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Environment Water Community



Solution Exchange for the Water Community Consolidated Reply

Query: Use of low-cost technologies to provide drinking water in Sundarbans - Experiences; Examples

Compiled by [Nitya Jacob](#), Resource Person and [Sunetra Lala](#), Research Associate
Issue Date: 28 September 2011

From [Sujoy Chaudhury](#), GOAL India Field Office, Kolkata
Posted 23 August 2011

I am Sujoy Chaudhury working with the GOAL India Field Office on issues concerning sustainable development. I am working on developing appropriate solutions for drinking water and sanitation in the Sundarbans, West Bengal.

In the Sundarbans I have observed, the current practice of extracting groundwater for drinking, using deep tube wells from depths in excess of 1000 feet is cost intensive (sinking these tube wells cost at an average INR 1, 25,000. In addition most tube wells (for a host of reasons) function efficiently for only about two years on an average. Further, the environmental impact of this method of extraction is not known but assumed to have severe impact.

I would like to know how to make safe drinking water available to the communities in the Sundarbans without having to depend on high investments, or cause severe environmental impact.

Therefore, I request Water Community members to please share with me the following:

- Are there any successful demonstrations of how surface water (saline in this case) has been treated/modified using techniques/technologies that are not energy intensive and require very small investments?
- Are there specific examples relating to using renewable energy, solar energy in particular?

The information provided by members will be used to inform GOAL projects, on the design of pilot interventions in one block of the Sunderbans in 2012.

Responses were received, with thanks, from

1. [Salahuddin Saiphy](#), Institute for Rural Research and Development, Gurgaon
([Response 1](#)) ([Response 2](#))

2. [Murali KochuKrishnan](#), Infrastructure Leasing and Financial Services Environment, Mumbai
3. [Dilruba Haider](#), Climate and Disaster Risk Reduction Community, Solution Exchange, Bangladesh
4. [Amitava Basu Sarkar](#), Society for Rural Awareness and Development in Himalayan Area, Dehradun ([Response 1](#)) ([Response 2](#)) ([Response 3](#))
5. [Rajesh Shah](#), Peer Water Exchange, Bangalore
6. [Jürgen Tümmler](#), European Commission Humanitarian Aid & Civil Protection, New Delhi
7. [Himanshu Thakkar](#), South Asia Network on Dams, Rivers and People, Delhi
8. [Anindya Basu](#), Rain Water Harvesting Consultant, West Bengal
9. [Terry Thomas](#), Wilbur Smith Associates, Bangalore

Further contributions are welcome!

[Summary of Responses](#)
[Comparative Experiences](#)
[Related Resources](#)
[Responses in Full](#)

Summary of Responses

The Sundarbans are typical of a problem of plenty – there is plenty of water, but it is salty; there is plenty of rain but only for a few months in the year and; there is plenty of sunshine but people have not cashed in on it for meeting their water needs. Taken together, they can possibly solve the drinking water problems in the region, caused partly by salinity in the groundwater and partly by the great depth of tubewells for sweet water.

Rainwater harvesting systems are inexpensive and easy to make. Rooftop rainwater harvesting can provide a regular source of water for drinking and other domestic use. The Sundarbans get about 2,000 mm of rain in a year. A catchment area of 100 square metres, the size of an average building, can yield around 150,000 litres of water that is enough to supply a family of five year round, if stored in a tank. The tank is the costliest part of the system but there is a range of options.

The roofs for rainwater collection must have an impermeable surface, such as cement; thatched roofs can be covered with plastic sheets. The runoff is channeled through gutters, filtered and directed into a tank. If space is a constraint, the tanks can be situated underground. The commonest type now is polyethylene, plastic that is relatively unaffected by sunlight. These can last 15 years, or even longer if not exposed to direct sunlight. Other types are made of ferro-cement, steel or fiberglass. Given the salinity ferro-cement or steel may be unsuitable for the Sundarbans. The Institute for Rural Research and Development, [Haryana](#), has developed several rainwater harvesting systems.

Harvested rainwater can also be directed into shallow aquifers rather than tanks for storage – this is cheaper but quality control is harder. As shallow aquifers in the Sundarbans are highly permeable, rainwater can be channeled into infiltration wells. Surface ponds are another way to capture and store rainwater and recharge shallow aquifers, provided they are fenced or otherwise protected from pollution by animals and humans. The water from these ponds can be filtered through a slow-sand filter (biosand filter) and drunk.

