# Analyzing the potential of Roof Rain water harvesting Systems for water supply in Manakha town and surrounding area

## Background

Yemen is characterized by arid to semi-arid climate and very little surface water.

The water scarcity is more acute in the western part of the country where 90% of the population is concentrated. Major cities are located there, in catchments with limited local water resources.

Rainfall is limited while the agricultural demand for water is very high, therefore Yemen has been categorized as one of those countries suffering from water scarcity.

the total annual national renewable water resources in Yemen are2.5 BCM, while annual abstraction is 3.4 BCM .

In Manakha city, the availability of water that is produced by National Water & Sanitation Authority counted to be 83,757 m3 per year which gives a daily water delivery of only 15.30 L/ per capital .

Due to the failure of the public system people also fetch water from other resources delivered by water tankers.

Roof Top Rain Water Harvesting in Manakha could be contributed in closing the growing gap between water demand and water supply, reducing the high pressure on groundwater .

## Objectives

**The overall objectives of the study are the following :**

- Assess the technical, economical and social feasibility, to introduce roof top rainwater harvesting systems in Manakha town to meet domestic water needs and reduce the pressure on groundwater resources and household's financial resources.

**However, other objectives will be addressed also in the study:**

- Evaluate socio economic feasibility of applying RTRWH techniques in the target area.
- Calculate total harvestable water volume from the roofs and suggested bonds of Manakha
- Identify the best techniques, including the quality aspects, that could be used for RTRWH in Manakha from the economic and equality.

## Research findings

Climate and meteorological variables which are particular to this study include: temperature, rainfall/precipitation, evaporation / evapo-transpiration, wind and humidity. Table (1) shows a summary for the metrological data for Manakha area .

**Table 1 Manakha Meteorological Data**

| Parameter /Month | Jan-Mar | Apr-June | July-Sept | Oct-Dec | Average |
|---|---|---|---|---|---|
| Temperature, ºC | 25.6 - 6.7 | 28.9 - 12.1 | 33.2 - 15.2 | 31.9 - 7.0 | 29.9 - 10.3 |
| Rainfall, mm/year | | | | | total 300 |
| Wind speed, m/s direction | 3.0 Southwest | 3.9 southwest | 4.3 Southwest | 3.5 Southwest | 3.7 South |
| Relative Humidity | 49% | 47% | 42% | 41% | 45 % |
| **Evaporation / transpiration** | | | | | **1,800 mm/ Year** |

The total area of rooftops in Manakha City has been estimated about 138189.65m2 and the potential rainwater harvested quantity shows in table (2)

**Table 2 Rooftops area and potential rainwater harvested quantity**

| Area Name | Annual Rainfall ( mm/year) | Rooftops Area (km2) | Harvested Water (CM/year) |
|---|---|---|---|
| Manakha | 300-350 | 0.138 | 31092.67 |
| Total Harvested Water | | | 31092.67 |

The main water sources for domestic uses in the area found 65% of household a public network and tankers is a major water source. However, there are 27% of the households using rainwater for domestic uses . shows in figure (1)

