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INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Rain water harvesting and women's empowerment

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THE STATE OF Maharashtra in India, covers an area of 307,713 sq. km. and supports a population of over 82 million people. Over half of this population is rural. The government of Maharashtra has identified 20,000 villages, which face problems related to water. In these villages conventional sources like open dugwells, borewells and piped water supplies fail due to depleting water tables, poor water quality or the high costs involved in operation and maintenance. Many of these villages are supplied by water tankers, especially during the dry pre-monsoon. Water supplied by tankers is prone to pollution, as well as extremely expensive.

Project

The purpose of this project was to develop a sustainable and replicable model for enabling women and their families to have access to safe drinking water in villages with acute water supply problems. Rooftop rainwater harvesting was introduced as one of the technologies to meet the water requirements of households, at least for drinking and cooking.

Communities and households facing water shortages were educated about rooftop rainwater harvesting technology. The design promoted by this demonstration project was household-based, consisting of capturing the water that falls on rooftops through roof gutters, from where the water is piped to a filter and into a reservoir tank. The capacity of the tanks varied from 2.5m^3 to 10m^3 depending on the annual rainfall distribution, roof area and space available for construction. The tanks were built in ferro-cement, which is about half the cost brick masonry and a third of the cost of constructing in reinforced concrete.

When a community showed interest in the technology, local women were identified and trained to build the ferro-cement reservoir tanks. This ten-day training on ferro-cement construction also educated the particpants on how to respond to queries from user households on the use of the stored water and the operation and maintenance of their tanks. The age of the trainees ranged from 18 to 55 years, while their educational standards varied from no formal education to Standard VII. Many more women volunteered for training than could be accommodated in the training events. This shows their keen interest in developing skills and enhancing their earning potential. During training, the women trainees were paid $1 per day.

This trained group of women then constructed the tanks for all interested households in the entire village. By encouraging women to take on construction, local capacity for maintaining the tanks was assured. Special attention was given to the skills that come easily to women. For ease of construction by women, engineering designs were modified. Initially almost all women groups were hesitant, unsure of their newly acquired skills. Once a team had completed the base and the main body of the first few tank, confidence levels increased and even though the covers and filters are comparatively more difficult to make, the women handled these tasks well.

Tank construction consisted of the following steps:

- Selection of a proper site, the tank needs to be near the house from which it will collect water.
- Marking on ground and evcavation as per soil conditions.
- Preparing the foundation and casting the PCC base slab.
- Erecting mould on the site and fixing GI sheets with corrugations in vertical direction and fixing with nuts and bolts.
- Binding rectangular wire mesh and chicken mesh.
- Applying mortor externally CM (1.3) for a coat of 15 - 19mm.
- Removing mould 24 hours after external plastering.
- Plastering from inside 19mm thick and 6mm water proofing compound.
- Plastering tank cover in WM (1'x3') for tank cover in three pieces.
- Casting of tank cover with mesh of 6mm.
- Proper niche for angles.
- Filter to be constructed with brick work on top of tanks.
- Perforated plate provided for filter base.

The entire process was facilitated by staff from local NGOs, with support from the District Administrations. Local communities and user households actively participated in the decision-making processes. Households contributed towards the cost of construction by assisting the women masons during construction, especially for the critical curing of the tanks. In this demonstration project, households were not required to contribute in cash towards the cost of construction. Most of the user households subsist below the poverty line.

While working with the women's groups the following observations were made:

- Training should to be conducted near the places where women live.