There are several relatively inexpensive ways to use solar energy for providing drinking water. Solar stills are the simplest of these. One, called the [Watercone](#), is a plastic cone made of transparent plastic, resistant to ultra-violet light. It yields a little over a litre a day of drinking water. The cone is inverted, placed over a pan of salty water (or floated over a pond of salty water). Through the day, the water evaporates from the pan or pond and condenses on the sides of the cone. In the evening, the cone is flipped over and the collected water flows into a bottle through a hole at the bottom. Watercones can last up to five years. A drawback is that with successive use, salt deposits form on the inside of the cone that can make the condensed water brackish – they need to be cleaned regularly. The drawback is the low yield, so a family of five would need ten of them (2-3 litres of water for drinking) just to meet their drinking water needs.

A cheaper solar still is made by digging a circular hole about 2 – 2.5 feet in diameter and 1 – 1.5 feet deep. Place a pan of water (this can be brackish or sea water) in the hole. Place a collection vessel in the centre of the pan. Cover the hole with a sheet of clear plastic (this works best, but any impermeable material can be used) and place a small stone on the sheet, above the collection vessel. The sun heats and evaporates the water in the pan, that condenses on the sheet, flows towards the centre and drips into the vessel. The yields are similar to the Watercone, but this is cheaper. These systems need several hours of sunlight to produce distilled water.

There are a few other methods for desalination. These include a mixture of rice husk ash, a locally available material, and cement that forms calcium silicate. When reacted with brine or bitterns, it will cause magnesium and sodium to precipitate and reduce the concentration of brine or bitterns. Rice Husk is a locally available material in the 24 Parganas district. Bio-sand filters, membrane filtration and reverse osmosis are few other methods for desalination.

Comparative Experiences

Haryana

Institute of Rural Research and Development (IRRAD) successfully introduces rainwater harvesting in Mewat, (*from Salahuddin Saiphy, Institute for Rural Research and Development, Gurgaon; [response1](#)*)

In the dry and arid regions of Mewat, which faces constant water shortages, IRRAD has been creating models of rooftop rainwater harvesting systems in schools, panchayat buildings, and community buildings. The rooftop rainwater harvesting system in Patkhori school is a model for others to replicate which is providing drinking water to its more than 350 students and teachers in absence of any other water source. Read [more](#).

Related Resources

Recommended Documentation

Consolidated Reply: Safe Water for the South West – Experiences; Advice (*from [Dilruba Haider](#), Climate and Disaster Risk Reduction Community, Solution Exchange, Bangladesh*)

Consolidated Reply; by Dilruba Haider and Shibaab Rahman; Climate and Disaster Risk Reduction Community, Solution Exchange; Bangladesh; 14 July 2011;

Available at <http://www.solutionexchange-un.net/repository/bd/cdrr/cr1-en-31052011-1.pdf> (PDF; Size: 474KB)

Discusses experiences and lessons learnt on supplying drinking water and sweet water for irrigation in Bangladesh

Solar Powered Water Distillation Device (from [Rajesh Shah](#), Peer Water Exchange, Bangalore)

Article; by Stephen Coffrin, Eric Fransch, Mike Santorella and Mikio Yanagisawa; Northeastern University; Boston, USA; 4 December 2007;

Available at <ftp://ftp.solutionexchange.net.in/public/wes/cr/res-23081101.pdf> (PDF; Size: 2.9MB)

Highlights how solar distillation is an affordable and reliable source for potable water that is often ignored and underutilized

From [Terry Thomas](#), Wilbur Smith Associates, Bangalore

Pro-poor Water and Wastewater Management in Small Towns: Rain Harvesting in Kerala

Report; by K.C.Bellarmino; United Nations Economic and Social Commission for Asia and the Pacific; Kerala; 15 March 2007;

Available at

http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/Water/Kerala/Kerala_MR.pdf (PDF; Size: 273 KB)

Describes how backwashing has proven effective in regions with sandy soil, common along the coastal regions where the shallow open wells face salinity intrusions

"Backwashing" -Injection of harvested rainwater into Open Wells for enabling water quality improvement

