WGP -AS
Water Governance Program
for Arab States

REPUBLIC OF YEMEN

NATIONAL FOUNDATION FOR
WATERSHED MANAGEMENT
(WAM)

Manakha Fog Harvesting Pilot Project

Sana'a Governorate - Yemen

Background and Rationale

Yemen stands out for the scale of its water problem. Yemen is one of the world's ten most water-scarce countries in the World. In many of its mountainous areas, the available drinking water, usually drawn from a spring or a cistern, is down to less than one quart per person per day. The water shortage crises are expected to intensify under predicted climate changes. The long-term average amount of water available is less than 100 m^3 per capita per year which is among the top lowest rates in the world. The Arab Water Governance Report (AWGR) predicted a declining amount of water available in 2013 to a rate that is below 80 m^3 per capita. Yet, the water shortage in Manakha Western Mount is more tragic as water availability rate may not even reach 50 m^3 per capita per year. As it is the case across rural Yemen, water shortage is the most critical risk undermining livelihood sustainability. The water shortages seriously affects women, girls and children, who perform the big burden of bringing water from far away open water ponds especially in winter (dry season).

The Water Crisis between Mission Impossible and Solutions

As Manakha has high potential to harvest fog to secure water especially for household and domestic uses, the pilot introduced cost-effective fog harvesting techniques leveraging and emulating the locally innovative fog-harvesting structures for coffee production. Up-scale of the techniques is derived by the role of women leveraging on local knowledge and using local materials.

What is Fog Harvest?

It is an alternative method for making water available for human use. This innovative technology is based on the theory that one can collect water from fog when conditions allow condensing the fog.

Why Fog Harvest?

The fog carries more than imagined. For instance; it contains hundreds of liters of water that is very pure and can be drank especially in fogy highland areas like Manakha, Socotra, Hawf, ErafLahj, Al-TurbahTaiz, Raimah, SummarahIbb, MilhanMehwetand other similar areas.

The National Foundation for Watershed Management – in partnership/support with UNDP's Water Governance Program for Arab States – partnered with CSOs in Manakha like Al-Nama Development Association for Coffee Producers and Al-daee Al-fatimy Association in establishing five fog harvest units in the target areas.

To What Extent Can Fog Harvest Contribute to Solving the Drinking Water Issues in Manakha?

Five fog harvesting units units were installed in various parts of Al-AWE' Mountain and

the results were well reaching beyond expected sometimes. The fog harvesting units comprise 3 m x 2 m mesh screens that were able to condense enough fog to provide drinking water for a family of five. This is the first example of a successful fog harvesting initiative in the Western Highlands. Local communities now benefit from the provision of drinkable water and women and children are no longer required to travel to collect water during the dry months.One of the fog harvesting units collected 40 liters in 6 hours with the others making 15-25 liters for the same period. The average water harvested in a month perunit was 350 liters with the topmost harvesting 400 liters and the least below 100 liters in the month between 15 October, and 15 November 2013.

The Result: A 6 m2 fog harvesting unit is able to condense enough fog to provide drinking water for a family of five. The harvested water is clean and has the potential to address water shortage in more cost-effective manner.

The Advantages of the System and the Harvesting Units:

- The installed units incorporated traditional and innovative fog harvesting techniques; ii) required locally available or simple inputs; and iii) responded to the anticipated effects of climate change on women, youth and other

vulnerable groups.

- The design of fog harvesting units included considerations of simplicity and ease of maintenance. Maintenance requirements form a significant factor in the sustainability of the system. Design aspects were taken into account when minimising maintenance include: i) size of the system; ii) distance between collection point and storage or use location; iii) distance of the system from the community or household; iv) potential water supply with no energy needs; and v) required materials and tools. Wherever possible, techniques that are user-friendly and easy to maintain were promoted in favour of complex and expensive systems so that specialized techni-

cal knowledge for installation, maintenance and repairs are not required. Moreover, locating the screen according to ease of access by its owners is preferable to a site that would provide greater water yields with minimal energy needs

- The system included focus on sustainability through promoting local community 'buy-in' and ownership using available locally-sourced materials
- The systems has the potential for scale-up through provision of supplementary water for irrigating green spaces, controlling of soil erosion and desertification.

Principles for Launching Fog Harvesting Initiatives:

- It is recommended that a small pilot is launched, monitored and assessed ahead of the installation to test the efficiency of harvest in the specific area.
- It is preferred that collection areas are the consumption sites or close to them.
- As the system depends on the continuity of fog and stops if weather changes; it is essential that backup options are made available to substitute the fog water and assure there is water.

The Idea of Fog Harvest in Manakha: Changing Community Perception

- Farmers of the area and those in higher altitudes used to perceive fog as a real problem. Locals used to complain from fog that used to affect their movements, and pose threats on their agricultural farms especially during frost periods. Locals did not know that it fog could carries substantial livelihood benefits However, this perception has changed after the introduction of the fog harvesting systems. Fog harvesting units provided a cost-effective method to provide drinking water

which used to be extremely short in terms of supply during winter– that consumed lots of time and effort by women and children to bring from distant sources. Such efforts usually come at the expense of caring for smaller children and school times.

