

[2] Negative values indicate earnings after full loan payback