Paper; by M. J. Joseph; PLANET Kerala; Thiruvananthapuram;

Available at www.planetkerala.org/downloads/Backwashing_English.pdf (PDF; Size: 450KB)

Explains the process of backwashing, which involves feeding rainwater, collected from rooftops using a gutter and feeding directly to the open wells located within the household premises

From [Sunetra Lala](#), Water CoP

Rebuilding Groundwater Dependent Economy through Managed Aquifer Recharge (MAR)

Report; by Grama Vikas Samstha and Andhra Pradesh Farmer Managed Groundwater Systems Project; January 2006

Available at http://www.apfamgs.org/upload/pdf/RE4406_40122.pdf (PDF; Size: 3 MB)

Assesses runoff potential for 3 Hydrological Units in Chittoor District of Andhra Pradesh and need and ways to improve groundwater recharge at the basin level

Managed Aquifer Recharge

FAQ; by The Commonwealth Scientific and Industrial Research Organisation; Australia.

Available at <http://www.csiro.au/files/files/pvuu.pdf> (PDF; Size: 291 KB)

FAQ on Managed Aquifer Recharge- a vital tool in the sustainable management of the world's underground water resources

Background: The Water Component of Ecosystem Services and in Human Well-being Development Targets

Report; by Jennie Baron; Stockholm Environment Institute, York, UK/ Stockholm Resilience Centre, Stockholm; in Rainwater Harvesting: A Lifeline for Human Well-being; United Nations Environment Programme/ Stockholm Environment Institute; pp 4-13; 2009.

Available at http://www.unep.org/Themes/Freshwater/PDF/Rainwater_Harvesting_090310b.pdf (PDF; 2.36 MB)

Highlights the link between rainwater harvesting, ecosystems and human well being and draws the attention to both the negative and positive aspects of using this technology

Rainwater Harvesting in India: Some Critical Issue for Basin Planning and Research

Research Article; by M. Dinesh Kumar, S. Ghosh, A. Patel, O.P. Singh and R. Ravindranath; Journal Land Use and Water Resources Research; Vol. 6, 2006

Available at <http://ageconsearch.umn.edu/bitstream/47964/2/paper06-01.pdf> (PDF; Size: 993 KB)

Identifies critical issues in rainwater harvesting efforts like lack of data on hydrological regime, water demand, poor integration between surface water & groundwater systems

Recommended Organizations and Programmes

Institute of Rural Research and Development, Haryana (from [Salahuddin Saiphy; response1](#))

Plot No.34, Sector 44, Institutional Area, Gurgaon 122002, Haryana; Tel: 91-124-4744100; Fax: 91-124-4744123; smsf@smsfoundation.org; <http://www.smsfoundation.org/aboutus.htm>

Has been creating models of rooftop rainwater harvesting systems in schools, panchayat buildings and community buildings in more than 20 villages of the Mewat region

University of Dhaka, Bangladesh (from [Dilruba Haider](#), *Climate and Disaster Risk Reduction Community, Solution Exchange, Bangladesh*)

University of Dhaka, Dhaka 1000, Bangladesh; Tel: 880-2-8614150; Fax: 880-2-8615583; duregstr@bangla.net; http://www.univdhaka.edu/the_university/index.php

Is piloting an initiative that drives rainwater to shallow pockets of aquifer to recharge ground water, which is then drawn through a tube-well

From [Rajesh Shah](#), *Peer Water Exchange, Bangalore*

The Water Foundation, Netherlands

Lupinesingel 234, 2403 CS Alphen aan den Rijn, Netherlands; Tel: 31-172-242443; dt@hotmail.com; http://www.waterfoundation.info/contents/water_pyramid_details.html;

Developed the WaterPyramid which is a foil structure, utilizing energy from the sun to evaporate dirty or polluted source water and to condense high quality drinking water

Mage Water Management, Germany

Mage Water Management GmbH, Rudolf-Diesel-Strasse 8, 85235 Odelzhausen, Germany; Tel: 49-8134-93599; kalb@mage-watermanagement.com; <http://www.thewatercone.com/Index.html>

The organisation developed the Watercone, which is a solar powered water desalinator that generates fresh water from salty or brackish water

