Potential of Rainwater Harvesting from Rooftop In Urban Areas
Case study: Sana'a City

1- Background

Rainwater harvesting systems have been used since ancient times and evidences of roof catchments systems date back to early Roman times. Roman villas and even whole cities were designed to take advantage of rainwater as the principal water source for drinking and domestic purposes.

In the ancient time in Yemen rainwater harvesting, especially in mountainous areas, has been implemented by making small traditional dams, dykes, cistern, Majel, Karief and Ogmas. Those traditional structures were used for both domestic water supply and agriculture uses.
At present, new rain water harvesting technologies have become dominate in Yemen. Two furro-cement tanks one over ground with 50m^3storage, and other underground tank with 100m^3 storage were installed in different schools in Sana'a. This manual will deal with its construction steps (Photo 1).
Sana'a city is experiencing a serious depletion of groundwater resources with associated water quality degradation. The water resources situation in Sana'a Basin is extremely serious as abstraction exceeds recharge by more than five folds. Consequently, the piezometric level declines about 4-8 meters annually. In addition, rainfall is becoming much less each year due to climatic changes. There are two rainy seasons, separated by a distinct dry interval (May-mid July). The annual rainfall generally varies between 150 and 250 mm, with some years having higher rainfall amounts of above 250 mm. The first rainy period starts in mid-March-beginning of April, the second rainy period begins mid-July-beginning of August and stops abruptly by end of August. The months September through February are generally dry, although occasional thunderstorms may

bring some rain during these months. Sixty-five to seventy-five percent of the rain falls during January-June. The number of rainy days with rainfall amounts above 5 mm/day varies between 5-15 days. The average amount of rainfall per rain day is about 16-17 mm.


Photo (1) Two Furro-cement tanks at two schools in Sana'a (Giz,2007)

A rainwater harvesting system comprises components for transporting rainwater through pipes, or drains, filtration, and tanks for storage of harvested water. The common component of a rainwater harvesting system is shown in the figure 1.

In this study the roof water harvesting from urban areas in the Sana'a city, especially from the roofs of schools, was evaluated qualitatively and quantitatively to meet the minimum requirements of water demands for drinking and hygiene.

2. Objectives:

The objectives of this research are:

1- To estimate the amount of water that can be collected from the roofs at the household level, as well as in the entire Sana'a city as an additional source for drinking water.

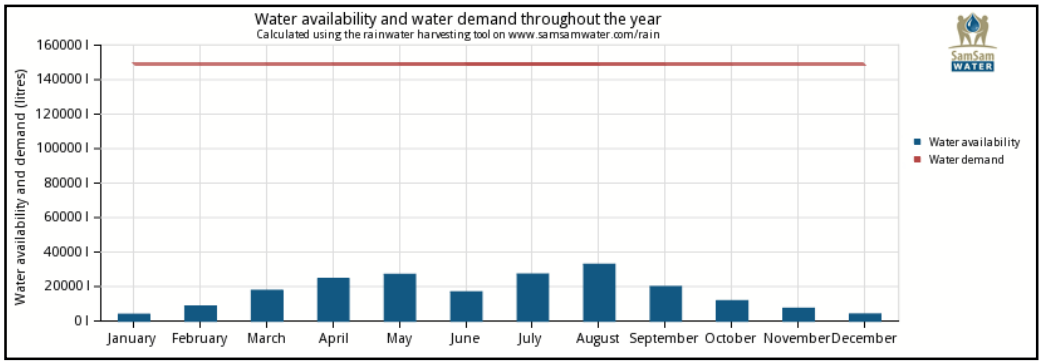
2- To estimate the amount of water that can be collected from the roofs of schools for drinking and toilets purposes.

3- To analyze the quality of the schools' roof water to meet the minimum requirements of water need for drinking and hygiene.