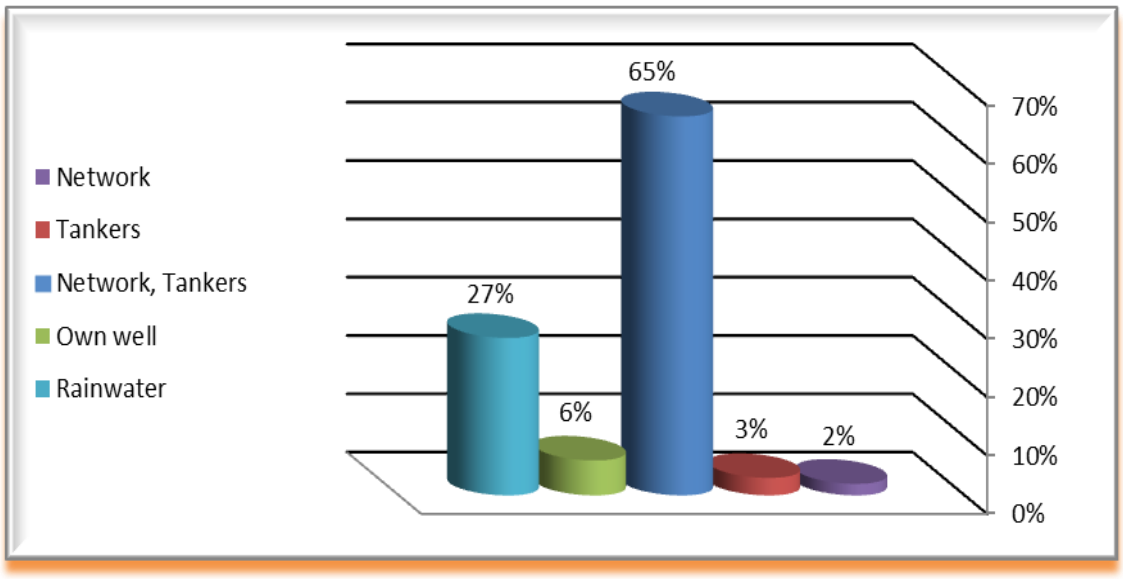


**Figure 1 The main water resources for domestic uses**

According to survey the average Water consumption (L / day ) per capital is 28-30 L / day as shows in figure (2) .

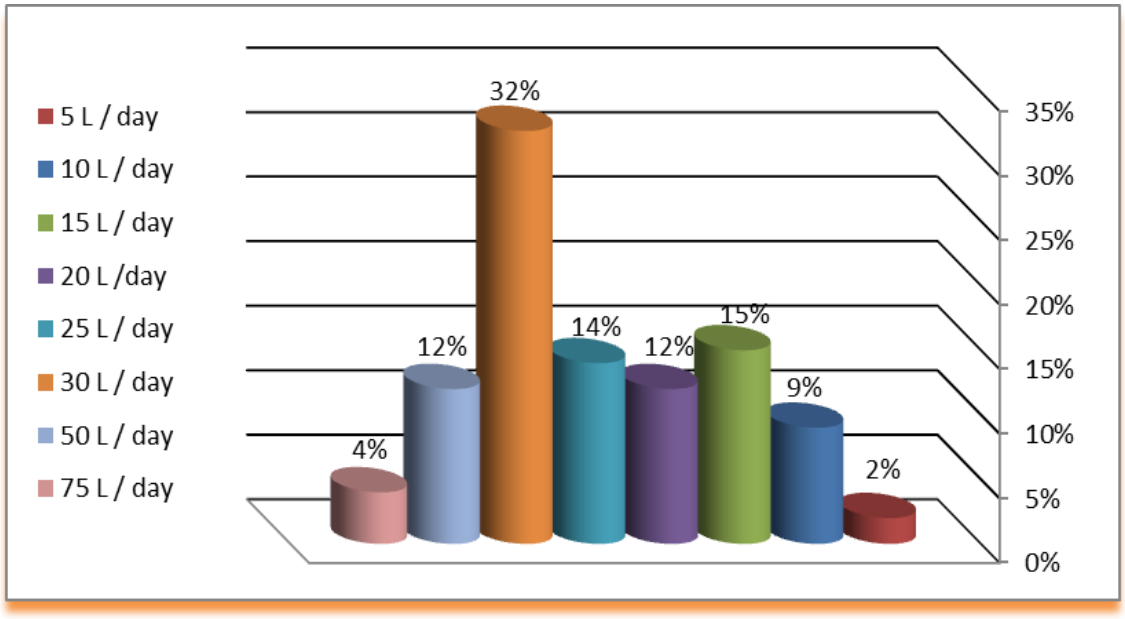


**Figure 2 Water consumption (L / day ) per capital**

The population of Manakha City will be as shown in Table (3) .

**Table 3 Manakha Population up to 2025**

| Manakha | 2004 | 2010 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|
| Population | 6,553 | 6,983 | 7,363 | 7,764 | 8,187 |
| Families | 1060 | 1119 | 1179 | 1243 | 1311 |
| Houses | 1,071 | 1,130 | 1,191 | 1,256 | 1,324 |

Average per capita water consumption / day from NWSA wells is 15.30 L /day and the total cost coverage 400YR/M3 .The capacity tanks for water storage required 37m3.

People's opinions and encouragement to use RTRWH are measured by survey, Only 18 % (Figure 3) didn't like the idea However, their reasons for this objection are illustrated in this study . The other majority (80 %) are encouraging the idea of using RTRWH systems .