Green Home, USA

505 Montgomery St. floor 2, San Francisco, CA 94111; Tel: 1-415-282-6400; Fax: 1-866-298-8392; help@greenhome.com;

http://www.greenhome.com/products/appliances/water_filters/106608/

Developed AquaCone, which is another floating water purifier that distills any naturally occurring water into safe drinking water

From [Sunetra Lala](#), *Water CoP*

Barefoot College, Ajmer

Tilonia-305816, Via Madanganj, District Ajmer, Rajasthan; <http://www.barefootcollege.org/>;
Contact Coordinator, Rain Water Harvesting Section; Tel: 91-1463-288210;
barefootclouds@gmail.com

Started rainwater harvesting in remote villages in 1984 and in schools in 1986; All water related initiatives of the Barefoot College are for and executed by rural communities

Tarun Bharat Sangh, Alwar, Rajasthan

Bheekampura- Kishori, Thanagazi, Alwar 302022, Rajasthan; Tel: 91-141-2391092;
info@tarunbharatsangh.org; <http://www.tarunbharatsangh.org/>; Contact Mr. Rajendra Singh;
Chairman; rajendra@tarunbharatsangh.org

Mobilises communities on the issue of water & supports them in reviving the traditional systems of water management through construction of 'Johads' for rainwater harvesting

Society for Promotion of Wastelands Development (SPWD), New Delhi

14-A, Vishnu Digamber Marg, Rouse Avenue Lane, New Delhi-110002; Tel: 91-11-23236440/23236387; spwd_delhi@yahoo.com; <http://www.spwdindia.org/>; Contact Mr. Viren Lobo; Executive Director; vlobo62@gmail.com

Took up a large programme on Tank Restoration in Rayalaseem, southern part of Andhra Pradesh under the wasteland development programme.

Responses in Full

Salahuddin Saiphy, Institute for Rural Research and Development, Gurgaon
(response1)

We (Institute of Rural Research and Development - an initiative of S M Sehgal Foundation) have been working in parts of Haryana where people face lot of water problems due to presence of saline ground water in most of the villages and surface water resources being scanty. Working over the years we have learnt that other methods like water transportation from long distances or reverse osmosis to make local water potable are not sustainable, neither financially nor technologically from villagers' point of view. Specially, a high initial investment and high recurring costs in the absence of proper training of local people and non-availability or expensive parts leaves behind these techniques as white elephants only. Most of our water resources are already facing threat of contamination and over exploitation. Most of the dug wells already being dry, more and more tube wells are also drying every year.

In such a scenario, rainwater harvesting is again resurfacing as a most promising option and IRRAD has been creating models of rooftop rainwater harvesting systems in schools, panchayat buildings, community buildings and selected other building in more than 20 villages of the Mewat region. The rooftop rainwater harvesting system in Patkhori school is a model for others to replicate which is providing drinking water to its more than 350 students and teachers in absence of any water source (dug well, tube well, hand pump or public water supply). The system can store more than 100,000 litres of rainwater at a time and after basic filtration by passing through a bio-sand filter which can remove any biological contamination present in water, it provides safe drinking water (confirmed by laboratory analysis) through taps to quench the thirst of students.

The Sundarbans is blessed with good rains. The average annual rainfall in Sundarbans is 1,640-2,000 mm which is higher than the national average. It can provide 140,000- 170,000 litres of rainwater from a 100 square m roof area. It is more than sufficient to meet all requirement of a family of five members (even considering its water requirement to the tune of 45-70 LPCD). By harnessing this precious gift (rain) from god which is available to everyone and everywhere, we can meet our water requirements without investing high amount on the unsustainable tube wells, which will fail within two-three years. The same investment in rainwater harvesting system will

ensure solution of water problems for years together. Our office also depends on rainwater only to meet drinking and all other water requirements for more than 8 months as we store more than 400,000 litres of rainwater. IRRAD can offer technological support if anyone is interested in it.

Murali Kochukrishnan, Infrastructure Leasing and Financial Services Environment, Mumbai

The only remedial and safe way to provide saline free drinking water to the community is by adopting "Roof top rain water Harvesting systems" either at individual house hold level or at community level by connecting the roof areas available in the village and harvesting the rain fall in to a low cost ferro-cement tank technology at surface or subsurface level for its appropriate usage during lean season by the community for drinking water needs.

