Roof top rain water harvesting in remote rural schools: an approach for global replication

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Abstract

The traditional practice of collecting rainwater where it falls has been revived to provide inexpensive drinking water for thousands of people. Rainwater harvesting has been carried out for generations in many areas around the world, including Colombia in South America, the Atlas Mountains in North Africa, the Himalayas and the deserts of Rajasthan in Asia and the remote Pacific island of Fiji.

Rural communities have the traditional skills and technical competence to collect rainwater. As they often cannot wait for Government action, a practical solution is that they come together to contribute labour and materials to construct their own rainwater harvesting structures. In the process, they collectively decide how much they are prepared to pay for the water that will be under their own ownership and management.

The innovative aspect of the Barefoot College rooftop rainwater harvesting programme is the application of a centuries-old technology to benefit whole communities in schools, dispensaries and other public places so that everyone, including men, women and children from both rich and poor families and different castes have access to drinking water from a single source.

During the 20 years during which this project has been implemented more than 550 rooftop rainwater collection systems have been constructed and it has been repeatedly demonstrated that, especially in drought prone areas or where the groundwater is saline, rooftop rainwater harvesting is the only sustainable alternative for ensuring continued access to safe drinking water.

Introduction

To provide drinking water for village communities, the primary choice for water planners and engineers in much of India is to install hand pumps for the exploitation of groundwater. Where this is not possible, the second preference is for piped water supply schemes sometimes from a source hundreds of miles away. Many companies provide the technical support to implement such projects, including gathering and interpreting information from satellites, manufacturing pipes, pumps and desalination plants and providing other accessories. This is an expensive process. Basically, as far as engineers are concerned, the provision of drinking water has always been considered a technical problem.

However, to poor rural communities, the provision of and access to safe drinking water is a social problem. No longer can remote rural schools wait for Government engineers to provide them with drinking water. The provision of hand pumps and piped water supply systems have failed to work and alternatives need to be found. Rooftop rainwater harvesting is a viable alternative.

Rooftop rainwater harvesting is a traditional practice that dates back hundreds of years, is relatively cheap to implement and is usually ignored by engineers. The technique is particularly relevant in arid areas, mountainous areas where rainwater would otherwise flow rapidly away, or areas where the groundwater is saline. Indeed, owing to the unsustainable extraction of groundwater, mainly for irrigating crops, many areas of India are suffering from increased groundwater salinity.

Problems with the increasing salinity of groundwater can also be mitigated by harvesting rainwater. In this case, run-off water from large areas of land can be collected and channelled into deep, specially constructed wells so that the rainwater flows directly into the aquifer. In this way, millions of litres of rainwater can quickly percolate into the ground instead of being allowed to evaporate and wasted.

Alternatively, ponds can be created that allow the collected rainwater to seep slowly through the rock layers to the aquifer.

Why rainwater harvesting?

- because water should never be wasted and allowed to flow out of any village or community facing a shortage of drinking water;
- because it costs less to collect rainwater than to exploit groundwater;
- because collecting rainwater is the only way of recharging the water sources and revitalising dry wells and hand pumps;
- because it provides an opportunity for communities to work together and manage their own water resources as well as productive employment for the rural poor in their own villages:
- because traditional knowledge, skills and materials can be used to collect water and no technical assistance is required from the Government for the repair and maintenance of the system.

Description

Rooftop rainwater harvesting involves linking together roofs via a network of pipes so that any rainwater falling on the surfaces is channeled into a central cistern, typically built underground, perhaps in the centre of a compound. The first rains of the season are used to flush dust from the rooftops and silt from the cistern. Thereafter, the rainwater is collected and stored. If needed, a chemical treatment such as chlorination can be used to purify the water, but this is not always necessary. Efficiently used, enough water can be collected in this way to last the whole year.

Ideally, the construction of rainwater harvesting structures should start four months before the start of the rainy season. Alternatives include building a rainwater harvesting structure in a school or community centre; deepening the village tank to collect and store more rainwater;channelling surface water into open wells to allow the water to percolate into the ground; and in mountainous areas, carving out the hillside for the collection of rainwater.

The Barefoot College (formerly known as the Social Work and Research Centre, SWRC) began its rooftop rainwater harvesting programme almost 20 years ago and, to date, 552 collection systems have been built.

The methodology employed by the college is to train architects and craftsmen, many of which may be illiterate, in the construction techniques. These people then become known as "barefoot water engineers".

The training is carried out by a collective of 20 to 25 people, including 5 to 8 women, who are SWRC programme and administrative coordinators and coordinators of village-level field centres set up by SWRC. Each member of the collective has spent some 12 to 16 years developing the programme and constructing roof top rainwater harvesting structures, mainly in rural schools and community centres.

