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A Partnership with the Government and Communities in the National Water and Sanitation Programmes

Evaluation of the Rooftop Rainwater Harvesting Project

Study Abstract
March 2004

Water, Environment and Sanitation Section
UNICEF, New Delhi, India

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This paper presents the results of an evaluation study of the Rooftop Rainwater Harvesting Project in the states of Kerala, Maharashtra and Uttar Pradesh. Some of the key parameters used for assessing the rooftop rainwater harvesting systems were their actual physical condition, functionality, usage, and quality of the stored rainwater.

Depletion of groundwater of the last few decades has led to a serious problem of scarcity of drinking water in parts of the country. In these areas, application of standard technologies for extracting and delivering drinking water have become difficult and expensive, while the quality of the extracted water is often poor. In this situation, the development of alternative sources of drinking water has become important.

Although the scale of the problem varies by hydro-geological area, the raison d'être for investing in alternative sources of drinking water emerges from the following facts:

- About 10 per cent of rural habitations are small, remote or in water-scarce regions. Conventional ways of supplying drinking water to such habitations are often difficult and expensive.
- The extraction of groundwater for agriculture, industry and urban needs has led to a lowering of the groundwater table in many areas.
- Groundwater as well as surface water sources often have water quality problems such as high levels of chemicals (iron, fluoride, arsenic, nitrates) and faecal contamination.

Rainwater harvesting is one of the alternative technologies for delivering drinking water. In fact, through the ages, this has been a traditional way of enhancing domestic water supply. Rainwater harvesting systems are viable options both for storing water for domestic use and for recharging groundwater aquifers.

Rooftop rainwater harvesting (RRH) enables individual households and communities to collect and store rainwater from their rooftops for future use. Generally, the runoff from hard-surface roofs is collected as this water is relatively free of bacteriological contamination. This is then channelled via a gutter and a drainpipe to a storage container. To prevent leaves and other debris from entering the tank, mesh filters are installed at the mouth of the drainpipe. Further, a first-flush device should be set up in the conduit before it connects to the storage tank. This ensures that the runoff from the first rains of the season does not enter the storage tank and contaminate it.

RRH systems have the following advantages for households:

- The convenience of having water for drinking and cooking at the doorstep, at least for part of the year.
- Better quality water, as compared to water from other sources.

Between 1996 and 1999, the Government of India and UNICEF's Child Environment programme promoted RRH for domestic water supply in Kerala, Maharashtra and Uttar Pradesh. The UNICEF support was aimed at helping about 1,000 households in water-stressed areas to have their own RRH system.

Water harvesting structure, Sonabhadra district, UP

To assess the achievements of this project, UNICEF commissioned Operations Research Group's Centre for Social Research in 2000 to conduct a sample study in each of the three states.

Objectives

The primary objective of the study was to review different aspects of the project, in both qualitative and quantitative terms. The following aspects were studied:

- The physical status of the RRH system.
- The beneficiary's use of the RRH system.
- The contribution of households in the project.
- The practices for maintenance and repair of the RRH system.
- The practice of water budgeting among the user households.
- The opinions of various project stakeholders and the factors affecting the sustainability of the RRH system.

Methodology

A combination of quantitative and qualitative research techniques were adopted for the study:

- Quantitative tools included structured questionnaires, which were administered to various village respondents, including user households, trained masons and the village sarpanch.
- Qualitative techniques involved in-depth interviews with stakeholders regarding various aspects of the project at the state, district and block levels. Focused group discussions were conducted in villages to assess the benefits as perceived by the participating households.

As per the terms of reference of the study, 20 per cent of all completed structures formed the sample size. Out of 1,251 completed structures, 253 structures in the three states were surveyed– 124 in Uttar Pradesh, 103 in Maharashtra and 26 in Kerala.

The structures to be surveyed in each district were selected by generating a random sample of households from a list of total user households from each district. In Maharashtra, however, this was not possible and sampling of the project villages was done using the "probability proportional to size" technique.

In Uttar Pradesh, the field study was carried out in November and December 2000, whereas in both Kerala and Maharashtra, the fieldwork was done in April and May 2000.

Analysis and key findings

Physical assessment

The functionality and reliability of an RRH system in providing safe drinking water depends to a large extent on the technical soundness of its various components. The study team undertook a technical assessment of the physical status of each system.

Roof

In all the states surveyed, the roofs of the houses were mostly unpainted and largely unclean. However, the practices for cleaning roofs differed across the states. For instance, only 29 per cent of the sample households in Uttar Pradesh cleaned their roofs while the corresponding figure for Kerala was 61 per cent.

Storage tanks

Although the tanks were designed as per the specifications of the project, there were many cases of leakage, breakage and cracks. To analyse these problems the evaluators conducted a structural review of the tanks and also queried the beneficiaries about performance.