Likewise, the traditional water harvesting systems like ponds and tanks in the villages needs to be revived to harvest rain water which will dilute the salinity. As rainwater is fresh water with lesser density than saline water, it always floats above the saline water for appropriate usage during lean season despite the transpiration losses.

As the average annual rainfall in Sundarbans is around 2,000 mm it is quite sufficient to meet out the drinking water requirements of the community in various villages without any huge investment otherwise incurred in developing very deep tube wells, which often fails after 3 years or so. There are so many experienced organizations providing technical knowhow are available in India.

Also, there are so many other simple technologies of concern for de-salination are like the mixture of RHA (rice husk ash) and various percentages of Portland cement which forms calcium silicate. When reacted with brine or bitterns, it will cause magnesium and sodium to precipitate and reduce the concentration of brine or bitterns. Rice Husk is a locally available material in the 24 Parganas district of West Bengal.

Bio-sand filtering techniques, membrane filtration techniques, reverse osmosis, etc., are few technologies adopted to work out the de-salination process of saline water. Another low cost treatment in the developing world is by using "Moringa oleifera seeds powder" for coagulation process and reduction in salinity.

"Watercones" is a new solution for de-centralized water supply in locations where salt water or brackish water is the only source of water. Watercones are solar-powered cone-shaped desalinator that generates fresh drinking water from salt or brackish water. It uses sunlight to evaporate the water contained in the cone, which is then condensed and collected as clean drinking water. It can provide to about 1.6 liters of drinking water per day.

Dilruba Haider, Climate and Disaster Risk Reduction Community, Solution Exchange, Bangladesh

The major part of the southwestern coastal zone of Bangladesh is the Sundarbans and is grinding under the curse of salinity; there is a major shortage of clean drinking water. The Climate and Disaster Risk Reduction (CDRR) Community of Solution Exchange Bangladesh ran a query on the issue which resulted in a very interesting discussion pointing out some low cost and low tech solutions and some high cost and hi-tech ones.

The most common low-tech and low cost technique used by communities is rainwater harvesting (RWH). Some NGOs, in the aftermath of cyclones set up concrete tanks, costing Tk 15,000 (\$1=

Tk 73) per family, while some provided local earthen containers ('matka') that cost individual families Tk 1,000 (including training).

Some rainwater collection methods mentioned that could address the crisis were setting up rooftop catchment areas. People mostly are using plastic sheets with a hole in the middle, spreading on four bamboo poles or on thatched roof to collect the rainwater. Another local practice commonly used by communities to access sweet water is excavating or renovating ponds on higher ground, building strong and high embankments, and installing Pond Sand Filters (PSF) on them. However, lack of maintenance in most cases rendered those abandoned.

In Shyamnagar of Shatkhira district, which is on the periphery of Sundarbans, an NGO and the Dhaka University are piloting an initiative that drives rainwater to shallow pockets of aquifer to recharge ground water, which is then drawn through a tube-well.

High-Tech/High-Cost solutions for drinking water include Solar Powered Desalination plants and 'Reverse Osmosis' (RO) machines; both options reduce the salinity of the water. An NGO installed four RO machines along the coastal region of Bangladesh, which treat saline water and produce pure drinking water. Members expressed some reservations about this, due to the high set-up and maintenance costs associated with this technology. However, in the long run, if well managed and maintained, the set up cost can be recovered just by selling the pure drinking water to the community people. In an effort to make it more cost effective and efficient, respondents suggested using nanotechnology - 'carbon nano tubes' (CNT), which is a filtering agent that RO desalination machines can use, which can significantly reduce the cost of RO plants. The Comprehensive Disaster Management Programme (CDMP) of the Ministry of Food and Disaster Management on the other hand has been trying to pilot a family level solar energy based desalination plant machine. It is little costly, but once installed does not have much of recurrent costs.

The discussion pointed out that there is no single ideal solution; it needs using a matrix of several options to address the specific problems of a particular area. The Consolidated Reply is available at the following link: at <http://www.solutionexchange-un.net/repository/bd/cdr/cr1-en-31052011-1.pdf> (PDF, Size: 474 KB)

Amitava Basu Sarkar, Society for Rural Awareness and Development in Himalayan Area, Dehradun (*response 1*)

I am working in Uttarakhand in the water-sanitation sector. The local communities themselves are being encouraged to solve their drinking water and sanitation problems. They plan and design the solutions, with the help of engineers. The community takes the responsibility of O&M of the scheme and contributes both towards the "Capital Cost" and voluntary labour.