- The women were more comfortable in constructing th elarger tank sizes, which are larger in diametre.
- The women used to decide the top of the tank, by measuring a distance down from the roof edge equal to the distance from their elbow to finger tips (approximately 43cm). If they did not decide this initially they tended to get carried away and at times the main body of the tank was even higher than the roof edge!
- Once the height of the tank was fixed, any surplus chicken wire mesh at the top was tucked in and tied rather than snipped off.
- The mould for a 10m tank has a diameter of 2.9 metres. Initially the mould was prepared in five pieces and the group experienced difficulties in removing the mould without damaging the external plaster. The design was modified and the mould was re-designed in seven pieces. While removing moulds the first piece has to be practically lifted out while the remaining sections can be pulled off.
- All nuts and bolts for the mould need to be on the inside as the wire mesh is tied around the mould.
- To make assembly easier, the mould should not only be numbered but also have an arrow indicating where the next number should come.
- Sometimes the mould sections get disfigured during transportation and assembly becomes difficult.
- The woman masons found external and internal plastering of the body of the tank comparatively easy.
- By comparison, the women found the construction of the cover and the filter more difficult.
- A lot of development was done for developing the base plate of the filter, which is a perforated plate. A perforated base plate in ferro-cement was not only difficult to fabricate but also difficult to lift out of the manhole for cleaning of the tank. This was finally replaced by a steel sheet with perforations.
- To protect the water in the tank, the roof cover of each tank, consisting of three separate ferro-cement slabs, was sealed with 1:2 ratio cement mortar.
- Getting graded filter material was a problem and generally it was filled with small pebbles and coconut husk.
- A pictorial step by step guide was developed to assist the women masons.

Results

To-date, the project has trained 240 women, who have constructed 600 tanks in eight districts. During discussions with users both men and women expressed their approval of the technology as it provided household water security, saved women the strenuous efforts of fetching water from distant sources, besides enhancing their status.

A few women of groups trained at an early stage of the project even became master trainers for groups of women in other districts later in the project. Some women used their skills in ferro-cement masonry to add small shelves or stools in their homes. About 20 learned plumbing skills and some were absorbed in the sanitation programme for the construction of toilets.

Sustainability

Over 70 per cent of the tanks constructed are in use. Individual households maintain their rainwater harvesting system and repair occasional damages. A few units constructed at schools are generally not so well used or maintained. In one village after the construction of tanks piped water supply was made available and consequently the tanks are not well used or maintained. Over the two-year period no structural failures of tanks have been reported. UNICEF is planning an independent evaluation of investment in the promotion of rooftop rainwater harvesting, in Maharashtra and other States.

Replicability

Thia project was implemented in the high rainfall areas of Sindhudurg, Ratnagiri and Raigad, as well as in the drought-prone areas of Nashik, Aurangabad, Dhule and Satara, and also in the fluoride-affected areas of Chandrapur district. Following this two-year experiment, the Government of Maharashtra has adopted rooftop rainwater harvesting as a means of reaching communities in difficult areas. UNICEF has assisted the government by providing design guidelines and training Government technical and non-technical staff.

The detailed specifications of the materials, costs, training schedule and tools are shown in the tables below.

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Table 1. Material specifications

Sand	Sieve size 5mm x 5mm.
Cement	Ordinary portland cement, 43 grade as per IS 456 - 1992.
Rectangular mesh	1:3 wire mesh.
Chicken wire mesh	Hegaxon mesh commercial quality.
Water proofing	Water proofing compound as per manufacturers specification.
Bars	8mm bars.

Table 2. Bill of quantities and abstract of costs for 10 m^3 tank

Item	*Description*	*Unit*	*Quantity*	*Rate/Rs. per unit*	Amount (in $)
1	Excavation	M^3	4.00	10.00	40.00 =$ 1.00
2	Rubble soiling	M^3	3.00	50.00	150.00 =$ 3.60
3	P.C.C. 1:3:6				
i)	Cement - >4.45 bags/M^3	Bag	4.45	155.00	689.75 = $ 16.50
ii)	Sand	M^3	0.48	183.00	87.84 =$ 2.10
iii)	Aggregate	M^3	0.94	424.00	398.56 =$ 9.50
4	Superstructure				
	Chicken mesh	M^2	42.45	8.00	339.60 =$ 8.00
	Welded mesh	M^2	16.33	59.00	963.50 = $ 23.00
5	Plastering external				
	Sand	M^3	5.43	183.00	993.70 = $ 23.60
	Cement	Bag	5.50	155.00	868.00 = $ 20.70
6	Plastering - Internal In c.m. 1:3				
	Sand	M^3	5.35	183.00	979.00 = $ 23.30
	Cement	Bag	5.50	155.00	852.50 = $ 20.30
7	Angles	Kg	35.00	15.00	525.00 = $ 12.50
8	Cover				
	Chicken mesh	M^2	13.20	8.00	105.60 =$ 2.50
	Welded mesh	M^2	6.60	59.00	380.40 =$ 9.00
	Sand	M^3	2.15	183.00	393.45 =$ 9.40
	Cement	Bag	2.20	155.00	341.00 =$ 8.12
9	Filter	Lump sum			500.00 =$ 12.00
10	Outlet Chamber	Lump sum			300.00 =$ 7.20
11	First flush chamber	Lump sum			200.00 =$ 4.80
					9116.50 = $217.12
12	Labour for 1 tank - 4 women x 6 days x Rs. 50/-				1200.00 = $ 28.60
13	Plumbing consisting of Pipe - 10m, Tee - 1 piece, Elbow - 1 No., Outlet pipe - 2 0.5, .5m, Cocks, Ben plug, Socket coupling, Tap	Lump sum			2210.00 = $ 52.60
	Guttering	Rft			500.00 = $ 12.00
	Total				13040.00 =$310.00

