# Solution Exchange for the Water Community
# Consolidated Reply

## *Query: Rooftop Rainwater Harvesting for Rural Schools in Karnataka - Experiences*

**Compiled by Nitya Jacob, Resource Person and Ramya Gopalan, Research Associate**
**Issue Date: 9 May 2008**

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### From S. Vishwanath, Arghyam and Rainwater Club, Bangalore
**Posted 4 April 2008**

I work as advisor, Rainwater Club and Arghyam. We work to promote rainwater harvesting in urban areas, to partly solve the water crisis that many cities and towns face. Rainwater harvesting is widespread in different parts of India, and is a low-cost, local solution to perennial water shortages.

In the Visioning Workshop of the Water Community, held in March 2007, we had discussed the Suvarnajala Programme of the Karnataka state government to provide drinking water to schools through rooftop rainwater harvesting in schools. I had proposed an Action Group to discuss how to make the programme more effective and feed back into its processes.

The state government started a Rs. 74 crore rooftop rainwater harvesting 'Suvarnajala' to provide drinking water to 23,683 schools with money from the 'Bharat Nirman' programme. 'Over the ground' rainwater storage tanks were proposed, with capacities of 3,000 to 10,000 liters, to collect, filter, store rainwater and provide each student 1.5 liters of drinking water. Arghyam has tried to understand and improve project's effectiveness. It created a partnership of civil society groups in 7 districts for this purpose. The group identified problems and worked out a strategy to optimize the investment after surveying all schools.

The survey revealed the following problems:

- Lack of a genuine need-based approach in selection of schools, the final list seems to have covered almost half of the rural schools
- Does not seem to have been any consultation with the Gram Panchayat or the School Development Management Committee (SDMC) about the programme, and therefore, there is no buy-in
- Technical design is 'one size fits all' and has not taken into consideration factors such as the appropriateness of an over ground tank, space, ground water recharge, etc
- No protocol has been developed for maintenance, water quality testing and treatment
- Seems to have been an underinvestment in genuinely deserving cases because the resources have been spread too thin, and investments have been made in schools that already had a reliable source of water
- It has turned out into a rainwater tank construction programme rather than a programme to provide drinking water to school children

Given the advanced status of the Programme, the challenge is tailoring these structures to at least partly meet desired goals; we request members share their experiences and insights on the following:

- Provide examples of when state governments have evolved a truly participatory process of delivering services (such as rainwater harvesting in schools)
- Discuss how NGOs could help the Suvarnajala programme meet the overall goal of better water and sanitation access in schools, as well the possibility of programme providing supplemental water for both drinking and sanitation in schools

The inputs will be compiled into a set of recommendations for the state government. We will arrange a consultation with officials to present the findings and discuss how they can be incorporated into the programme. The publication and the government's feedback will be shared with the members of the Water Community.

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## Responses were received, with thanks, from

1. **J. P. Maithani, SFCID, Pipalkoti, Chamoli, Uttarakhand**
2. **S.D. Limaye, Ground Water Institute, Pune**
3. **Johnson Rhenius Jeyaseelan, WaterAid (UK) India, Lucknow (Response 1; Response 2)**
4. **Yusuf Kabir, Consultant UNICEF, Kolkata (Response 1; Response 2)**
5. **Hiren Patel, Development Support Agency, Tribal Development Department, Government of Gujarat, Ahmedabad**
6. **Prabhakar Sinha, Japan International Cooperation Agency (JICA), Bhopal**
7. **Abhishek Mendiratta, Consultant, New Delhi**
8. **Nitya Jacob, United Nations Children's Fund (UNICEF), New Delhi**
9. **T. N. Anuradha, Food and Agriculture Organization of the United Nations (FAO), New Delhi**
10. **Nafisa Barot, Utthan, Gujarat**
11. **Kalyan Paul, Pan Himalayan Grassroots Development Foundation, Ranikhet, Uttarakhand (Response 1; Response 2)**
12. **Vijay Dhasmana, Arambh Society, Dehradun, Uttarakhand**
13. **Avudai Nayakam S., Water Partners International (WPI) India Office, Tiruchirappalli, Tamil Nadu**
14. **Raj Kumar Daw, Consultant, WASH, United Nations Children's Fund (UNICEF), Abuja, Nigeria**
15. **M Jahangir, Drinking Water Pakistan Google Groups, Islamabad, Pakistan**
16. **P. S. Yadav, Haryana Institute of Rural Development and Department of Development and Panchayats, Haryana**
17. **Arunabha Majumder, Jadavpur University, Kolkata**
18. **Arumugam Kalimuthu, WES-Net India, New Delhi**
19. **R. K. Srinivasan, Centre for Science and Environment (CSE), New Delhi**
20. **Rahul Banerjee, Khedut Mazdoor Chetna Sangath, Indore**
21. **Surekha Sule, National Institute of Rural Development, Hyderabad**
22. **Michael Martin, Independent Consultant, USA***
23. **V. M. Nataraj, Pravara Rural Engineering College, Maharashtra**
24. **Murali KochuKrishnan, Action for Food Production (AFPRO), Bhubaneswar**
25. **J. Geetha, Gramalaya, Tiruchirappalli**
26. **Avinash Zutshi, Feedback Ventures Pvt. Ltd. (FVL), New Delhi**
27. **Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi**

**From Yahoo Groups - Water Watch*

***Further contributions are welcome!***

## Summary of Responses

Rooftop rainwater harvesting (RWH) is a viable source of drinking water for schools, as well as a means for recharging groundwater. However, RWH schemes can only effectively provide drinking water, if the water is collected using certain safeguards and is filtered; therefore school authorities, students and communities must be involved for school RWH programmes to work, as they need constant maintenance and water quality monitoring. Discussing the request for examples of participatory service delivery and suggestions on how to ensure better access to drinking water and sanitation in schools, members shared a range of RHW experiences, outlined ways NGOs can facilitate the implementation of these programmes and discussed different types of RWH tanks.

Respondents noted the development of RWH systems are a component under the national Total Sanitation Campaign (TSC), as part of the school sanitation programme. Every school must have a "child cabinet" with ministers for education, health and environment to ensure meaningful participation by schoolchildren. Moreover, several states now have byelaws requiring all new buildings to incorporate RWH systems, to provide water for consumption and groundwater recharging.

Members shared several **experiences** with community, NGO, and government led initiatives constructing **RWH structures**. Several of the experiences involved youth and schoolchildren in the process. In **Madhya Pradesh**, an agency helped tribal girls implement a RWH project, in **Delhi,** the Government provided some financial support for the construction of RWH systems through its school eco-club programme and several city schools have built these systems and using the water for gardening, and another initiative in **Delhi** involved college students in implementing a RWH system. Additionally, in **Uttarakhand** and **Himachal Pradesh**, schoolchildren and teachers contributed to the creation of an rooftop RWH system that is now being expanded to other schools, in Chirawa, **Rajasthan** private schools have set up RWH systems that meet a large part of school's water requirements, and in **Jharkhand** an NGO involved schoolchildren and teachers in a groundwater recharging and rainwater conservation programme. In Jhabua and Dhar, **Madhya Pradesh**, where rainfall is low and erratic and the fluoride has contaminated the groundwater, the government has launched an initiative to set up RWH systems for tribal schools and hostels.

Other examples mentioned were cases where schools, communities, local governance institutions and individuals were engaged in RWH activities. In **Uttar Pradesh**, a rainwater recharging scheme involved the school authorities, the panchayat and parent teacher association (PTA) in the management and quality monitoring of a RWH system and in **Tamil Nadu** a Gram Panchayat manages and maintains a water sharing system based on RWH tanks located on the village cyclone center roof. Members also listed two organizations in **Kerala**, which are engaged local communities in the creation of RWH systems to provide a reliable water source, and an NGO in **Tamil Nadu** built roof water-harvesting structures in schools, temples and the panchayat office. Finally, a college in **Rajasthan** developed an extensive RHW system involving schools and community centers.

Along with these successful efforts, discussants also mentioned an experience from the **Andaman** and **Nicobar Islands** where an agency faced major issues trying to set up a RWH system.

Respondents felt that for RWH programmes to work three steps are necessary. First, government and implementing organizations must select the right schools and households for RWH systems based on talks with the community. Next, water budgeting is needed to design an appropriately sized system. Third, ensure community participation during construction, and in the maintenance and security of the system, as well as water distribution. Government, NGOs and donor have complementary roles to play in this – in terms of provision of funds, technical assistance, training and awareness generation on RWH systems.