Fog Harvesting and resilience Building

Many locals gathered at the units' locations in amusement and to get some water – as some people believed it is medicine since it comes from heaven – that looks very pure and shining in color as they are used to stained looking water from the open and enclosed cisterns.

FOG HARVESTING EXPERMIENT IN THE AREA OF MANAKHAH

TARGET AREAS:

- Since there is a significantly encouraging amount of fog that lasts for long and that there is need for water; a big model was proposed as a harvesting unit and a guiding model for the people. Installation was done in five different areas and the units will be monitored for a whole year with daily collection rates registered in the "daily harvest forms" before results are analyzed and comparative findings are reported. The model can then be spread in the area.

Table (1): Fog Harvesting Pilot Areas

Area	Location	Unit Size	Fog Period
Al-aWEEI Mountain	Addukmih	6 sq meters	6 months Oct-March
	Ashuquq	6 sq meters	6 months Oct-March
	Ashiber	6 sq meters	6 months Oct-March
	Al-Urdhi	6 sq meters	6 months Oct-March
Al- ssa'ud Mt	HiffdhallahY-asseen Cistern	6 sq meters	6 months Oct-March

Factors behind Choosing a Location for Fog Harvest

1. The space available
2. Fog streams areas
3. Available materials – material capacities
4. The speed and direction of winds (the common wind patterns)
5. The areas in most need for water
6. The land topography
7. The altitude above sea level
8. The community willingness to cooperate and desire
9. The nature of the area (the fog formation – density – length of fog season)
10. The slope nature in the area.

The Technical Specifications of Aunit

The unit IS A SQUARE FRAME OF PIPE-LINES 2 m x 3 m standing on bars at 3 m height covered by a net that is tied with a steel bar of 8 ml in size. It is fixed vertically facing the common wind direction. This means the water harvesting area is 6 sq meters. There is an outflow at the lowest point of the frame taking the water into the containing tool. The materials available locally wee used with quality taken into consideration in order to make a model that lasts and bear the harsh environment. The materials were:

1. Steel pipes of 2 inches
2. A green net of 50% like the one used in plant nurseries
3. Steel bars to fix the net
4. Small twister to fix the bars strong
5. Cement
6. A needle and thread to fix the net on the frame
7. Corner fixers to make the pipes connected
8. 20 liters jeer cans
9. A 0.75 inch hose to take water from outflow to the containers.

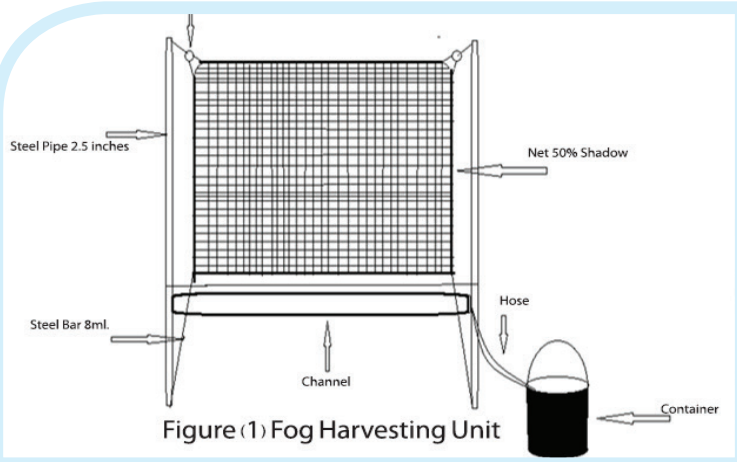
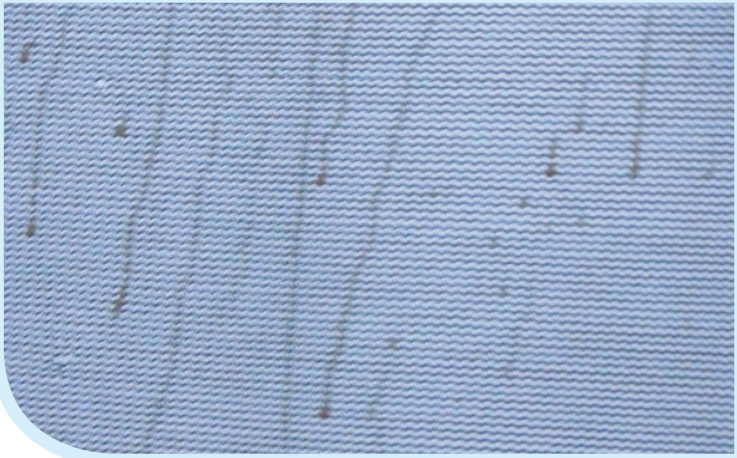