The "Technical Solutions" used in the state are detailed below:

1. Rooftop Rain Water Harvesting - using ferro-cement tanks and PVC pipes, to collect water from the roof of the houses.
2. Using various structures, made of suitable locally available sources, they design pipe lines to carry water from the sources at higher elevation, (generally), by the force of gravity. There are cases where water is also pumped from source at a lower elevation to the village at a higher elevation. This is generally avoided as it involves more capital cost and huge O&M responsibilities.

Now, in the Sundarbans, rain water harvesting is technically feasible, due to abundant rainfall

and this is also being practiced in Bangladesh. This is the cheapest technical option. The other option that is technically feasible is the infiltration well, as the soil is pervious and the particles allow water to flow/filter through. The yield of the well could be designed to cater to the water demand of the end user group and also evidently will depend on the soil characteristics. It involves digging a well, where water infiltrates from the aquifers and/or adjacent water bodies. A lot of reference material is available in the net. You may look up SWAp and the Centre for Science and Environment sites.

Salahuddin Saiphy, Institute for Rural Research and Development, Gurgaon (*response 2*)

I highly appreciate the response from Mr. [Sarkar](#) emphasizing on use of rainwater harvesting to solve the Sundarban's water problems. However, I differ from him on use of infiltration wells in Sundarbans. Infiltration wells are generally constructed along some river/stream/channel which carries rainwater runoff only. The quality of this water is generally very good except some suspended particles and bacteriological contamination (especially e-coli) picked up from catchment areas. They are particularly effective in areas of steep slopes where biological contamination and turbidity/total suspended solids (TSS) are very high. In plain areas also they are used to remove turbidity and bacteria to an extent.

Some chemical impurities are also removed in the process (by absorption, adsorption, ion-exchange etc) as water moves through mother earth. But as the input water (surface water) in the case of Sundarbans is saline, they will be least effective in removing the salinity, TDS or any other chemical impurities. I welcome whatever successful case studies are available on use of infiltration wells to remove the inland/coastal salinity or lower it considerably when the input water is saline.

Rajesh Shah, Peer Water Exchange, Bangalore

I was impressed by a small scale model of the solar pyramid/cone distiller at the World Water Forum in Mexico in 2006. However, I have not heard much since then on its effectiveness.

Below is some information I dug on the internet:

http://www.waterfoundation.info/contents/water_pyramid_details.html

<http://www.thewatercone.com/Index.html>

http://www.greenhome.com/products/appliances/water_filters/106608/

I have attached a study which shows that water properties on plastic v glass may impact operation (<ftp://ftp.solutionexchange.net.in/public/wes/cr/res-23081101.pdf>, PDF, 2.9 Mb)

Seeing the conditions in the Sundarbans with abundant solar energy and saline water source, this could be effective. As in all such pilots it would be good to track operations (especially if it fails) so that the community can really learn from it.

Amitava Basu Sarkar, Society for Rural Awareness and Development in Himalayan Area, Dehradun (*response 2*)

Surface water contains impurities; when it percolates through the soil particles, the impurities get removed. This is a known phenomenon. Now the extent of removal of impurities is a function of soil mechanics (characteristics). Three types of filtration occur: Physical filtration - simply strains suspended particulates that are too large to pass through the spaces between soil particles, especially alluvial particles, which is the case in Sundarbans. Biological filtration remove micro-

organisms - either filtered by the soil or as the passage of time is sufficient for them to be inactive, digest dissolved or suspended organic material as well as chemical nutrients. Ion exchange may take place when aquifer soils react with chemicals soluble in water. River Bank filtration, practiced in Europe since 1870 works on the same principle, where basically a pit is dug away from the surface water source (the distance depends on the type of soil particles). Water percolates from the adjacent water body. There is a marked improvement in the quality of water collected in the well from that of the surface water source. Efficiency of removal depend not only on the type and load of contaminants but also on the hydraulic, chemical properties of the aquifer, the local recharge conditions and bio-chemical process.

Thus I personally feel it will be a feasible option in Sundarbans. The capital cost of a 7.0 kilo-litre rainwater harvesting tank made of ferro-cement will cost close to Rs. 20,000 each, whereas the capital cost for this option will be much less.