**NGOs have a major role** in ensuring the success of RWH in schools and households, members argued. NGOs tend to be skilled at community mobilization and could work to ensure ownership through panchayat and Gram Sabha meetings, arrange for discussions on school RWH plans with communities, collect contributions in kind and cash for such efforts and help set up school eco-clubs to maintain RWH structures. This approach actively involves communities and enables NGOs to regularly monitor water quality and train students, teachers and community leaders on water testing methods, and dispel the notion that stored water is unfit to drink. Respondents also thought NGOs could participate in the process of selecting suitable schools and households for RWH structures.

In addition, NGOs can do water budgeting to assess the needs of schools to design a suitable system. Members explained it is simple to work out the storage capacity needed, assuming 1 litre of water per student per day; thus for 200 students, to supply water for over 150 non-rainy days, a storage tank of 30,000 litres is necessary. For the 5-6 hours of school, students need half a litre of water, and thus, a smaller tank can suffice. These calculations have cost and space implications, so before implementing a RWH scheme in a school, discussants stressed the necessity of determining whether it is the only option to provide drinking water or if there are cheaper options, as well as other water requirements (sanitation, washing hands, preparation of the mid-day meal) available.

Another important role for NGOs is in maintaining the quality of water, by training schoolchildren and authorities. To drink rainwater it must be free of bacteria and chemicals. Members explained it is essential that schools maintain the RWH structure and clean it before the first rains, this water must be discarded because it carries atmospheric pollutants. Before drinking, the water needs filtration and quality checks, performed using the $H_2S$ strip method. If necessary, small amounts of disinfectants may be added either fortnightly or monthly. Each group in the school has a role to play, students as members of eco-clubs and the parent-teacher association as a monitoring body.

Finally, respondents deliberated on the **different types of tanks** for storing collected rainwater and discussed the implications for communities along with the costs. Ferro-cement tanks are widely used to store collected rainwater for drinking, as they are cheaper than other material and can be built in-situ. Locally trained masons can make tanks with capacities up to 25,000 liters using this technology. These tanks cost Rs 0.85-1.2 per litre to construct, plastic or steel tanks cost around Rs 3 or more per litre. Common storage structures are the cheapest option, costing between Rs 1,000 and 3,000 per household. Another cheap alternative is diverting harvested rainwater into a clean well, which lowers the cost to around Rs 1,000 per family.

Discussants highlighted the importance of carefully examining the local water situation before deciding on a solution and stressed the need to look at the water requirements in a holistic manner to ensure the approach chosen would effectively meet local needs (of schools and the larger community) and be a sustainable option, in terms of community support and long-term maintenance costs.

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## Comparative Experiences

**Uttar Pradesh**

**Engaging PTA, Sarpanch and School Management in Rainwater Recharge, Lalitpur District** *(from Johnson Rhenius Jeyaseelan, WaterAid (UK) India, Lucknow; response 1; response 2)*
WaterAid India partnered with SSSO to promote rainwater recharging through soak pits, which unlike rain water harvesting tanks do not need regular O&M. As part of the initiative, the PTA, the sarpanch and school management were trained on all the hardware uses, and involved in the planning, procurement of quotations and formation of the purchase committee. They were also included in raising contributions, quality control efforts and the O & M, ensuring sustainability of the scheme. Read more

**Madhya Pradesh**

**Engaging School Children in RWH Activities, Bhopal** *(from Yusuf Kabir, Consultant UNICEF, Kolkata; response 1; response 2)*
In drought prone areas, which suffer from severe water scarcity from January to June every year, UNICEF and its partners have formed and trained a water safety and hygiene club with tribal girls living in the Tirla school hostel. They implemented wise-water management activities, including RWH, grey water recycling, pumping water using roundabout pump and dilution of water contaminated with fluoride. The club is monitored using a water safety plan. Read more

**Jharkhand**

**Additional Benefits of RWH Structures, Deoghar, Palamu and Latehar** *(from Prabhakar Sinha, Japan International Cooperation Agency (JICA), Bhopal)*
To address water conservation, WaterAid supported the creation of RWH structures on village schools and houses. The structures have been functional for two years and have benefited the rural masses through the involvement of teachers and schoolchildren along with their families, which have proved to be a crucial factor for its success. Other benefits include groundwater recharge and rainwater conservation, providing a sustainability source of rainwater for petty household tasks. Read more

**Delhi**

**Rainwater and Tap Water Harvesting (TWH), New Delhi** *(from T. N. Anuradha, FAO, New Delhi)*
As part of the CLEAN India program, RWH and TWH techniques were tried in schools. The Central Ground Water Authority surveyed schools and suggested appropriate techniques/designs. Using school maps and translating designs, awareness was created among children and authorities on RWH. The cost implications, regular monitoring and training discouraged some schools from taking it up. However, several schools adopted RWH or TWH, and children are learning about water conservation. Read more

**Youth as Agents of Change, New Delhi** *(from Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi)*
The Vigyan Vijay Foundation set up RWH systems and created awareness through eco-clubs that used demonstration models of RWH systems and waste management to explain their importance. They implemented a RWH system in Bharati College, wherein students of the eco-club are involved in cleaning the system and filtration beds, and efforts to raise awareness on water conservation. As a result, similar eco-clubs from other colleges are now coming forward to participate. Read more

**Andaman and Nicobar Islands**

**Process Problems in Establishing RWH Systems** *(from Raj Kumar Daw, Consultant, WASH, UNICEF, Abuja, Nigeria)*
During 2005-06, as a part of the tsunami recovery effort, UNICEF supported the construction of household level RWH systems on the Islands. Several problems were encountered such as the need to plead with dock officials for warehouse space and shipping passage, having to negotiate with local community "captains," and finding volunteers to build up the capacity of communities. The actual construction of the RWH systems was the least of the problems and was successfully used. Read more

**Tamil Nadu**

**Community Based RWH Systems, Siruthalaikadu, Vedaranyam and Nagapattinam** *(from Arumugam Kalimuthu, WES-Net India, New Delhi)*
In these areas, over 95% of houses are thatched; therefore, water is collected for the 200,000 liter RWH tank through the village cyclone centre roof, which is cemented. The Gram Panchayat took up the maintenance and management and evolved a "ration system of water sharing". One lesson the initiave learned is that there can be no blanket promotion of RWH and success is dependent on users' participation in evolving appropriate mechanism for water use and system management.

**RWH Structures Creating Awareness and Increasing Demand, Nagapattinam District** *(from J. Geetha, Gramalaya, Tiruchirappalli)*
Gramalaya installed 30 roof water-harvesting structures in schools, temples and the panchayat office, as well as in 90 households. As information to people, the technical diagrams with month wise rainfall data in the region are painted on community buildings. Field tests showed that families received rainwater for own needs and sold surplus at Re.1 per pot. Water tests found it safe for drinking and given the increasing demand, the project is being scaled up. Read more

**Rajasthan**

**School RWH Supplies Water and Recharges Groundwater, Chirawa** *(from Nitya Jacob, UNICEF, New Delhi)*
A school run by Dalmias had a rooftop RWH structure. Water from the large roof was channelled into two large underground cement tanks, open at the bottom so the aquifers were also recharged. Their combined capacity is around 40,000 litres, enough to supply the school's needs for a few months. Dalmias covered the costs. Now, the school has a regular supply of water for a range of purposes, but not for drinking, since they use the municipal water supply.

**Taking School RWH Systems to Community, Tilonia** *(from Surekha Sule, National Institute of Rural Development, Hyderabad)*
The Barefoot College created a massive infrastructure that collects 29 million litres in 470 schools and community centres. This benefits people in 13 villages, who have piped water supplied through this infrastructure. They pay Rs. 30 per month for two hours of water supply each day. The goal of providing easy access to drinking water was thus achieved and this model connected the school RWH systems to the community.