In total, there are seven field centres, each of which works with 20 to 30 neighbouring villages. The critical role of the members of the collective includes:

- **organizing** meetings in villages where rural communities have submitted written requests for assistance with building rainwater harvesting tanks. During these meetings, sites are selected. If the proposed land belonged to a private party, the title of the land must be surrendered to the village by the owner so that it becomes common property.
- **creating** Village Water Committees (VWCs) comprising an equal number of men and women;
- **opening** bank accounts to be jointly operated by one man and one woman member of the VWCs;
- **training** VWC members in simple book- and record-keeping;
- **selecting** the sites for the construction of the rainwater harvesting tanks and, with the help of barefoot architects and VWC members, designing the dimensions of the tanks;
- **monitoring** the implementation process with rural communities; and

- **handing** over the operation of the rainwater harvesting tanks once they have become operational and a social audit has taken place.

A **social audi**t is a village meeting during which all the accounts are displayed for open scrutiny. All villagers have the opportunity to raise queries related to construction expenses. Once approved by the meeting, the rooftop rainwater harvesting structure is formally handed over to the villagers managed by the VWCs.

As described above, as well as support from national and international donors, local villagers greatly contribute to the construction of rainwater harvesting systems. Among the villagers, those that are able make direct cash contributions. If this is not possible, villagers give two days in a month voluntary labour towards the work involved in the construction of the system. Together, such local inputs contribute about 10 per cent of the total construction costs. In addition, wherever possible, local materials such as bricks, cement, gravel, limestone, sand, stone slabs and hand pumps are used to construct the systems.

Keeping records of these inputs, and indeed much of the success of the whole Barefoot College rooftop rainwater harvesting programme, relies heavily on the VWCs. In villages where rainwater harvesting structures are to be constructed, VWC members are responsible for selecting supervisors to be trained as "barefoot managers". These supervisors are responsible for overseeing the work being undertaken and also for keeping a record of the number of people working at the site. The Barefoot College organizes three-day workshops for the barefoot managers to train them in the allotment and measurement of work, the maintenance of muster rolls and labour cards, the disbursement of wages and financial record keeping. VWC members are also responsible for inviting tenders for the purchase of construction materials, approving the design of the system developed by barefoot architects, and finally giving a written guarantee of its longevity and durability.

Once work the work is complete, two tankers of water are emptied into the tank so that it can start functioning immediately. This water should last for 6 to 8 months. Subsequently, if the tanks need replenishing once more, the VWCs have the responsibility of ordering a fresh tanker consignment.

Costs

The Barefoot College works with poor communities. By 2004, it had helped install more than 550 rainwater harvesting tanks that had been constructed by the local communities.
Community contributions are through cash, if possible, or voluntary labour, usually two days a month. Together, these inputs account for about 10 per cent of the cost of building a rooftop rainwater harvesting system.

The process of installing and maintaining the rainwater harvesting structures has the built-in innovative component of being community managed through the formation of Village Water Committees (VWCs). Other community partners included labourers, schoolteachers, community elders and the headperson of the village council or panchayat.

To date, inputs of this kind are estimated to value more than US$1 million. Other contributions have been received from the German Agro Action (50 per cent), Plan International (35 per cent), the Ministry of Water Resources, Government of India (10 per cent), the Rajiv Gandhi Drinking Water Technology Mission, Government of India (2 per cent), the Georg Fischer Foundation, Switzerland (3 per cent) and the Smita Suchde Foundation (2 per cent). Together, these contributions total almost US$1 million.

Sikkim as an example

Previously, water management in the mountainous State of Sikkim, a drought prone region, involved allowing rainwater to flow down to the rivers in the valleys below and then install heavy-duty pumps to pump the water all the way back up the mountain through a series of pipes to provide drinking water to isolated rural communities.

When it was suggested to the Chief Minister of Sikkim that schoolchildren could be provided with safe drinking water using the school buildings themselves to harvest rainwater, the State's Chief Engineer considered the proposal technically impossible.
Using local "barefoot architects", locally available building materials and the traditional knowledge and skills available in the villagers of Sikkim, the first rooftop rainwater harvesting tank was constructed in the village of Sadam, located on a mountain peak south Sikkim. The tank, which has a capacity of 160,000 litres, was constructed in six months.

On completion, Barefoot College staff went back to the Chief Minister of Sikkim and asked him to come and inaugurate the system. He was surprised and delighted and agreed to bring his Chief Engineer along to show him what he had declared was technically impossible.