Jürgen Tümmler, European Commission Humanitarian Aid & Civil Protection, New Delhi

Knowing the situation in the Sundarbans on both side of the border I can only say, that deep wells reaching down into the (tertiary) fresh water aquifer would be the best solution. The deep seated water is free of arsenic (because the aquifer is older, than 10 000 years and arsenic has been washed out over this period) and it is definitely not saline. It is a renewable resource and one of the most important aquifers in South Asia. If deep wells (i.e., between 250 and 500 meters) are drilled and built correctly, they will last on average for over 20 years and an electrical quality submersible pump (in some areas even India Mk II or III or IV handpumps will do) as can be purchased in most qualified plumbers' shops in Asia will do a job over years before needing repair or maintenance or replacement. Calculated to the volume of water consumed over this period, no other method can even come close to the low prices water from well built deep wells.

The problem is the bad qualification and negligent work of local drilling enterprises, who do not invest time and money into qualified staff and equipment needed to build a decent well following technical guidelines established since many decades in the US or Europe.

Amitava Basu Sarkar, Society for Rural Awareness and Development in Himalayan Area, Dehradun (*response 3*)

Technically, I agree with Jurgen Tummler's situation analysis. It is technically "feasible" but certainly cannot be termed as a "low cost" option. Kindly share with the members what, in your opinion, would be the capital and O&M cost of such an option, for let us say 100 people.

Himanshu Thakkar, South Asia Network on Dams, Rivers and People, Delhi

I would like to request Jurgen Tummler to explain how this tertiary aquifer water is a renewable resource and is it less expensive than rainwater harvested?

Anindya Basu, Rain Water Harvesting Consultant, West Bengal

I am working as an individual consultant on rainwater harvesting in the Sundarbans. My experience is that ferro-cement tanks are not suitable for the West Bengal. The West Bengal Pollution Control Board experimented with this option, which was not successful. One such

project can be seen at the Bidhan Nagar College, Salt Lake. I suggest that brick or PVC tanks are more suitable for the Sundarbans and they are also easy to transport.

Terry Thomas, Wilbur Smith Associates, Bangalore

Let me suggest a simple form of rainwater harvesting without need for artificial storage structures.

Install a rainwater collection gutter on any roof (at least 40 square metre in area, and leave the few first rains), and divert the water into any existing nearby small shallow wells or ponds. Watch changes in water quality especially dissolved solids levels (main indicator) over the next season. You can use a digital TDS meter for this. Possibly, surface water through wells and ponds was the main water sources in the past, and has disappeared on account of brackishness or saline intrusion.

The principle is simple. When rainwater is directly fed into wells, the quantity increases and dilution occurs inside the source. The excess water seeps further into surrounding soil to attain equilibrium. The more the water feed, the surrounding fresh water lens is enhanced and the stored water returns as a usable resource for the post-monsoon period (up to a certain percentage of water fed into well or pond).

If you are successful in the above stage, some more explorations need to be done and also to follow certain minimum guidelines like for example: Roof area, well depth factor, biodiversity surrounding the water source, influence of soil profile, other non-point polluting sources, movement of freshwater lens, drawing optimum water in summer, post treatment process, etc. In general the water after a rainy season will have low TDS and will need biological purification through boiling or use of simple filters like TATA Swach or similar. Refer to the weblinks given below and also the attached PPT to guide you further.

http://www.unescap.org/pdd/prs/ProjectActivities/Ongoing/Water/Kerala/Kerala_MR.pdf;
www.planetkerala.org/downloads/Backwashing_English.pdf

This technique called ***Backwashing*** was tried out in Kerala coast since 2004 (later scaled up as "Mazhapolima") and showed very promising results. Here the water problem was addressed by enhancing the access to local water resources, than in installing end use treatment options. At a later stage you can think of providing institutional protection through establishing a community fresh water reserves in Sundarbans.

Many thanks to all who contributed to this query!

If you have further information to share on this topic, please send it to Solution Exchange for the Water Community in India at se-wes@solutionexchange-un.net.in with the subject heading "Re: [se-watr] Query: Use of low-cost technologies to provide drinking water in Sundarbans - Experiences; Examples. Additional Reply."

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