As shown in Table 1, the systems in Kerala were generally in good condition, with top covers and first-flush devices in place and very few instances of any breakage of or leakage from the tanks.

Storage tank surroundings

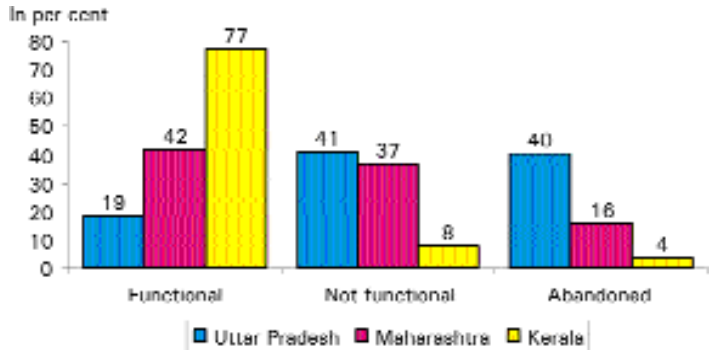
In Uttar Pradesh, the areas surrounding the tanks were generally dirty (86 per cent); many had garbage dumps (78 per cent) nearby. In some places, livestockwas being tied to the tanks. In

Table 1: Physical condition of the storage tanks (%)

	Uttar Pradesh	Maharashtra	Kerala
Top cover in place	78	79	100
First-flush device present	80	71	100
Presence of cracks	18	44	23
Report of leakages	34	54	8
Breakage of tank	40	26	8
Flaking of outer surface	2	12	4

Source: Rooftop Rainwater Harvesting Study, 2000

Figure 1: Status of RRH systems



Source: Rooftop Rainwater Harvesting Study, 2000

Maharashtra, 42 per cent of the tanks had dirty surroundings, 26 per cent had garbage dumps nearby and 21 per cent had cattle tied to them. In Kerala, in contrast to the other states, the surroundings of most of the tanks were clean (69 per cent) and free from garbage (81 per cent).

Functional status of RRH systems

The survey found that the key variables for functionality were proper construction and maintenance of the storage tanks. There were variations across the states, with the functionality ranging from 19 per cent in Uttar Pradesh to 77 per cent in Kerala (Figure 1).

Use of stored rainwater

Stored rainwater was primarily meant for cooking and drinking. However, the respondents informed that the stored water was also used for other household purposes. It is evident from Figure 2 that in both Uttar Pradesh and Maharashtra, the collected rainwater was used primarily for household chores other than cooking and drinking. In Kerala, on the other hand, households were using the collected rainwater primarily for drinking and cooking.

Water budgeting

Different stakeholders, like village leaders, participating NGOs, UNICEF and state water supply agency staff, advised the user households on the need to budget and ration the use of stored water. The study revealed that the percentage of user households following water budgeting was extremely low in all states.

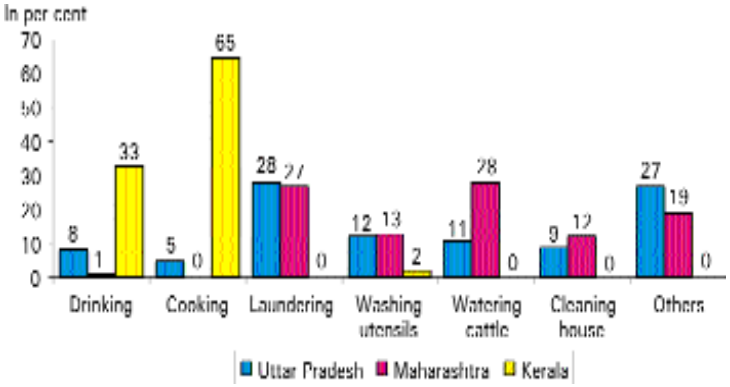
While Kerala performed well on most parameters, there was not a single household practising water budgeting. This may be due to the fact that the dry season in Kerala is comparatively short, and water budgeting, therefore, is less important.

Management and maintenance

As an RRH system is an individual household asset, its operation and maintenance was the sole responsibility of the user households. Proper maintenance of the roof catchment, first-flush devices, screens, overflow pipes and storage tanks was critical to ensure collection of clean water.

An analysis of the three states revealed that the households were not maintaining their systems properly. It was found that while some parts of the system were regularly checked, others were neglected. This trend was more pronounced in Uttar Pradesh and Maharashtra than in Kerala. The study found that this lack of maintenance was largely due to the absence of a demand-driven approach and the inadequate ability of the implementing agencies to mobilise households.