Figure (1) Fog Harvesting Unit



Local Ownership and Scale-Up:

1. SIMPLE, CHEAP AND EASY IDEA

Owing to key advantageous characteristics of fog harvesting models including their easy construction, installation and maintenance on-site, besides the immense potential for scaling-up, locals begun replicating the idea using cheap and practical methods. The locals have even become more engaging and trying other ways to increase the efficiency of fog harvesters units through introducing some new design elements such as drilling of tanks for collecting the condensed water instead of the use of plastic tanks which used to be parts of the demonstration system. Replicating the model using locally-sourced materials and skills, the initiative has gained strong community buy-in because local communities have owned it. As such, this initiative has demonstrated cost-effective method to support an increased replication of the intervention that promotes greater potentiality for scaling-up.

2. THE ROLE OF LOCAL COMMUNITIES

Since the locals are the beneficiaries; a real partnership between WAM and AL-Nama' Development Association for Coffee Producers and Al-ddae' Al-Fatemi Foundation in Haraz reflected in a partnership agreement for implementing the project. The two CSOs have played a major role

in the design, planning and implementation of the experiment and most importantly building the capacity of local communities to understand the system, which have already created a feeling of ownership and collective responsibility for the project seen as potential for successful water solutions that require local cooperation and interaction.

Education and Awareness

The WAM foundation team launched a training during the unit installation and after that for some individuals. Adding to that awareness about preserving water and keeping the units well as well as observing and taking the harvest amount readings were done. Various citizens were trained on how to install the units and part of it was done practically during the project work.

Several workshops were held and attended by various stakeholders like universities, research centers and the Agricultural Research Authority.

LESSONS LEARNT AND SUCCESS STORIES

As the consultative team started installing the units; locals split between some sarcastic ones and others who were skeptical about its success. Some gathered in a session making fun of the foundation's initiative and waiting for dawn to go and laugh at the disappointment created by such lunatic work. However; once the threads of water came down the net, those present were astonished at the amount of water collected into the tank. The long feared for the crops fog has become a good thing and may bring drinking water. Prior to this some farmers wanted big fans installed to scatter the fog away but as the experiment goes on the image of the fog is changing.

THE ACHIEVED OUTCOMES

The primary results obtained from Al-Awee Mt (the Western slopes in specific) indicate the existence of fog that brings considerable amounts of water due to the area being open at the Tihama plains. Western parts of Manakhah are full of fog. Readings collected indicated that amounts differ from a day to another as the fog does with the highest reading of 40 liters per day on a 24 hours

period of ongoing fog. Fog usually comes from 3:00 pm and may continue until early morning hours and the season is during winter when water becomes short in supply with springs drying out and harsh drought looms.

Early Signs of Impact:

One old lady says we were pessimistic of fog, we were staying in our homes, we did not bring water, but we did not know that God has given us the fog to quench our thirst.

Another lady who do not find the money for making fog unit has sold her sheep in order to construct fog unit. She says all the good is coming from the sky, thank Allah.

Local Ownership and Scale-Up

Owing to key advantageous characteristics of fog harvesting models including their easy construction, installation and maintenance on-site, besides the immense potential for scaling-up, locals begun replicating the idea using cheap and practical methods. The locals have even become more engaging and trying other ways to increase the efficiency of fog harvesters units through introducing some new design elements such as drilling of tanks for collecting the condensed water instead of the use of plastic tanks which used to be parts of the demonstration system. Replicating the model using locally-sourced materials and skills, the initiative has gained strong community buy-in because local communities have owned it. As such, this initiative has demonstrated cost-effective method to support an increased replication of the intervention that promotes greater potentiality for scaling-up.

Next Steps at the Local Level

The locals in Al-AWEE Mt of Al-Magharibah Al-Awlia are looking forward to the sooner rather than later invention of their own models that can be put in place to collect water. They are eager to find available funding for such fog harvesting techniques so that a network of them is installed as part of a multi-village project with a high productivity that compensate for the shortage in water supplies.

The way Forward: National Level

Developing the experiment and expanding it to local communities within the Haraz (Sana'a') area as well as fogy mountainous areas like Summarah in Ibb, Hajjah Highlands, Raimah Highlands, Mahweet Highlands, Hawf Highlands in Al-Maharah Mt, Socotra Island Mt, Al-Twrba Highlands in Taiz and Erraf Highlands in Lahj.

Recommendations

- Regular maintenance of the units.
- Continued education and guidance in the area about harvest in the cheapest in easiest ways.
- Helping people who adopt the idea by info
- Extending the experiment longer and analyzing results before publishing the final reports
- Looking for funds to implement it wider in the area in a productive way

Rrepublic of Yemen

National foundation for Watershed Management

Sana'a taiz St. 45 Square

Tel fax : 009671 632259

mobile: 00967 777466038

P.O Box: 17368 - Sana'a

Email : wam.yemen.serv@gmail.com

Web: wam-yemen.org