**Kerala**

**Community Level Systems vs. Individual Household Systems** *(from Avinash Zutshi, FVL, New Delhi)*
Either most wells were abandoned or in need of a reliable water source as groundwater levels had fallen. Thus, Feedback Ventures Pvt. Ltd. (FVL), with Dutch assistance constructed different RWH systems, with costs varying by per type- common storage tanks for communities and individual residential roof RWH structures. The latter type could not be extended to many areas given the high costs, which required grants/subsidies. However, community level systems with shared costs worked well. Read more

**Role of NGOs to Promote RWH Systems, Cherthalai Taluk, Allappuzha District** *(from Avudai Nayakam S., Water Partners International (WPI), Tiruchirapalli, Tamil Nadu)*
Water Partners International promoted RWH systems and created awareness among user community and schoolchildren through classroom sessions and practical orientation i.e. on the job training to local masons, plumbers and engineers. A local mason trained by WPI in Pallithodu coastal village trained more

than 20 other masons and constructed hundreds of ferro-cement water tanks in and around the taluk. As a result, his social status improved and income level increased. Read more

**Uttarakhand and Himachal Pradesh**

**Involvement of Teachers and Children in RWH Systems in Schools** *(from Kalyan Paul, Pan Himalayan Grassroots Development Foundation, Ranikhet, Uttarakhand; response 1; response 2)*
The NGO Grassroots promotes runoff rooftop rainwater harvesting in schools wherein rainwater is stored in underground rainwater storage tanks with capacities of 30,000 to 40,000 litres. The water is mostly used to maintain a set of six toilets. Teachers and children have appreciated the facility, and contributed 10% of the initial investment. The benefit of this technology was demonstrated in 40 schools (with 400 children and 20 teachers per school) and now will be extended to another 30 schools. Read more

**International**

*From Ramya Gopalan, Research Associate*

**China**

**Rainwater Harvesting Use in Daily Life, Beijing**
Initiated by the Beijing Municipal Water Conservancy Bureau and Essen University, 5 sites were selected 2 residential compounds, a section of the old town, an urban public construction site, and a school. The project worked to convert several paved roads into more porous surfaces to encourage rainwater infiltration, collected and stored rainwater from rooftops, and road surfaces, and used the water for irrigation, washing cars, and toilets and succeeded in saving water and controlling floods. Read more

**Japan**

**RWH Promoted to Mitigate Water Shortages, Tokyo**
The Ryogoku Kokugikan Sumo-wrestling Arena, built in 1985 in Sumida City, is a well-known facility that utilizes rainwater on a large scale. The 8,400-m2 rooftop of this arena is the catchment surface of the rainwater utilization system. Collected rainwater is drained into a 1,000-m3 underground storage tank and used for toilet flushing and air conditioning. Following this example, many new public facilities began to introduce rainwater utilization systems. Read more

**Thailand**

**Storing Rainwater from Rooftop Run-Off in Jars**
Communities are using rooftop run-off in jars, an inexpensive way to obtain drinking water and store rainwater. Prior to this communities had no way to protect drinking water from waste and mosquitoes. The size of jars range from 100-3,000 litres, and are equipped with a lid, faucet, and drain, the most popular size is 2,000 litres, costing 750 Baht, and holds enough rainwater for a six-person household for six months. Based on its success, the government intends to make it a national program. Read more

**Bangladesh**

**Rainwater Collection as Alternative to Arsenic Affected Water**
Since 1997, about 1,000 rainwater-harvesting systems have been installed primarily in rural areas. RWH tanks range in capacity from 500 litres to 3,200 litres, and the costs vary accordingly. Composition and structure include ferro-cement tanks, brick tanks, RCC ring tanks, and sub-surface tanks. Rainwater harvested is used for drinking/cooking, and is now accepted as a safe, easy-to-use source of water. Quality tests shows that water preserved up to 5 months is not contaminated. Read more

## Related Resources

### *Recommended Documentation*

**Rainwater Harvesting and Artificial Recharge to Ground Water: A Guide to Follow** *(from T. N. Anuradha, FAO, New Delhi)*
Guide; Central Groundwater Authority, International Hydrological Programme (IHP), United Nations Educational, Scientific and Cultural Organization (UNESCO); September 2000
http://www.unesco.org/water/ihp/publications/water_harvesting.pdf (PDF, Size: 6 MB)

*Provides examples of roof top harvesting installations successfully operating in India constructed and maintained by CGWB, provide a snapshot of current systems.*

**The Texas Manual on Rainwater Harvesting** *(from Nitya Jacob, UNICEF, New Delhi)*
Manual; Texas Water Development Board; Third Edition; 2005
Available at http://www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf (PDF, Size: 1.89 MB)

*Serves as a primer in the basics of residential and small-scale commercial rainwater harvesting systems design giving implanting options, advantages and constraints*

*From Ramya Gopalan, Research Associate*

**Manual on Rooftop Rainwater Harvesting Systems in Schools**
Manual; Arghyam and Rainwater Club
Available at http://www.rainwaterclub.org/docs/MANUAL%20ON%20ROOFTOP%20RAINWATER%20HARVESTING%20SYSTEM%20FOR%20SCHOOLS.pdf (PDF, Size: 699 KB)

*Provides maintenance schedule, post storage treatment procedure and precautions for rooftop rainwater harvesting systems in schools*

**Study of Rainwater Harvesting Potential of Zura Village of Kutch District of Gujarat**
Journal Article; by A. K. Tripathi and Uma Kant Pandey; Forest Research Institute (ICFRE); Journal of Human Ecology; 2005
Available at http://www.krepublishers.com/02-Journals/JHE/JHE-18-0-000-000-2005-Web/JHE-18-1-000-000-2005-Abst-PDF/JHE-18-1-063-067-2005-1280-Tripathi-A-K/JHE-18-1-063-067-2005-1280-Tripathi-A-K-Full-Text.pdf (PDF, Size: 27 KB)

*Attempts to find out the rainwater harvesting potential (RWHP) of the Zura village which is faced with droughts, increasing ground water salinity and a decreasing ground water table*

**Water and Community Development: Rainwater Harvesting and Groundwater Recharge: A Sustainable Approach to Human Development at the Global Level**
Briefing Paper; by Robert Davies and Bunker Roy; International Business Leaders Forum and The Barefoot College; Rajasthan; 2004
Available at http://www.globalrainwaterharvesting.org/pdfs/SDI13-14-4.pdf (PDF, Size: 470 KB)

*Presents some ideas and practical applications with regards to rainwater harvesting in India and other countries as well as possible public-private partnerships*

**Roof Top Rain Water Harvesting in Schools - The First Private-Public Community Partnership on Drinking Water Showing Corporate Social Responsibility**
Available at http://www.globalrainwaterharvesting.org/pdfs/NEW%20RWH_31_07_changes.pdf (PDF, Size: 7.5 MB)

*Completed roof top rain water harvesting tanks in 33 rural schools in Rajasthan and 3 schools in Sikkim by end July 2003 before the monsoons arrived*

**Hope for a Thirsty City: Rainwater Harvesting in Beijing**
Article; by Yingling Liu; World Watch Institute; June 20, 2006
Available at http://www.worldwatch.org/node/4129

*Presents per capita water availability in the city and discusses the RWH alternative, also for abating urban flooding, groundwater depletion, and rainwater runoff pollution*

**Rainwater Harvesting and Utilisation**
Paper; Newsletter and Technical Publications; United Nations Environment Programme
Available at http://www.unep.or.jp/ietc/Publications/Urban/UrbanEnv-2/9.asp

*An introductory guide for decision makers on RWH as an environmentally sound approach for sustainable urban water management presenting global examples, including from Japan*

## *Recommended Organizations and Programmes*

*From Yusuf Kabir, Consultant UNICEF, Kolkata; response 1; response 2*

**People's Science Institute, Uttarakhand**
252 Vasant Vihar-1, Dehradun 248006 Uttarakhand; Tel.: +91-135-2763649/2773849; Fax: +91-135-2760334; psiddoon@gmail.com; http://www.peoplesscienceinstitute.com

*Conducted a field level investigation on different traditional rain water harvesting structures of Uttarakhand*

**United Nations Children's Fund (UNICEF), New Delhi**
73 Lodi Estate, New Delhi 110003; Tel.: +91-11-24690401/24691410; Fax: +91-11-24627521/24691410; newdelhi@unicef.org; http://www.unicef.org/india/

*Implemented "wise-water management" activities which include RWH, recycling of grey water, pumping of water using a roundabout pump and dilution of fluoride contaminated water*