Figure 2: Use of stored rainwater



Source: Rooftop Rainwater Harvesting Study, 2000

Quality of stored water

The survey teams collected water samples from 10 per cent of the functional tanks which held water at the time of the visit. These samples were checked on the spot for bacteriological contamination (H_2S test). In addition, 10 per cent of the samples were tested at a laboratory for determining the type of bacteriological organism present in the water.

The H_2S tests confirmed that almost all the samples were contaminated (Table 2). This implied that the water stored in the tanks was unsafe for drinking. This also corroborated the perception of stakeholders in Uttar Pradesh and Maharashtra that the harvested rainwater was not potable.

Stakeholder participation

Technical soundness of the RRH system

Perceptions of the performance of the RRH system were limited to the stakeholders' view of the storage tank. The study found that most of the stakeholders doubted that the tanks would be able to retain water over long periods due to cracks and leakages in them.

Willingness to contribute

Figure 3 shows that the willingness to contribute towards the RRH systems was low in Uttar Pradesh and Maharashtra, while in Kerala the willingness to contribute was quite high, in terms of both labour and cash. This may be a significant factor in explaining the differences in success seen across the states.

Recommendations

Before the project, households in these areas reported water shortages mainly in the dry months from March to May. In the post-project phase the situation improved dramatically for the user households in Kerala. However, most of the households in Uttar Pradesh and Maharashtra still reported water shortage in the dry months. This was mostly because:

- In both Uttar Pradesh and Maharashtra, there was an attitudinal barrier against drinking water that had been stored for a long time. Therefore, most of the water collected during the monsoon months was used immediately and thus there was no water was available in the tanks during the summer months when the need was greatest.
- Kerala, on the other hand, has good rains spread throughout the year, except for the dry months of April and May. As a result, even during these peak summer months, almost 60 per cent of the user households were found to be using stored tank water.

Table 2: Tests for bacteriological contamination

Tests done	Cases found unacceptable (%)		
	Uttar Pradesh	Maharashtra	Kerala
H_2S	71	94	75
MPN (Coliform)	92	85	80

Source: Rooftop Rainwater Harvesting Study, 2000

Some recommendations that emerge from the study are:

Project approach and implementation

This study revealed that the indifferent implementation of the project in Uttar Pradesh and Maharashtra was partly responsible for the failure of the RRH projects there. One of the possible reasons for this was the involvement of multiple agencies resulting in uncoordinated execution, lack of accountability and an increase in overheads. In addition, the projects also lacked a demand-responsive, community-managed and household-managed approach.

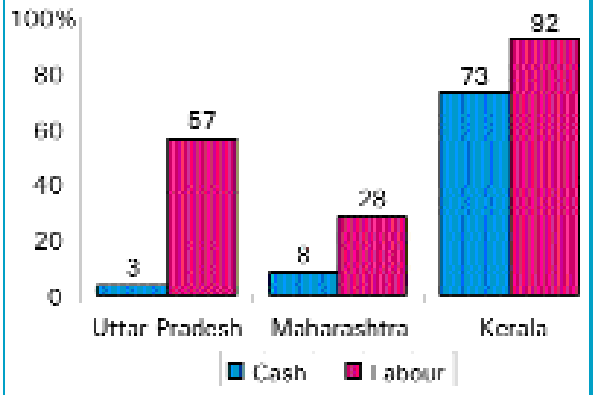
Recommendation 1

There is a need for greater coordination among the agencies involved. For better project outcomes, a demand-responsive, community-managed and household-managed approach (including cost-sharing) is needed.

Dry season water availability and use

If dry season water availability is considered as a key indicator of the success of the RRH projects, only the project in Kerala succeeded. In other

Figure 3: Contribution of user households



Source: Rooftop Rainwater Harvesting Study, 2000

states, strong attitudinal barriers against drinking stored water; measurably low quality of stored water; and the near-total absence of water budgeting, led to the failure of the project.

Recommendation 2

Construction quality must be ensured and, more significantly, the project must focus on informing the users on critical issues such as household water budgeting and water quality management. Third-party quality control is essential for a demonstration project to be successful.

Maintenance functions

The evaluation study showed that the users do not regard maintenance of the RRH system as their responsibility. As a result, maintenance of the systems was generally poor, especially in Uttar Pradesh and Maharashtra.

Recommendation 3

Households that invest their own resources in the construction of RRH systems are more likely to feel ownership, which would enhance maintainenance of their RRH systems. The project should impart proper training on operation, maintenance and repair of the system. ■

Note: This summary is based on an evaluation study by ORG for UNICEF. For further details please refer to the study document "Evaluation of Rooftop Rainwater Harvesting Project" available with Water, Environment and Sanitation Section, UNICEF, 73 Lodi Estate, New Delhi 110 003, India.