As a result of this visit, the Chief Minister changed the whole policy of the Government of Sikkim. He immediately sanctioned the construction of 40 more rooftop rainwater harvesting tanks and approved funds for rainwater harvesting in three schools.

Public-Private-People Partnership

The Georg Fischer Clean Water Campaign, based in Schaffhausen, Switzerland, has since offered to support the construction of rainwater harvesting structures in 50 more rural schools during 2004 and 2005 in Sikkim. The project, which depends on matching funds from the State Government, is the first ever public-private partnership to install rooftop rainwater harvesting systems in schools in India.

Replicability

The simple approach of a village community constructing its own rooftop rainwater harvesting structure using local materials and skills has been replicated in nearly 400 villages across India.

Furthermore, the Barefoot College has recently begun a collaborative programme to disseminate the technology in other countries. As a start, the College established the Global Rain Water Harvesting Collective (GRWHC) registered in both Jaipur, Rajasthan, India, and in the Netherlands.

At the World Summit on Sustainable Development held in Johannesburg, South Africa, in 2002, 144 organizations from 44 countries mandated GRWHC implement rooftop rainwater harvesting as a priority. They also endorsed the idea of developing long-term partnerships with as many interested stakeholders as possible.

One aim of the GRWHC programme is to increase the volume of collection tanks in regions where they are already in use so that less rainwater is wasted. Where 200 litres are currently being collected, it should be possible to collect 20,000 or even 200,000 litres since the communities in these areas are already aware of the importance of collecting rainwater for drinking water purposes.

Partnerships

Among this growing list of partners are:
Governments: the Government of Ethiopia, the Government of Nepal, the Government of Senegal and the Government of India (Central Ground Water Board, Development of North Eastern Region, Ministry of Rural Development, Ministry of Water Resources, Ministry of Tribal Welfare, and the State Government of Sikkim)

International community: the United Nations Development Programe (UNDP), India, through its Community Water Initiative and the United Nations Environment Programme (UNEP), Geneva, Switzerland.

Other **major organizations**: Austria: the Sunshine Fellowship Foundation; Canada: Engineers Without Borders and the International Secretariat for Water; Germany: Earth 3000, Berlin and German Agro Action; the Netherlands: Gender Water Alliance and Plan Nederland; Norway: NORAGRIC and

Norwegian Church Aid; Switzerland: the Clean Water Campaign of the Georg Fischer Foundation, the Schwab Foundation for Social Entreprenuership, the UBS Foundation, the Water Supply Sanitation Collaborative Council and the World Economic Forum; U.K.: the Fresh Water Action Network, the International Business Leaders Forum, the Saintsbury Foundation, Water Aid and the World Technology Network.

Scaling Up (Advocacy, Networking and Outreaching)

In 2003 in the Year of Freshwater ,at the National level, the Ministry of Water Resources of the Government of India allocated some US$275,000 to be used to build rooftop rainwater harvesting structures in 100 remote rural schools that were facing acute shortages of drinking water. The structures are designed to hold between 30,000 and 50,000 litres of drinking water and, included in the budget are two low-cost toilets for girls.

Twenty grass-root organizations completed the project in 13 Indian States.(a 6 min video film is available on a CD).

In December 2004 nearly 30 prominent CEOs from the Corporate Sector were invited to a Water Workshop in Clarence House London and in the presence of the Prince of Wales there was a discussion on how best to scale up the issue of roof top rain water harvesting in schools for drinking water and sanitation not only in India but also on a global scale. One of the decisions endorsed by the group –with the Prince of Wales as the patron-was the establishment of the first partnership of its kind between the Global Rain Water Harvesting Collective and the Prince of Wales Business Leaders Forum(see www.globalrainwaterharvesting.org) to promote roof top rain water harvesting in schools and ground water recharge. The CEO of The Skoll Foundation was present at the meeting.

In January 2005 at a Workshop organized in Oxford jointly by UNICEF and DGIS (Netherlands) the issue of roof top rain water harvesting in remote rural schools to collect water for drinking and sanitation was endorsed as one of the recommendations and one of the outcomes was a possible Memorandum of Understanding between UNICEF and the Global Rain Water Harvesting Collective to collaborate in Mozambique, Sudan and Ethiopia.

In January 2005 the issue of roof top rain water harvesting in schools was the topic as part of Corporate Social Responsibility (CSR) in one breakfast meeting in the World Economic Forum at Davos. The meeting was convened by the Chairman and CEO of Nestle, Switzerland. Several CEOs at the end of the presentation insisted on more information and their desire to keep in touch.