*From T. N. Anuradha, FAO, New Delhi*

**Department of Environment, Government of NCT of Delhi, New Delhi**
http://environment.delhigovt.nic.in/achif.html

*Provides support for eco club programme and sanctions rain water harvesting and R&D projects implemented through RWAs, Academic Institutions, eco clubs*

**Community Led Environment Action Network (CLEAN)-India, New Delhi**
Development Alternatives, B-32, Tara Crescent, Qutab Institutional Area, New Delhi 110016; Tel.: +91-11-26134103/26890380; Fax: 91-11-26130817; cleanindia@devalt.org; http://www.cleanindia.org/

*Undertakes implementation of RWH systems in school by involving school children in creating awareness and understanding various RWH structure and design elements*

**Utthan, Gujarat** *(from Nafisa Barot)*
36, Chitrakut Twins, Nehru Park, Vastrapur, Ahmedabad 380015 Gujarat; Tel.: +91-79-26751023/32926; utthan@icenet.net; http://utthangujarat.org/

*Has an experience of 27 years, in understanding the rainwater harvesting and promoting it from the gender, ecological, economic and political perspective.*

**The Pan Himalayan Grassroots Development Foundation, Uttarakhand** *(from Kalyan Paul, Pan Himalayan Grassroots Development Foundation, Ranikhet, Uttarakhand; response 1; response 2)*
Post Bag # 3, Ranikhet 263 645, Almora District, Kumaon, Uttarakhand; Tel.: +91-5966-222298/221654; Fax: +91-5966-221516; http://www.grassrootsindia.com/; Contact Anita Paul; Community Coordinator; apaul@grassrootsindia.com

*Involved with promotion of the concept of roof runoff rainwater harvesting in schools in the states of Uttarakhand and Himachal Pradesh for the past few years*

**Foundation for Ecological Security, Gujarat** *(from Vijay Dhasmana, Arambh Society, Dehradun, Uttarakhand)*
PB No.29, NDDB Campus, Anand 388001 Gujarat; Tel.: +91-2692-261303; Fax: +91-262087/262196; ed@fes.org.in; http://www.fes.org.in/

*Undertook an initiative of rooftop rain water harvesting for schools in the Bhilwara district, Rajasthan which emphasizes the need for sensitization for water harvesting*

**Action for Food Production (AFPRO), New Delhi** *(from Murali KochuKrishnan, AFPRO, Bhubaneswar)*
25/1-A Pankha Road, D-Block, Janakpuri, New Delhi 110058; Tel.: +91-11-28525452/28522575; Fax: +91-11-28520343; afprodel@afpro.org; http://www.afpro.org/; Contact D. K. Manavalan; Executive Director; ed@afpro.org

*Developed several models of RWH for schools and colleges maintained by the students' community in UNICEF-supported projects in various states*

**The Vigyan Vijay Foundation (VVF), New Delhi** *(from Ajit Seshadri)*
C-3 A/126 C, Janakpuri, New Delhi 110058; http://www.vigyanvijay.org/

*Works with many institutions in the NCR of Delhi to set up RWH systems and create awareness through eco-clubs*

**WaterAid India, Lucknow** *(from Johnson Rhenius Jeyaseelan; response 1; response 2)*
Lucknow, Uttar Pradesh; http://www.wateraid.org/international/what_we_do/where_we_work/india/

*Implemented schemes of rainwater recharge through soak pit helps, which thus ensured sustainability of the source*

**Gramalaya, Tiruchirappalli** *(from J. Geetha)*
12, 4th Cross, Thillainagar West, Tiruchirappalli 620018, Tamil Nadu; Mobile: +91-9443161263; Fax: +91-431-4021563/4220263; gramalaya@hotmail.com; http://www.gramalaya.org/

*Installed 30 roof water harvesting structures in schools, temples and panchayat office, as well as 90 households in Kameswaram, Serudhur, Pudupalli and Nambiar Nagar in Nagapattinam District*

**Feedback Ventures Pvt. Ltd. (FVL), New Delhi** *(from Avinash Zutshi)*
Feedback House, 7 LSC, Panchsheel Park, New Delhi - 110 017; Tel.: +91-11-42009100/42007100; Fax: +91-11-4200 9123; http://www.feedbackventures.com/

*Constructed different RWH systems through a Dutch assisted program in Kerala wherein it was found that systems worked well as a community-based one since costs are shared*

**Desert Marigold School, Valley of the Sun Waldorf Education Association, Phoenix, Arizona, USA** *(from Michael Martin, Independent Consultant, USA)*
6210 S. 28th Street, Phoenix, AZ 85042 United States; Tel.: +1-602-243-6909; Fax: +1-602-243-6933; http://www.arizonawaldorf.org/home/default.asp

*Recently awarded a community garden rainwater harvesting system through Organic Gardening Magazine's Waterworks program*

**Water Partners International (WPI), Tiruchirapalli** *(from Avudai Nayakam S.)*
South Asia Office, D-56, 6th Cross (NEE), Thillainagar, Tiruchirappalli 620018 Tamil Nadu; Tel: 91-431-4023516; http://www.water.org/index.aspx

*Played a major role to promote RWH systems and create awareness among the user community and school children thru various class room sessions and practical orientation*

**Rainwater Club, Bangalore** *(from Ramya Gopalan, Research Associate)*
264, 6th Main, 6th Block, B.E.L. Layout, Vidyaranyapura, Bangalore 560097 Karnataka; Tel.: +91-80-41610190; rainwaterclub@gmail.com; http://www.rainwaterclub.org/

*Undertakes several projects on RWH and provides case studies, design elements, articles and other information on rainwater harvesting and water management in the country*

## *Recommended Portals and Information Bases*

**Rainwater Harvesting, Tamil Nadu Water and Drainage (TWAD) Board, Tamil Nadu** *(from Ramya Gopalan, Research Associate)*
http://www.aboutrainwaterharvesting.com/

*Provides success stories, conservation techniques, rainfall statistics, individual household methods for rainwater harvesting, etc.*

## *Related Consolidated Replies*

**Roof Water Harvesting in Urban Areas for Groundwater Recharge, from Mihir Maitra, ICEF, New Delhi (Experiences).** Water Community. Issued 22 August 2006
Available at http://www.solutionexchange-un.net.in/environment/cr/cr-se-wes-22080601.pdf (PDF, Size: 205 KB)

*Discusses the challenges, and available mechanisms/systems through various experiences of RRWH*

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## Responses in Full

**J. P. Maithani, SFCID, Pipalkoti, Chamoli, Uttarakhand**

Thanks for the information, which you circulated.

You will be surprised to know that though we are in the area which known as the source of water in India i.e., Central Himalayan region of Uttarakhand, there are many villages in our area that face an acute water crisis. This is good initiative where rainwater harvesting is going being done through the rooftops of school buildings.

The state government made it mandatory for all urban buildings to have a provision of rainwater harvesting, without which the design would not be passed. But this is lacking in rural areas. We can propose to the government agency concerned that they can go ahead with the design of improved government buildings and include rain water harvesting and proper storage facilities and this water can be used for gardening, sanitation.

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**S. D. Limaye, Ground Water Institute, Pune**

The comments on RTRH (Roof Top Rainwater Harvesting) in the Government programme for Karnataka rural schools has brought forward many important points:

*It has turned out into a rainwater tank construction programme rather than a programme to provide drinking water to schoolchildren.*

- Construction of tanks is the capital cost item where the money lies and therefore, offers scope for corruption.

*There seems to have been an underinvestment in genuinely deserving cases because the resources have been spread too thin, and investments have been made in schools that already had a reliable source of water.*

- Surely the approach was not need based. The money had to be spent and it was spent where the officers had *convenient connections.*

*Seems to have been an underinvestment...*

- In an average school with 400 students (600 lit/day) providing water for 200 days (excluding rainy season, holidays and summer vacation) would need storage capacity of 120000 lit or 120 cu.m. The tanks of 3 to 10 cu m capacity in the scheme could have been grossly inadequate.

This is why we need active NGOs like Rainwater Club and Arghyam.

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**Johnson Rhenius Jeyaseelan, WaterAid (UK) India, Lucknow** *(response 1)*

WaterAid India in Lalitpur district through one partner SSSO has promoted rainwater recharge. Rainwater recharge through soak pit helps in sustainability of the source. As rain water harvesting tanks need regular O & M, rainwater recharge is considerably easier as there is no need for O & M.

