Rainwater harvesting in rural India – *taankas* in the Thar Desert

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Traditional catchment rainwater harvesting structures are used in India to store domestic drinking water between monsoons. Does the value of the water they store justify their building costs, and how efficient are they?

Rainwater harvesting systems collect, store and conserve local surface runoff and have an important role to play in improving access to water resources and meeting development objectives. India has an extensive history concerning the utilization of diverse rainwater harvesting systems and much to offer the global community. Rainwater harvesting remains prolific throughout India and there are many opportunities to improve these systems and further increase access to water resources.

The *taanka* system

Rainwater harvesting has undergone a resurgence of popularity with the development community for the provision of an affordable and dispersed water supply. The *taanka* is a rainwater harvesting system that has proliferated throughout the Thar Desert over the last two decades, championed as the most effective means of providing domestic water supply in this arid environment without access to groundwater resources.

The *taanka* system is composed of two main and interlinked components: a catchment area and storage tank. The catchment area may be a ground surface, rooftop or courtyard. When a ground surface is used as the catchment, it may be either natural or artificially prepared to improve its ability to capture rainfall. The storage tank is commonly 3–4 m in diameter and 4–5 m deep, capable of holding approximately 25,000–50,000 litres, theoretically enough to last the average family 4–8 months. These systems are heavily dependent on rainfall variability and catchment efficiency.

Taanka monitoring programme

Wells for India (WfI) began a *Taanka* Monitoring Programme in 2001 with Indian partner agency GRAVIS to measure *taanka* performance and to realize opportunities for improvement. In 2004 data were collected from 21 *taankas* in the Pabupura cluster of seven villages and from 12 *taankas* in Bhalu Rajwan village.

Bhalu Rajwan village is located in Shergarh tehsil of Jodhpur District, approximately 100 kilometers north-west of Jodhpur. It has an average annual rainfall of 250 mm, with a high inter-annual variability (50 per cent). The village is 20.8 square kilometres in area with a population of 1,786 distributed amongst 268 households. Drinking water facilities are relatively good for the region; the village has a well, a pond and hand pumps. However, women still have to walk 1 to 5 kilometers to obtain drinking water.

Pabupura cluster is composed of seven villages located in a very remote area of Baap Block, 50 km outside Phalodi. The villages cover 243 square kilometres and include 105 scattered hamlets, 1,269 households and 9,086 people. Water availability is very poor; camel-drawn tankers often have to wait over three days to access water.

Four rain gauges were evenly distributed across Bhalu Rajwan and one rain gauge was installed in each village in the Pabupura Cluster. Three *taankas*, located within 500 m of a rain gauge, were selected to correspond with each rain gauge in the programme.

Camels pulling water tanks are a common sight in the Thar Desert

Key results

Volume calculations. Daily measurement of water depth enabled increases in *taanka* storage volume to be calculate. Each time an increase in *taanka* water volume was discovered it was cross-checked with the rainfall data and records of purchased water to determine the source of the addition. This procedure enabled a careful approximation of both the volume and the percentage of water received from rainfall to be made (see Figure 1).

	Bhalu Rajwan	Pabupura Cluster
People Days	1,274	1,379
Animal Days	1,059	1,556
Total Consumption (Litres)	38,125	27,325
Human Consumption (Litres)	34,948	22,657
Animal Consumption (Litres)	3,177	4,668
Total Daily Consumption (Litres/Day)	23.54	10.75
Human Daily Consumption (Litres/Day)	33.51	19.98

Figure 1

Box 1: Camel tankers

Camels pulling water tanks are a common sight in the Thar Desert. The ability to store water purchased from a camel tanker also highlights another benefit of *taankas*. However, the main purpose of this study was ultimately to increase the ability of *taankas* to harvest rainfall.