In 2005 because of the successful completion of the project the Ministry of Water resources has approved another $ 450,000 for the coverage of 179 schools in 15 Indian States across the country to be completed by September 2005. An additional 300 remote rural schools will be covered in the Second Phase between October 2005 and March 2006.

In February 2005 the Skoll Foundation approved a 3 year grant of $ 615,000 to promote roof top rain water harvesting in 30 schools in some of the poorest countries of the world according to the UNDP HDI. The countries identified are Sierra Leone, Senegal,
Ethiopia, Afganistan and Bhutan.

Many national governments and international organizations are now partnering the Global Rain Water Harvesting Collective (GRWHC, see "Replicability" below) in a growing, worldwide effort to promote the use of roof top rainwater harvesting technologies.

Learning by Doing

The Barefoot College and the Global Rain Water Harvesting Collective (GRWHC) are strong believers in the process of **Learning By Doing**.

The Water World is full of too many Generals and very few soldiers and water warriors on the ground. Too many Conferences, Seminars and Workshops producing a proliferation of non-implementable recommendations and Action Plans leading to nowhere. Global Declarations have just resulted in millions of dollars being spent on travel, per diems, tons of paper being wasted and creation of more jobs to push paper. The first and only casualties are the often quoted 1 billion people with no access to drinking water and sanitation. Their status remains the same. "The more it changes, the more it remains the same".

We believe making sophisticated Teaching Aids in English on glossy paper is a waste of money because the rural poor are certainly not going to read these manuals. They have been produced for the converted and for a limited audience. Such unsolicited material reach the library of the Barefoot College in the hundreds. They are actually trashed and made into glove puppets.

It is time poor communities learnt from other poor communities. It is time South-South Partnerships dealing with the exchange of traditional knowledge and practical skills are facilitated and there is less dependence on urban paper qualified "experts" who have little or no knowledge of rural realities and the urgency that is missing in their deliberations.

Semi-literate and illiterate rural men and women have come to the Barefoot College Tilonia Rajasthan India to construct roof top rain water harvesting structures in schools with their hands and go back to Sierra Leone, Ethiopia, Senegal and Nepal to put into practice what they have learnt.

Today there are 10 poor rural semi-literate men and women from Afganistan and 17 from Ethiopia in the Barefoot College learning how to construct a 40,000 rain water harvesting tanks. This knowledge and experience they will take back and replicate in the schools in their own remote villages.

Sustainability

This is a Case Study demonstrating the amazing traditional skills of barefoot architects in the desert of Rajasthan in India. Even today rural communities in the deserts construct their own rain water harvesting tanks in schools.

Barmer district is situated in the Thar Desert which falls under the Western part of Rajasthan. Land here is sandy and the weather dry. During summer months the day temperatures rise up very high and often accompanied with hot dusty storms. The area experiences acute problems of drinking water. There is very little rainfall during the monsoons. The groundwater table levels in this region run very deep and with scanty rainfall open dugwells used for drinking water are at a depth of 350ft.

These dugwells are situated at a distance of 3-5 kilometres away from the village(s) and hamlet(s) making the rural population fetch drinking water through their camel and mule carts.

As this area is desert terrain, stone slabs are not available. The rural communities use thatch and shrubs to build their huts which are locally called Jhoopas. Every household lives in such huts which reflects the rural lifestyle here.

This part of Rajasthan records very little rainfall and when it does rain, the sandy soil because of the desert land absorbs the rainwater completely. Thus the rainwater neither flows through or is collected. How can each single drop of this rainwater be saved to enable the rural population to access drinking water. For this the communities use their traditional knowledge and methods in constructing tankas to collect rainwater for drinking. There exist only a few amongst them here who possess the traditional knowledge of constructing tankas in the sandy soil of this desert region and they use all their knowledge and methods with ingenuity and alacrity in carrying out their occupation.

The site(s) selection of tanka(s) construction is done through a public meeting organised in the village(s) where they choose those which are located in public buildings. Such sites where each of its citizen have a right over it. The emphasis on public buildings being chosen as sites for the tanka construction is borne out of the fact that the common person could use them and the entire village community access water.

For tanka construction they dig the land to dimensions of 10-12 ft in circumference and at a depth of 15 ft. It is an extremely hazardous task for those involved in digging since the soil rendered sandy due to the desert terrain poses every risk to lives of the persons while digging where they could get buried underneath in case the loose sandy soil caves in. Digging operations during the tanka construction therefore is carried out with caution and utmost safeguard. Avoiding risk to lives while digging and getting the right measurements and dimensions of the tankas that are to be evenly dug can only be carried out by specially skilled persons having the traditional knowledge.