In all hardware implemented, the PTA, sarpanch and school management was involved in planning, procuring quotations, forming of purchase committee, procurement of spares, raising community contribution (labour, cash, material), quality control and O & M after completion. This ensures that schemes are sustainable. School students, teachers, PTA members were trained on the same. So if rainwater harvesting tanks are to be promoted then the above should be ensured.

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**Yusuf Kabir, Consultant for United Nations Children's Fund (UNICEF), Kolkata** *(response 1)*

Thank you for sharing such important information and putting up a valuable query in front of us. It is really unfortunate in the manner the importance of rain-water harvesting has been restricted only to the erection of a structure.

As long as people are not taken in confidence, the faith of such structures is doubtful. Rainwater harvesting is not a new concept to the Indian Society. It is an old traditional practice. PSI, Dehra Dun had an impressive field level investigation on different traditional rain water harvesting structures of Uttarakhand.

However, due to paucity of space, roof-top rain water harvesting is a new concept to our society. But, idea and purpose remain the same.

UNICEF Bhopal has successfully demonstrated a project in a tribal Girls school Hostel in Tirla, Dhar District, where a water safety and hygiene club has been formed from the school children. Already a drought prone area, the Dhar district suffers from severe water scarcity from January to June every year. Global climate change seems to have caught up with this forgotten land as the dry spell seems to grow longer and more intense every year.

Now, in their school, UNICEF and its partners have implemented "wise-water management" activities, which include the harvesting of rainwater, recycling of grey water, pumping of water using a roundabout pump and dilution of fluoride contaminated water. This is all monitored by the water safety club using a water safety plan.

The schoolchildren are given training on water management, water quality monitoring.

Under the Total Sanitation Campaign (TSC) of GOI, there is a component of School Sanitation and Hygiene Education (SSHE), and as per the revised guideline of TSC, RWH has also been included as another component. Under SSHE, there is a concept of child cabinet having different ministers like Education, Health, and Environment. This child cabinet platform can be explored to ensure meaningful participation of schoolchildren and their skill building for proper use and maintenance of RWH structures and bring about a positive change within the communities.

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**Hiren Patel, Development Support Agency, Tribal Development Department, Government of Gujarat, Ahmedabad**

The same problem is widespread in Gujarat as per my experience in rooftop rainwater harvesting systems in schools and the main problem is lack of people's participation. NGOs can play vital role in mobilizing the community effectively by involving not only the community leaders but organizing gram sabhas and discussing the plan with the entire community. If possible, the gram sabha can collect contributions from parents in either kind or cash.

In the absence of such community participation, the channels and pipes that are distributed get damaged or stolen in the summer holidays as both the teachers and authorities refuse to take responsibility for the material. This is happening in many Gujarat schools.

Only systematic planning and community involvement can make a sustainable rainwater-harvesting source in schools. Safe drinking water at the school level is a serious problem.

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**Prabhakar Sinha, Japan International Cooperation Agency (JICA), Bhopal**

Last month I was in Jharkhand, visiting WaterAid-supported water, sanitation & hygiene promotion interventions in the remote areas of Deoghar, Palamu & Latehar. Excellent work is being done by organizations involved. Along with other issues, water conservation and rooftop rainwater harvesting is also on the agenda.

RWH structures have been created in village schools and houses. The structures have been functional for the last 2 years and have benefited the rural masses. The involvement of teachers & children in schools and families in the villages is crucial for success of such systems.

Recharging of underground water and conservation of rainwater for source sustainability is the selling point. Availability of enough rainwater to last for 4-5 months for petty household tasks is an added benefit. Accessing families at their door step to create community consciousness on this issue is the suggested approach. This should be followed by construction of RWH systems in few schools & houses where the people are interested.

Upscaling can be done, but should wait till few demonstration structures in schools/houses are created, accepted and approved by the community. Providing RWH structures without community acceptance and approval would result in dysfunctional systems like many subsidized household toilets, bio-gas plants & smokeless chullahs.

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**Abhishek Mendiratta, Consultant, New Delhi**

In the last few decades, due to the depletion of groundwater, scarcity of drinking water has become a serious problem in parts of the country. In these areas, 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 alternate sources of drinking water supply has become important.

Although the scale of the problem varies by hydro-geological area, the raison d'être for investing in alternate 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 areas has led to a lowering of the groundwater table in many areas.
- Ground water 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 alternate 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 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 drain pipe to a storage container. To prevent leaves and other debris from entering the tank, mesh filters are installed at the mouth of the drain pipe. 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 is not allowed to enter and contaminate the storage tank.

RRH systems have the following advantages for households:

- The convenience of 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. The functionality and reliability of a 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 households cleaned their roofs in Uttar Pradesh while the corresponding number from 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.

The systems in Kerala were generally in good condition, with top covers and first flush devices in place and very few instances of any breakages or leakage from the tanks.

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 shortages in the dry months. This was mostly because:

- In both Uttar Pradesh and Maharashtra, there was an attitudinal barrier against drinking water that has been stored for a long time. Therefore, most of the water collected during the rainy months was used as soon as it was collected with the result that 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.

**Some recommendations that emerge from the study are:**

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

Recommendation: There is a need for better co-ordination among the responsible agencies. For better project outcomes, a demand-responsive, community- 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 to judge the success of the RRH projects, then only the project in Kerala succeeded. In other states, strong attitudinal barriers against the drinking of stored water; measurably low quality of stored water; and the nearly complete lack of water budgeting, led to the failure of the project.

Recommendation: Construction quality must be ensured during construction 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 did not regard the maintenance of the RRH system as their responsibility. As a result, maintenance was poor, especially in Uttar Pradesh.

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

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**Nitya Jacob, United Nations Children's Fund (UNICEF), New Delhi**

Rainwater harvesting has been used for millennia in India and other civilizations for providing drinking water. In all but the heavy rainfall regions, people have, developed systems based on the amount of rainfall, weather and needs. In Rajasthan, the tankas are closed structures to catch and store rainwater, but are built underground to reduce evaporation. In Gujarat, there are similar tanks under houses that store rooftop rainwater.

Rooftop rainwater needs to be filtered and then stored for drinking. Filtration can be done simply by passing it through a layered sand filter, and the water stored in a plastic, steel or concrete tank for subsequent use. The overflow from the tank goes towards recharging the aquifer. Thus, a single system serves two purposes – providing drinking water and recharging aquifers.

In Chirawa, Rajasthan, I saw a school run by the Dalmias with a rooftop RWH. Water from the large roof was channeled into two large underground cement tanks; both open at the bottom so that the aquifers also got recharged. Their combined capacity is around 40,000 litres, enough to supply the school's needs for a few months. The water is used for everything but drinking, for which there is the municipal water supply. The cost isn't a factor here as it was entirely paid for by the Dalmias but in other schools, the money has come from different sources – the education department, sanitation, panchayats, a local philanthropist – but seldom from the community itself.

Under the Total Sanitation Campaign, I have seen models of school toilets where rainwater from the rooftops has been harvested, filtered and used for drinking, flushing and washing hands. The excess is diverted into a aquifer recharge system, usually an unlined well. In the dry season, water is extracted through a pump operated through a merry-go-round or see-saw (that children play on) into an overhead tank. The focus is on water for washing hands, but this can be easily changed to using harvested water for drinking as well as the water quality for both have to be the same.

The drawback is the tanks used for storing the filtered rainwater are too small to hold water for more than a few days. This is due to a lack of planning rather than finances or space, as panchayats in many places are willing to put in the additional funds to get a large tank, and rural schools have plenty of space in their courtyards for large tanks. However, most schools seem to have gone in for 500 or 1000 litre overhead tanks, that will supply water only for a few days. The tanks attached to the rooftop harvesting system are also equally small.

The system works best when the local people contribute a part of the project in either cash or kind, as is mandatory under the campaign, as they also help out in its maintenance. Where this involvement is lacking, as has been documented well in many cases, the system simply breaks down and people do not use rainwater at all. Tanks stink and become cesspools, eventually breeding the very diseases they were meant to prevent.

There are many instances where a school toilet complex, built under National Literacy Mission or other campaign, has been upgraded and a rooftop rainwater harvesting system added by the panchayat. The water is either filtered and stored in (too small) tanks, or directed into aquifers from where it is pumped out through handpumps.