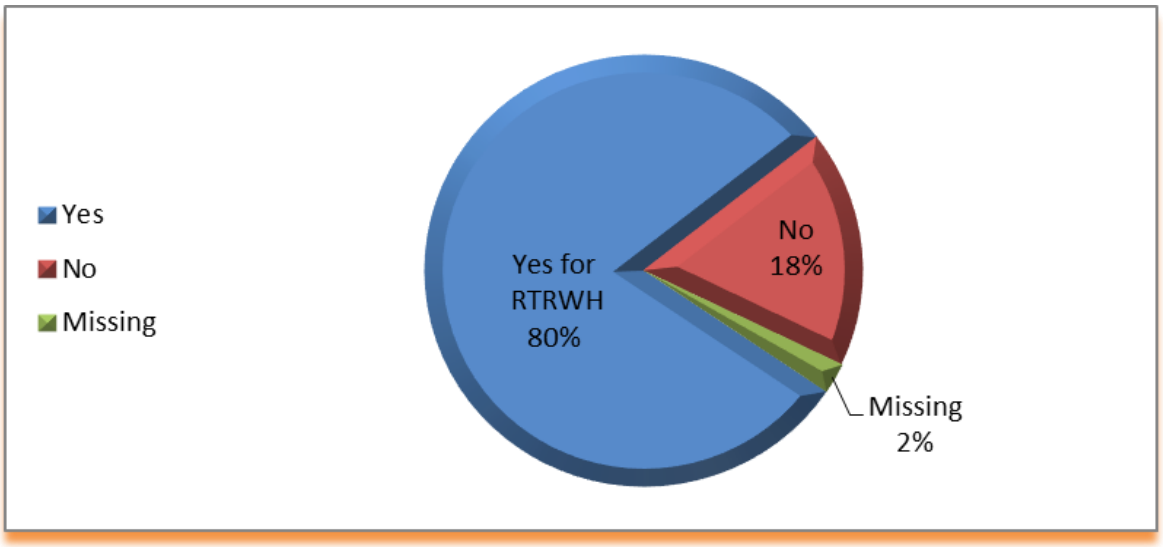


**Figure 3 The agreement and encouraging RTRWH**

The majority of people and the high rate of 94% respondents about their willingness and ability to participate in such projects (see Figure 4). Most of the people, who encouraged the idea of RTRWH, are not willing to participate financially, while, 47% of the samples are willing to participate financially and share in work. However there are some people willing to provide financial support even though they either retired, while 42% of interviewees are willing to participate sharing in work. To the extent that women who have shown their willingness to participate in the establishment of such projects (harvesting projects) to the extent possible that they will soled their gold to participate and create harvesting project in order to alleviate the suffering of fetching water over long distances. This social indicator and positive evidence of the urgent need to water in the region .