During digging operations of tankas the soil that is dug caves in due to its sandy nature causing the dug portions to be filled again. Casting of ferro-cement is therefore undertaken along with the digging operations and cylindrical ferro-cement castings are lowered for plastering according to the dimensions of the tanka. Once done further digging operations along with the lowering of ferro-cement castings are then undertaken. This avoids the caving in of the dug soil and at the same time facilitates the plastering of tankas. Tankas are constructed cylindrically in this region. They cannot be constructed in rectangular dimensions due to the nature of its soil. Tanka construction is carried out only by those skilled persons having the traditional knowledge to make them. This knowledge and methods have been learnt and passed on to them traditionally for generations.

With the castings done plastering of tankas take place wherein after the first casting is allowed to dry, the second casting is plastered and then the plaster continues to get lowered as the tanka gets further deepened. Dimensions of the tankas are only upto a depth of 15ft and a circumference of 12ft. The cement keeps getting into a cast and the task of making cylindrical casts for tankas are completed in 20-25 days. As the upper portion of the tankas have to be covered with stone-slabs, its length can only be upto 12ft because longer ones can cause problem of it breaking.

After plastering of the tankas are completed the bottom portion of the tankas are also plastered as well, so that the casts are able to fit properly and ensuring that there are no leakages.

Stone slabs are used to cover the upper portions of tankas. As the tankas are cylindrical in dimension placing the stone-slabs also require its own skill by which these persons cover the tankas with slabs.

In this desert region, the rainwater gets absorbed into the sandy soil, so much so the rainwater neither flows through nor can get collected. A catchment area with a dimension of 25 to 30 ft in circumference is cemented around tankas to collect the rainwater. A filter trough is also made alongside the tankas for collecting rainwater.

To avoid dust, pollutants and other waste material getting into the tankas and to prevent its misuse, handpumps are fitted on to the tankas for optimising its use. To facilitate cross-ventilation and the air to flow freely, tankas are wire-meshed and covered with lids. The catchments area is safeguarded by putting up thorny shrubs all around it, to avoid damages caused by cattle. Masons constructing these

tankas reside in this region who possess the requisite knowledge about the soil and of constructing tankas. This knowledge has been learnt and passed on to them for generations. These persons have received no formal training whatsoever from anywhere.

Impact

During the 20 years that the programme has been running, poor rural communities have been able to preserve, encourage and promote the building skills of more than 1,250 barefoot architects, including women. In addition, building the rooftop rainwater harvesting systems has provided gainful employment to more than 20,000 other villagers. In total, rooftop rainwater harvesting has benefited nearly 200,000 people in 18 Indian States.

In Rajasthan, the employment generated and wages provided (60 Indian rupees or US$1.50 a day for 90 days, even in years of drought) has helped reduce the exodus of local workers to towns and cities in search of labour.

In addition, through these community-managed initiatives, the Barefoot College has been able to collect some 22 million litres of rainwater a year from the roofs of 596 rural schools and community centres in 492 villages. This has assured access to drinking water for five months of the year. Water tankers replenish the cisterns during rest of the year.

The impact on women and children has also been considerable. Not only have the VWCs brought rural women into the mainstream decision making processes but, as a result of safe drinking water being made available at schools, the attendance of girls attending school has increased substantially.

Many rural communities now understand that the collection of rainwater for drinking in schools is one way of bringing communities closer together. It enhances the bonds of solidarity between different castes and communities, and between rich and poor families because no member of any village community will object to collecting rainwater if it ultimately benefits woman and children.

Lessons learnt

Among the lessons learned during the 20 years of encouraging and applying traditional rooftop rainwater harvesting techniques in schools are:

collecting rainwater where it falls on roofs is the most inexpensive method for providing drinking water to remote villages anywhere in the world;

traditional knowledge and skills to construct these rainwater harvesting tanks exists in every village around the world; and for the cost of one "down-the-hole" drilling rig it is possible to collect 15 million litres of rainwater in over 100 communities and provide employment to 1000 people for 4 months.

Future plans

The ultimate aim of the Barefoot College and GRWHC is to make rooftop rainwater harvesting in schools and health centres a global movement. It can achieve this by sensitizing donors, engineers, planners, and policy-makers, making them aware of the urgent need for and cost effectiveness of rooftop rainwater harvesting at as many national and international forums as possible.

Very slowly, it has been possible to observe a change in the mindset of water engineers. The Barefoot College also aims to facilitate more interaction between the water engineers and community-based barefoot engineers so that they come to respect each other’s points of view.