To quantify effectively the value derived from rainfall the cost of water from a camel tanker was used as a standard for comparison. A tanker of water in Pabupura costs between Rs450 and 800 for 4,500 litres of water, depending on the distance travelled and availability of water. In Bhalu Rajwan, where water is more readily available, a tanker of water ranges from Rs350–450. Therefore an average cost of Rs0.10/litre was used to value rainfall in this study (though in the case of Pabupura this is a cautious underestimate).

Valuing rainfall. Using an average cost of Rs0.10 per litre (see Box 1), *taankas* in the Pabupura cluster saved approximately Rs506 by means of rainfall harvesting, while *taankas* in Bhalu Rajwan saved Rs1,337 rupees during the period of study, as shown in Figure 2. These savings may be extrapolated to an annual amount of Rs1,012 per *taanka* in the Pabupura Cluster and 2,674 rupees per *taanka* in Bhalu Rajwan.

Taankas cost approximately Rs11,910 to construct and their life span is approximately 10 to 15 years. For this cost and life span, a *taanka* must achieve savings of approximately 800 rupees per year to make construction costs worthwhile. The average *taanka* in Pabupura Cluster is recovering costs within 12 years. All of the *taankas* in Bhalu Rajwan have obtained sufficient value from rainfall harvesting to recover their construction costs within five years.

Indirect benefits of the *taankas* include savings in women's time.

	Bhalu Rajwan	Pabupura Cluster
Volume Received (Litres)	37,670	26,375
Percent Rainfall	37%	17%
Percent Purchased	63%	83%
Volume Rainfall (Litres)	13,371	4,581
Volume Purchased (Litres)	24,299	21,793
Value of Rainfall (Rupees)	1,337	506

Figure 2

Additionally, *taankas* provide many indirect benefits that are much more difficult to quantify, such as significant savings of time (especially important for women), improvements in sanitation and health, increased self-reliance and standard of living of the rural poor and opportunities to store water. When these indirect benefits are taken into account it is clear that *taankas* are worthwhile investments.

Efficiency data

The efficiency of the *taanka* catchment to transfer rainfall into the storage tank is an important factor to consider when determining the amount of water harvestable. The catchment efficiency was calculated by determining the theoretical maximum amount of water that could have been harvested if 100 per cent of the rainfall entering the catchment area had entered the storage tank. The actual amount of rain that was harvested was compared with the theoretical maximum for a measure of harvesting efficiency.

The catchment areas in the Pabupura cluster are larger than those in Bhalu Rajwan, where land is more valuable. Despite large catchment areas, *taankas* in the Pabupura Cluster did not harvest as much rain as those in Bhalu Rajwan (they were not as efficient per unit area). The harvesting efficiency for the Pabupura Cluster is 12 per cent while for Bhalu Rajwan it is 55 per cent. This is a significant difference.

Improving harvesting efficiency

In the study area, catchment surfaces are composed of compacted *murrum* (red clay), however, there is significant variation between surface quality. Murrum is not locally available in all villages, which probably explains the quality difference between villages. The cost of transporting murrum by tractor to areas where it is not locally available is very high. When the costs were measured of providing three inches of compacted murrum over a 70-foot diameter catchment for a *taanka* in one of the villages, they exceeded Rs8,000, and this has prevented the use of murrum in certain areas.

It will cost approximately Rs9,459 to increase the catchment efficiency of existing *taankas* to 60 per cent and Rs21,370 to construct a new *taanka* with a catchment efficiency of 60 per cent. Additionally, polymer spray must be reapplied every four years at a cost of Rs1,059 rupees. Despite this additional cost the *taankas* pay off construction costs in a reduced period of time due to increased volume of water derived from rainfall.

If the catchment efficiency can be maintained at 60 per cent then *taankas* in Pabupura Cluster will harvest 27,071 litres on average annually, which, based on consumption data, is enough for the average family to last from one monsoon to the next. This is significant, because the main goal of development agencies in the Thar Desert is to provide a reliable water supply for rural households during the nine months following the monsoon.