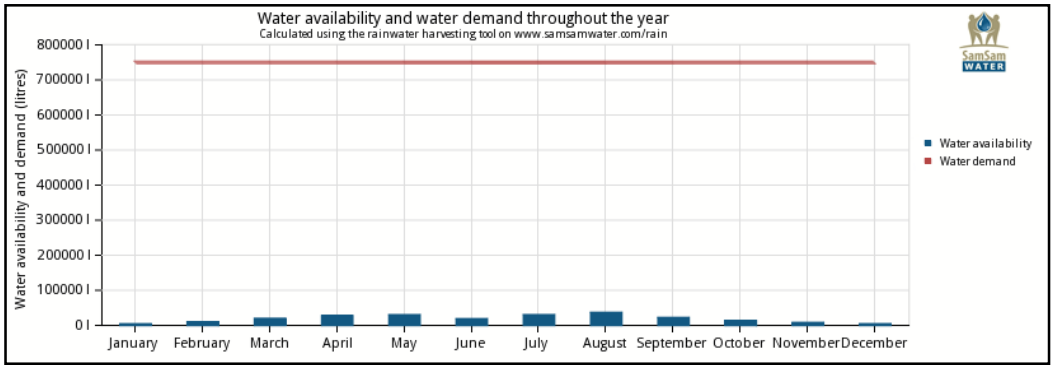
4- To identify the sizes of the tanks required to collect the roof-water harvesting.

3. Result and discussion

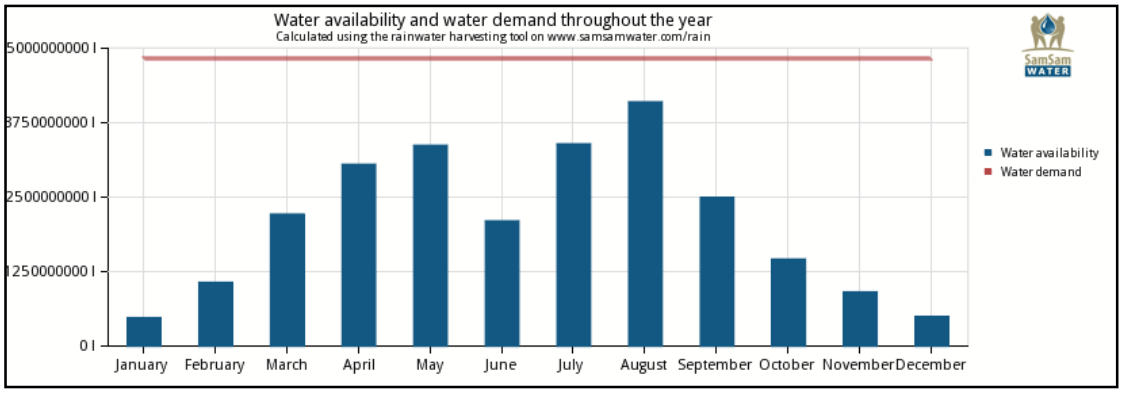
3.1. Rainwater at the houshold level



3.2. Rainwatwer from Schools' Roofs



3.3. Rainwater from the entire Sana'a City



3.1. Result of the Water quality analysis:

The physical and chemical analysis of the drinking water samples taken from the metallic tank of Ikhwan Thabit School (Table 10) comply with WHO standards for drinking water, though the concentration of components (TDS, Na, CL, S) are higher than those in the harvested rainwater. It is expected to find more minerals in ground as they dissolve from the soil layers during the travel time of infiltrated water. This indicates how pure harvested rainwater is when compared to groundwater. The microbiological analysis shows bacterial contamination due to the presence of

total and Fecal coliform and thus it is not suitable for drinking though it is used now for drinking. It is not known yet where this contamination came from, and thus further investigation is needed. It could be from the groundwater source itself, from the storage of water tanker, or from the metallic tank at the school.

4. Conclusions and recommendations

Public awareness has an important role in harvested/collected rainwater management. Education, training, and financial supports are needed to encourage people to consider the importance and quality of the collected water. Clean environment produces clean water. Several environmental conditions should be taken into consideration to improve the water quality such as proper design; operation and periodical maintenance of collection systems; cleanness of catchment area and water storage; and protection of collection systems from any kind of pollutants.

It was hence finally concluded that implementation of Roof rainwater harvesting for the Sana'a University staff's residential campus will be the best approach to confront present scenarios of water scarcity in all aspects; whether it is from a financial point of view or from optimum utilization of land surface. By investing in and implementing water harvesting we can set an example and be part of rainwater conservation that will be useful for the campus students. Our campus with its rainwater harvesting system will become a role model for others. Not only that, but this experience will be of many benefits domestically, environmentally and economically. This research fulfilled with all aspect of improving the water scarcity problem in the residential campus by implementing Roof rainwater Harvesting.