One of the lessons seems to be storing harvested rainwater in tanks does not work, because the quantity that can be stored is limited by the size of the tank. It is possible to provide a 1000 or even 2000 litre tank to hold filtered harvested water but larger tanks become costly (it is roughly Rs 3 per litre of capacity to install a tank). It makes more sense to use the harvested and filtered rainwater for recharging aquifers, and put in a shallow handpump to get the water out as and when needed. Some precautions are needed when installing the handpump, such as adequate drainage, clean aprons, regular water testing and maintenance.

The sanitation work is coordinated by the district sanitation coordinator under the TSC, that is now operational in all districts of India. However, the revised TSC guidelines do not mention rooftop rainwater harvesting to ensure a steady supply of water, one of the main reasons why school toilets are not used and the hygiene loop remains open – a lack of clean water discourages children from washing up after using the toilet.

TSC provides for direct financial assistance to construct or renovate school toilets, and this can be supplemented by the funds of the panchayat or from a Rs 50 lakh revolving fund available to all districts through the campaign – this is meant to be routed through self-help groups. The money can be used to put in place RWH systems to ensure water is available, and the hygiene and sanitation goals are met.

NGOs have, and can, play an important part in educating people about RWH. Starting with traditional wisdom, they can bring in modern systems and emphasise the advantages of using rainwater for human consumption – it is relatively free of pollutants, tastes good, is cheap and easy to collect and does not discriminate on the basis of caste or community. They can help to set up, or provide the technical to do so, RWH systems for individuals, communities and schools. However, given that water cannot be stored in tanks in large quantities, the emphasis should be on a mix of surface storage and aquifer recharge, the latter making water available during the long summer. NGOs can also, with the local panchayats, arrange for exposure visits to speed up the adoption of RWH.

Refer the link below - The Texas Water Development Board's Manual on RWH. Now, that is something coming from the 'oil state' of the United States!
http://www.twdb.state.tx.us/publications/reports/RainwaterHarvestingManual_3rdedition.pdf (Size: 1.89 MB)

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**T. N. Anuradha, Food and Agriculture Organization of the United Nations (FAO), New Delhi**

When I was involved in conducting environment awareness programme (CLEAN-India) in schools of Delhi and few cities in India in 2004 we tried few harvesting techniques in schools, mostly private ones. As a part of the action component of the programme, we did roof top rainwater harvesting and in some schools, we tried tap water harvesting.

The Central Ground Water Authority (CGWA) (http://cgwb.gov.in/NR/cgwamain.htm) helped us in surveying the school premises and suggesting appropriate recharge techniques – recharge pits, trenches, recharge wells, shafts, etc., along with providing designs for capturing the rainwater. In schools it was important create awareness among children about the processes and requires quite a bit of effort to get it going. Getting hold of the school map from the authorities, coordination with CGWA and schools for the design, translating the design into appropriate structures dealing with contractors and coordination between the engineers and schools are some. Sometimes the cost implications discourage schools from taking it up. The eco club programme of Delhi Government (http://environment.delhigovt.nic.in/achif.html) does provide some support but the schools also have to contribute to the cost. Regular monitoring of the construction work and training of school authorities on the maintenance of these structures is an important aspect, like handling first rain, overflow, etc.

Few schools tried tap water harvesting as in schools there is line of taps and children are used to drinking from hand, the overflow was stored in a tank from the drainage and used of gardening purposes. There were separate taps for drinking and washing hands to maintain hygiene. This helped in creating awareness among children about the importance of water conservation.

At that time, we were successful in implementing roof top water harvesting in two schools of Delhi and tap water harvesting in about four schools, it was really a great experience to see water levels rising within a year. Iam sure there are many more schools adopting it now. I think NGOs can play the key role of coordination of such activities with schools and the authorities.

You can refer to
**Rain water Harvesting and Artificial Recharge to Ground water: A guide to follow**
Guide; Central Groundwater Authority, International Hydrological Programme (IHP), United Nations Educational, Scientific and Cultural Organization; September 2000
http://www.unesco.org/water/ihp/publications/water_harvesting.pdf (PDF, Size: 6 MB)

> *Provides examples of roof top harvesting installations successfully operating in India constructed and maintained by CGWB, provide a snapshot of current systems.*

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**Nafisa Barot, Utthan, Gujarat**

Utthan has an experience of 27 years, in understanding the rainwater harvesting and promoting it from the gender, ecological, economic and political perspective. From our experience, we have learnt that promoting 'a technology' (such as roof top rainwater harvesting), becomes a target to achieve rather then the goal of addressing access to safe water.

The question one needs to ask before promoting roof water tank is why is roof water the best option, say in this case, in school. What are the other options? What options would be best managed and used by the school, children in short and long run? This will depend on the consultation and assessment of what

those schools may be practicing presently and their readiness for adapting a new system with responsibility.

I would wish that Government of Karnataka could have given the funds for promoting rain water harvesting (which obviously would include roof top water), this would expose the schools to different options and enable them to select the best option.

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**Kalyan Paul, Pan Himalayan Grassroots Development Foundation, Ranikhet, Uttarakhand** *(response 1)*

Our organisation - Grassroots - has been involved with promotion of the concept of roof runoff rainwater harvesting in schools in the states of Uttarakhand and Himachal Pradesh for the past few years.

The typical size of these underground rainwater storage tanks is 30 to 40,000 litres and most of the rainwater is used for maintaining a set of half a dozen toilets. The teachers and children appreciate the facility and contribute at least ten percent of the initial investment.

So far, we have demonstrated the benefits of this appropriate technology in 40 schools with about 400 children + 20 teachers in each school and over the next year, we would spread the concept of rainwater harvesting to another set of 30 schools.

Both the state governments are aware of this small demonstration and are keen to prepare plans for a larger thrust in this sector.

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**Vijay Dhasmana, Arambh Society, Dehradun, Uttarakhand**

Recently, I had an opportunity to visit the field areas of Foundation of Ecological Security in Rajasthan. I came upon the organization's initiative of rooftop rainwater harvesting in the Bhilwara district for schools.

My interaction with the community (users) reveals that though it is a water stress area, a certain level and kind of sensitisation is required for water harvesting. Unfortunately, otherwise, it becomes a government programme and the infrastructure erodes over time.

In present context, we have no other alternative but to harvest as much fresh water as we can. I offer my best wishes to the various programmes and organizations promoting it.

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**Avudai Nayakam S., Water Partners International (WPI) India Office, Tiruchirappalli, Tamil Nadu**

Indiscriminate exploitation of ground water, increased access to drilling rigs and accessories, combined with the Government policies on subsidized power supply to agricultural pump sets resulted in massive increase in number of borewells being used for irrigation. Such localized extraction of ground water for drinking and irrigation purposes beyond recharge potential of the areas resulted in decline in ground water level. As no consistent efforts are made to bridge the gap between **rapid withdrawal** and **slow recharge**, the declining trends continued in the absence of a sound regulating policy. Thus decline in ground water level rendered many borewells dry either seasonally or completely. In addition, due to demise of traditional water systems in our country put forth hardship of water crisis and conflicts of water sharing among the neighbouring states. To overcome the above situation, one of the best solutions is harvesting rainwater from rooftop of the buildings, as an alternate source of water supply. Harvesting rainwater is conserving ground water; conserving ground water meets demand of domestic, agriculture and industrial needs.

The technical design of the storage structure should not be "one size fits all" concept. The sizing of storage tank should meet the parameters of water demand, available roof area to meet the demand, Demand Vs supply to fix the dimension of the storage structure and space available for construction. The designed capacity of structures should meet at least three to four months water demand during peak summer.

The excess rainwater from rural school buildings could be diverted through channels or pipes for various activities mentioned below,

- Developing kitchen garden
- Kitchen wastewater treatment plant (a simple system of stone-gravel filter associated with plants / grass. The water that is treated can be safely used for gardening purposes and in larger installations can be redirected for use in flushing the toilets.)
- Construction of soil and water conservation structures across the streamlets such as checkdam, nala bunds, earthen dam, percolation tank, subsurface dam, farm pond and gabion dam
- Promotion of Iron removal plants
- Constructions of artificial ground recharge structures such as recharge trenches, recharge pits, recharge pits with boreholes, recharge wells and diverting water to abandoned open wells/ bore wells. (The soil profile, the overall geomorphologic setup and underlying geological structures, mode of weathering and fractures pattern are the factors to determine for favourable conditions of ground water recharge, in addition to availability of runoff and space available for construction.)