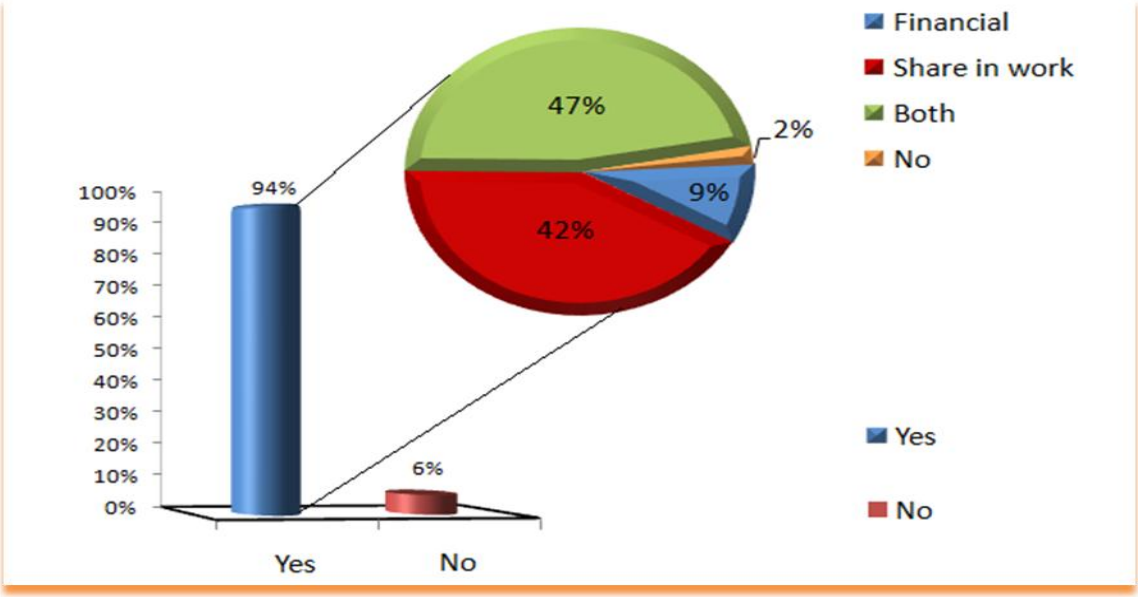


**Figure 4 Interviewees' willingness and ability to participate in RTRWH projects**

The survey of household have been designed to measure the people awareness. 34% of Interviewees realized that the reason of water shortage in Manakha is rainfall rare (figure 6) while 21% admitted people increasing is the reason, but 6% said irrational use of water is the reason, 5% people ratio said the digging wells, 24% said topography case, 34% said the reason is rainfall rare, 3% interviewees said miss management is the reason

Measure the people awareness

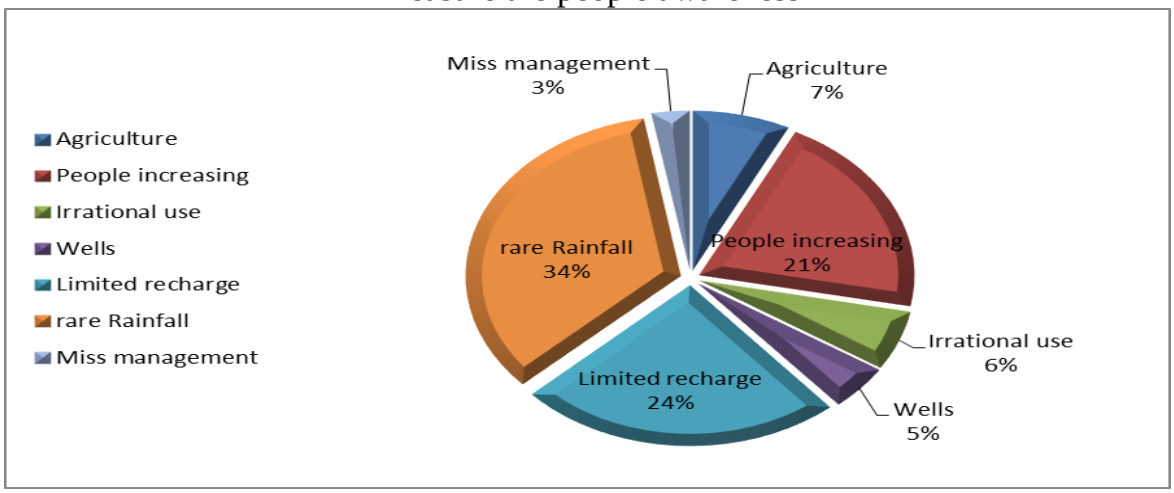


**Figure 5 The reasons of water shortage in Manakha area**

Having (NWSA) agree to manage, operate and maintain such projects ensures their sustainability, control of water depletion and the pressure on ground water, and supply Manakha town with water.

Applying (RTRWH) projects will result in time and effort saving and investment; and in reducing the residents' suffering from fetching water over long distances from the springs and surrounding ponds.

Improving household income.

## Recommendation

- Raising awareness among the people in the region through the media, workshops, as a first step to define the importance and use of RTRWH
- RTRWH should be defined as a necessity, not an option
- Encourage and enhance Gender to participation and integration in water management projects .
- Need for coordination and cooperation between the relevant government institutions private sector and urban, ruler households is required for access to Better water management.
- Strategies and policies should be paid for rainwater harvesting management
- General tanks for water harvesting and shared with water project within the system( NWSA) for the purpose of operation, maintenance and sustainability, thus relieve the pressure on groundwater
- Recommend using silver filters ,etc.. in household for drinking RTRWH
- Trend government, NGOs to implementation RTRWH system as first step in the region to encourage all people, stakeholders relevant agencies
- Required RTRWH systems on building designs