Conclusions

To improve the harvesting efficiency of *taankas* and to obtain greater value from each system, the catchment surfaces should be improved through the addition of a three-inch compacted murrum surface and sodium carbonate spray. Development agencies should focus their efforts on the improvement and maintenance of existing *taanka*

	Bhalu Rajwan	Pabupura Cluster
Catchment Area (Square Meters)	166	353
Potential Harvest (Litres)	23,630	45,119
Actual Harvest (Litres)	13,371	4,581
Harvesting Efficiency	55%	12%
Volume Lost (Litres)	10,259	40,538

Figure 3

catchments to maximize returns from investment. This analysis highlights the importance of catchment efficiency, and future *taanka* construction should incorporate these findings.

This research demonstrates that *taankas* are valuable rainwater harvesting systems in the Thar Desert and provide a domestic water supply for rural communities. The majority of *taankas* are worthwhile investments that provide substantial direct cost savings to beneficiaries, as well as numerous indirect benefits that have not been quantified.

About the author

Megan Konar carried out this research in collaboration with Wells for India, a UK charity.

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web**watch**

Solid Waste Management

- **Urban Solid Waste Management**
  This World Bank website outlines the issues relating to urban solid waste management. It expands on the needs of sustainable solid waste management project development, which include strategic planning, institutional and financial capacity building, and private sector involvement. It also has links to useful video resources on associated issues.
  http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTURBANDEVELOPMENT/EXTUSWM/0,,menuPK:463847~pagePK:149018~piPK:149093~theSitePK:463841,00.html

- **WEDC**
  WEDC's focus on SWM is concerned firstly with seeking solutions to the problems associated with inadequate collection and poor disposal of waste in low- and middle-income countries; and secondly, with those who derive their livelihoods from work with waste. The website has links to the many WEDC publications on this topic, many of which are available to download.
  http://wedc.lboro.ac.uk/specialist-activities/interests.php?area=6

- **International Solid Waste Association (ISWA)**
  The ISWA is an international, independent and non-profit-making association, working to promote and develop sustainable waste management worldwide, having members around the world. Member benefits include access to publications, newsletters, conferences and meetings.
  http://www.iswa.org/web/guest/home

- **SANDEC/EAWAG Solid Waste Management**
  SANDEC/EAWAG's web pages offer a range of useful resources, such as a primer on SWM in developing countries; the 'decomp database' which contains details of different composting schemes and related expertise; and key readings.
  http://www.sandec.eawag.ch/SolidWaste/SWM-Home.htm

- **WASTE advisers on urban environment and development**
  WASTE is an NGO that works for organizations aiming at a sustainable improvement of the living conditions of the urban poor and of the urban environment in general, focusing on bottom-up development in relation to recycling, solid waste management, ecological sanitation and knowledge sharing. WASTE, located in the Netherlands, has alliances with organizations in Africa, Asia, Latin America and Eastern Europe.
  http://www.waste.nl/

- **UNEP Integrated Waste Management Scoreboard: A tool to measure performance in municipal solid waste management**
  This downloadable scoreboard is a planning tool that evaluates existing municipal solid waste management systems. It has been developed by the United Nations Environment Program for use by governmental authorities in the ASEAN Region as well as for communities and institutions that are involved in management of municipal solid waste. It can be applied at the national, regional, municipal, community and institutional levels.
  http://www.unep.or.jp/Ietc/Publications/spc/IWM_scoreboard-binder.pdf

- **UN Habitat Best Practices database in improving the living environment: Environmental Management Practices**
  Lists cases of best practice from around the world, many of which are examples of successful solid waste management
  http://www.bestpractices.org/bpbriefs/environment.html

- **Sanitation Connection: Solid Waste Management**
  One of Sanitation Connection's major themes is Solid Waste Management, for which it provides a general introduction, with selected links to key online publications and other useful resources.
  http://www.sanicon.net/titles/topicintro.php3?topicId=4

Compiled by Julie Fisher, Water, Engineering and Development Centre, UK for WELL. WELL is a resource centre network providing access to information and support in water, sanitation and environmental health for the Department for International Development (DFID) of the British Government.