*Water – lifeline*

It is important to think of ground water like a bank account – we need to live off its interest (the water that we recharge) and not its capital (the stored water)

Community based water storage structures and individual based Rooftop rainwater harvesting structures are constructed many places in Karnataka, Tamil Nadu, Kerala, Northern and North Eastern States. Based on the experience gained from above activities, a manual was prepared (as co-author) on "Construction and maintenance of household-based roof water harvesting system" for UNICEF. The simple, innovative, low-cost, **Ferro cement technology** was introduced and widely accepted in north eastern states of India for harvesting rainwater from rooftops as drinking water.

In this manual, components of Roof Water Harvesting System (RWHS), design, construction techniques (both for skeletal cage and fabrication of mould), cost estimation, materials / tools required for various capacities of storage structures, tips for maintenance of entire system, water quality aspects and human resource development needs among the user community (for engineers, masons, craftsman, artisans, social workers and community organizers) and feasibility of RWH to be adopted in India especially arid, semi-arid, coastal and hilly regions are described.

**Ferro cement** water tank is cheaper than all other materials like brick, RCC, Stone masonry and steel (It doesn't require any shuttering, scaffolding, vibrator and mixers which cut down infrastructure costs). Most of the Ferro cement tanks are fabricated in-situ by using skeletal cage method and at few places fabrication of mould using corrugated GI sheets are used for construction.

The unit cost required for construction of Ferro cement water tank is around Rs.1.25 to Rs.2.25 per litre. The cost is inclusive of storage structure, downpipe, first flush pipe, gutters and filter units. By using Ferro cement technology, water storage structures ranging from 1000 litre to 25,000 litres have been constructed. Whenever we go for bigger the size of the structure, the unit cost per litre of water reduces. These types of storage structures can be constructed above ground level, below ground level, partly above and partly below GL depends on working space available for construction, soil profile and willingness of the community.

NGOs can play a major role to promote RWH systems and create awareness among the user community and schoolchildren thru various classroom sessions and practical orientation. i.e. on the job training to local masons, plumbers and engineers. One of our past experiences reveals that a local mason whom we trained in Pallithodu village (a coastal village by fishing community in Cherthalai taluk of Allappuzha district, Kerala) has trained more than 20 other masons and constructed hundreds of Ferrocement water tanks in and surrounding of the taluk. His social status has been improved among the community and his income level has been increased manifold.

The sustainability of RWH program depends on effective and efficient methods of implementation of the scheme successfully by various stakeholders such as students committee, school teachers, parents' teachers association, supervisory staff, field workers, social workers and community organizers in government and non-governmental organizations.

**Harvest rainwater individually; enjoy groundwater collectively.**

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**Raj Kumar Daw, Consultant, WASH, United Nations Children's Fund (UNICEF), Abuja, Nigeria**

During 2005-06, as a part of the tsunami recovery effort, WES, UNICEF, Delhi, had supported a programme of construction of household level roof water harvesting systems in Andaman and Nicobar Islands. Most of the inputs were concentrated in the Nicobar District on the islands of Car Nicobar, Kamorta, Katchal and Teressa.

I wonder if there are any consolidated experiences recorded from this programme.

It certainly did pose some problems - pleading with dock officials for warehouse space and shipping passage, moving and storing materials shipped in remote places, food and shelter for resource persons, negotiating with local community "captains" and tribal elders to understand the mechanics of decision making in that environment, finding volunteers to build capacity in the communities to take up construction on their own, making sure that tanks did not get taken away to the road-sides for water from the water-tankers rather than from the roofs, improvising with local material for filters (coral and coconut shell charcoal). On one occasion, a work group from SEUF, Kerala, were stranded on the high seas for a day, because the sea was too rough for their ship to reach the Car Nicobar dock. At another time, the ships crane over-swung (or something similar happened) and the load went into the deep blue sea.

Building the RWH structures was the simplest of our problems. It confirmed the nagging feeling that roof water harvesting is much more than "roof water harvesting". And that was the most important lesson I came away with.

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**M. Jahangir, Drinking Water Pakistan Google Groups, Islamabad, Pakistan**

In Nepal, there is a housing complex for poor, displaced families, with rooftop rainwater harvesting systems along with a sand-bed sewerage water treatment facility. In 2007, there was a drought and the rainwater reservoir was empty, so the people were using groundwater for drinking.

I have found that it is critical to discard water from the first rains as these washes down the dust from the rooftops and is usually polluted with dust and other air pollutants. It is usually sufficient to let water form the first five minutes' rain pass, and collect the rest, to effect cleaning. The initial rainwater collected has a pH higher than 7 in the Kathmandhu area, while that in industrialized regions is acidic.

Rainwater can recharge aquifers and is also popular in Pakistan in hilly areas, where many rooftops are connected to some storage device in households, hotels and restaurants. This has become all the more important given the fall in the groundwater levels and after the intense earthquakes in the northwestern part of Pakistan.

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**P. S. Yadav, Haryana Institute of Rural Development and Department of Development and Panchayats, Haryana**

Rainwater is said to be the purest form of water but nearly 70% is lost as run off. Communities have evolved traditional methods to harvest and store rainwater in areas where rainfall is very low and these are good examples to follow. All of us have to put in our best efforts to harvest the rainwater to tide over times of scarcity.

In place costly water harvesting systems, we should learn about the low cost water harvesting techniques traditionally practiced for rainwater harvesting in Rajasthan. We can also learn from villages of Kuttch (Saurashtra) Gujarat, where communities can harvest enough water to last them for 6 months, even though rainfall is as low as 50-200 mm a year. In the Chamini Village of Uttarakhand, I saw RWH systems in households also.

For schools, RWH systems should be low cost with underground water storage tanks. Resources can be pooled under National Rural Employment Guarantee Scheme (NREGS) for digging of the pit. I have seen such an excellent RWH system in the Central Arid Zone Research Institute in Jodhpur (Rajasthan) several years ago, and more recently in an Engineering College in Sirsa District of Haryana in village Panniwala Mota. Not only schools, all households in the villages should be motivated to practice rooftop rainwater harvesting but systems have to be low-cost.

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**Arunabha Majumder, Jadavpur University, Kolkata**

In areas where water is scarce and quality is a problem, the roof-top rainwater harvesting is a good option for supplying water to village-based primary schools.

The scheme depends on per capita water demand (actual requirement; whether for drinking or for toilet use or both), number of students and teachers, non-rainy days, roof area, rainfall, etc. I understand that the State Government of Karnataka has allocated funds for rooftop rainwater harvesting in village schools for providing 1.5 litres of drinking water per student per day.

If 1 litre of drinking water per student per day were required, then for 200 students and 150 non-rainy days, the storage tank capacity would be 30,000 litres. The proposed 10,000-litre tank would provide 67 students the drinking water for 150 non-rainy period. The calculation may be different if the number of non-rainy days is different.

It is sufficient to provide each student half a litre of drinking water during the 5 or 6 hours of school, and therefore, the tank size can be reduced. The filter must be good enough to remove all suspended and colloidal solids. The water quality needs to be monitored at least monthly using the $H_2S$ strip method. The regular addition of small amounts of disinfectants may be necessary, either fortnightly or monthly. Alternately, water jugs can be given in the classes and a few drops of disinfectant can be added but this depends on actual requirements to be determined by testing water quality.

For the system's maintenance and sustainability, teachers must be trained to manage the system. Students need to be awarded and sensitized. The local panchayat should play a positive role in this context and the primary education department should be involved in the schemes.

An NGO must also be involved to draw up school-wise schemes, water testing, monitoring the system including extending support services. An NGO can take responsibility of a district.

Roof-top rain water can also be stored to meet water demand in the toilets.

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**Arumugam Kalimuthu, WES-Net India, New Delhi**

Rainwater Club and Arghyam are doing excellent work in promoting rain water harvesting in the state of Karnataka. I must congratulate for your down to earth works in this field.

Ground water depletion, deterioration in water quality and increasing demand due population growth have necessitated vigorous steps towards rain / rooftop water harvesting. At the time of launching the rainwater-harvesting project irrespective of small or large scale, the critical question we need ask – is it for drinking or recharging? If it is for recharging and your answer is **'Yes'**, there shouldn't be any arguments and wherever possible / feasible, available rain water needs to be harvested.