Conversion is based on $1 = Rs. 42 (Indian currency)

Table 3.

After training, women in groups of three to four were presented with the following set of tools for ferro-cement construction:

Skeleton making / reinforcement work:			
1.	Measuring tape	-	1 No.
2.	Chisel (25mm width) small	-	1 No.
3.	Hammer (2 kg)	-	1 No.
4.	Bar bending key for 8mm rod	-	1 No.
5.	Bar bending slab (flat slab with nails)	-	1 No.
6.	Mesh cutter (16 - 18 gauge wire)	-	1 No.
7.	Wire tying key	-	1 No.
8.	Anvil (small size)	-	1 No.
9.	Weld mesh cutter	-	1 No.
Plastering / mason's work:			
1.	Trowel (small size)	-	1 No.
2.	Trowel (medium size)	-	1 No.
3.	Long trip Trowel	-	1 No.
4.	Spirit level (15cm)	-	1 No.
5.	Plumbing bob	-	1 No.
6.	Pan	-	1 No.
7.	Tamping rod	-	1 No.
8.	Sieve for size (0.2mm)	-	1 No.
9.	Gloves (hand) - 2 pairs	-	1 No.
10.	Ladder	-	1 No.
11.	Water bags	-	1 No.
12.	Hacksaw blade	-	1 No.
13.	Cutter	-	1 No.
Miscellaneous Items:		-	4 pcs
1.	Chalk marker	-	1.5 kg
2.	Lime powder	-	5m
3.	Nylon rope	-	1 set
4.	Bucket and mug	-	3 kg
5.	Old news papers	-	1 No.
6.	Paint brush	-	1 No.
7.	Drums		

Cost of the above is $25. Equipped with these tools they set off to become water managers for their families and communities.

Table 4. Ten-day Training Programme for Women Masons

Day		*Description*
1st Day	-	Introduction of different construction aspects of ferro-cement tanks.
	-	Slide show and discussions with the women.
2nd Day	-	Exposure tour to rainwater harvesting structures in nearby villages (if any).
3rd Day	-	Site selection as per the design criteria (some parameters must be explained).
	-	Marking the site, excavation and placing P.C.C. in 1:3:6.
4th Day	-	Erection of the mould.
	-	Cutting and placing of weld mesh and chicken mesh.
5th Day	-	Making the proper mix and external plastering of the tank body.
6th Day	-	Internal plastering of tank body.
	-	Placing reinforcement for the cover.
	-	Curing the tank.
7th Day	-	Casting the cover, in three parts
	-	Curing the tank.
8th Day	-	Placing the cover on the top of tank.
	-	Fixing the cover in three parts on the tank.
	-	Providing hole for the filter.
	-	Making the perforated sheet for the filter.
	-	Curing the tank.
9th Day	-	Keeping perforated sheet on filter hole.
	-	Construction of filter with brick work.
	-	Placing filter material.
	-	Curing the tank.
10th Day	-	Plumbing work.
	-	First flush pipe.
	-	Bottom small tank with fitting of taps etc. placing drain pipe, placing overflow pipw.
	-	Curing
	-	Finishing

Stipend of $1 per day was paid to the participants during the training period.