If we propose roof water harvesting for drinking, especially in schools, a thorough assessment on the following aspects is important:

- Is rainwater harvesting only option?
- Is it cheaper than any other options, for example, extension of a pipe line from a mini water supply system located even a few km away from the school, that may be cheaper and more sustainable than RWH?
- Drinking water is the most critical part of RWH design calculations because other water requirements for noon meal preparation and hand washing might put pressure on the available storage. In addition, there should be backup plan to address sanitary block water needs for use and maintenance.
- Along with scheme implementation, educating the teachers and students in optimal use of available storage, periodical water quality monitoring (bacteriological) and simple disinfection methods are essential. An evaluation carried out by AFPRO in the CAT project area during the early 1990's on household RWH revealed bacteriological contamination.

Irrespective of all these difficulties and challenges, there were many successful RWH projects across the country. Community based RWH systems exist in Siruthalaikadu, Vedaranyam and Nagapattinam in TN. Here, over 95% of houses are thatched, and therefore the roof of the cyclone centre that is cemented has been used to collect water for the 200,000 litre tank.

The gram panchayat has taken up the maintenance and management and evolved "ration system of water sharing". The lesson learned from the above and other RWH projects is that there can be no blanket promotion of RWH, especially for drinking alone. In case the drinking water need is critical, there is a higher chance of success and in such situation, the users themselves evolve appropriate mechanism for optimum use of water, maintenance and management of the system.

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**Kalyan Paul, Pan Himalayan Grassroots Development Foundation, Ranikhet, Uttarakhand** *(response 2)*

Our organization has been promoting of runoff rooftop rainwater harvesting in schools in the states of Uttarakhand and Himachal Pradesh for the past few years.

The underground rainwater storage tanks have capacities of 30,000 to 40,000 litres and most of the rainwater is used for maintaining a set of six toilets. The teachers and children appreciate the facility and contribute at least 10 per cent of the initial investment.

So far, we have demonstrated the benefits of this technology in 40 schools with about 400 children and 20 teachers each. Other the next year, we would spread the concept of rainwater harvesting to another set of 30 schools.

Both the state governments are aware of this small demonstration and are keen to prepare plans for a larger thrust in this sector.

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**Johnson Rhenius Jeyaseelan, WaterAid (UK) India, Lucknow** *(response 2)*

Communities use harvested rooftop rainwater for village schools when there is no good source in the village. When RWHS is promoted in schools, one has to ensure that there is no misuse of the same by others in the community. Hence, when promoting RWHS, the parent-teacher association, panchayat and school should be involved. Schoolchildren should be trained in doing water quality testing regularly. The system should be promoted where water is scarce and there should be facilities to provide water for the village community as well, otherwise they will use water from the school system when they face a shortage.

The selection of school is also important for RWHS works. Some of the issues to consider while selecting schools are presence of good teachers/headmasters, boundary wall, good relationship with panchayat. The last one is especially important to ensure success of the scheme as both have important roles to play.

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**R. K. Srinivasan, Centre for Science and Environment (CSE), New Delhi**

The presence of bacteria is not an issue, because they are present everywhere and even treated water supplied by water supply agency have it. A simple boiling will do the job. The studies conducted by Dr Padma Vasudevan of IIT Delhi, shows bacteria die after some time in the storage tank due to non-availability of food. Rainwater is better than groundwater which contains arsenic, flouride, iron and pesticides which are difficult to handle and to managed by community in spite of adopting hi-tech filters

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**Rahul Banerjee, Khedut Mazdoor Chetna Sangath, Indore**

In urban areas rooftop rainwater harvesting and the recharging of all wastewater after proper treatment should be made compulsory. This way not only will the problem of water scarcity be solved but also the problem of pollution due to waste water (95% of the storm water and the water supplied for washing and drinking, etc., becomes waste water and causes serious problems).

We have implemented a very low cost and entirely scientific water harvesting and recharging system that also uses this water for cooling the building and thus saves on energy consumption. The video of this process can be seen at the following link http://video.google.com/videoplay?docid=-8600337152533335705&pr=goog-sl.

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**Yusuf Kabir, Consultant United Nations Children's Fund (UNICEF), Kolkata** *(response 2)*

Round about pump is just like forced lift pump, where a merry-go--round or a see-saw attached to a hand-pump and by force water is being lifted to a overhead tank. Some of the schools with technical support from UNICEF in Jharkhand and Bhopal have installed such play pumps. Without any electricity water is being lifted to a tank.

**Surekha Sule, National Institute of Rural Development, Hyderabad**

I would suggest looking at Tilonia (Rajasthan) experience where Bunker Roy runs a school rainwater-harvesting project.

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**Michael Martin, Independent Consultant, USA***

I am a special projects facilitator to a small number of public schools inspired by the Waldorf pedagogy in Arizona in the southwestern United States of America. Although I am not able to respond directly to your post request, one of the schools I work with, the Desert Marigold School in the city of Phoenix, was recently awarded a community garden rainwater harvesting system through Organic Gardening Magazine's Waterworks program.

This project is yet to begin, but we would like to know if there is any interest in developing direct dialogue with 12 to 15 year old youth here by any youth there in the Karnataka schools in relation to the varying conditions and concerns regarding water accessibly, quality, and use, as well as the emergent socio-political water cultures of our two states. You can find more information about our school at: http://www.arizonawaldorf.org/home/default.asp.

** From Yahoo Groups – Water Watch*

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**V.M. Nataraj, Pravara Rural Engineering College, Maharashtra**

I work for an engineering college at Loni, a village in western Maharashtra where rainfall is low. We are trying to utilise rainwater harvesting for some schools. As our institute has several schools & colleges in the surrounding villages under its umbrella, the scheme can be planned implemented and maintained as suggested.

However with government-run schools, although planning and implementation is not a problem, maintenance definitely is. The following few points would be helpful:

- Selecting schools with sizable strength with little or negligible surface & groundwater potential
- Separate storage for drinking and other purposes
- Maintenance is solely the responsibility of the schools
- Students to be trained to use water glasses for drinking, not directly from taps, to save water
- Another is to fill bottles of 1 to 2 litres for each student every day at the elementary level, and discouraging direct use of water for any purpose by suitable laws/rules for students at the higher level
- Periodical/frequent water quality check is the responsibility of Gram/village Panchayat
- A separate fund for maintenance and repairs can be developed by suitably pricing the water available in the premises for any user other than schools

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**Murali KochuKrishnan, Action for Food Production (AFPRO), Bhubaneswar**

The promotion of rainwater harvesting structures in institutions should be done on priority in schools/ colleges to meet the demand for drinking water, especially during summer. The government should select those institutions where the need is severe on the basis of a detailed baseline study and location specific criterion. The structural dimension of the tanks has to be based on the water demand, availability of space for construction, roof area available, etc., rather than a 'one size fits all' approach.

From your write-up, it is clear the performance of the Suvarnajala Programme of the Karnataka State Government in providing drinking water to schools through rooftop rainwater harvesting has been poor. It is based on a target-driven approach of completing the number of schemes within a stipulated time frame, rather than a demand driven approach with an accurate analysis of the needs.

The sustainability of RWH programmes in schools depends on the involvement of students and teachers through eco-clubs/committees. They need to be responsible for distribution of water, operation and maintenance of the RWH system. The quality of the water needs to be appropriately tested to ensure potablity before distribution. The tanks, pipes and roofs need to be cleaned and maintained, before the rainy season to collect rainwater and prevent breeding of mosquitoes, by the student/teacher committee.

Each group in the school needs to play a role in looking after RWH systems. They can be educated and trained through an IEC campaign simultaneously with the planning and implementing of RWH structures. Both senior and junior students can be members of the eco-club so maintenance is not affected even after the seniors pass out from school. These students can be incentivized by giving extra marks for involvement in the eco-clubs to encourage upkeep of rainwater harvesting structures. This will improve the sustainability of the structures. The Parent-Teachers Association with suitable training can monitor the system.

AFPRO has developed several models of RWH for schools and colleges that are maintained by the students' community in UNICEF-supported projects in Andhra Pradesh, Northeast, Himachal Pradesh (Dalhousie), Ranchi and New Delhi. A good example of school-based RWH systems can be seen in the drought-prone regions of Jhabua and Dhar in Madhya Pradesh, where groundwater is contaminated with fluoride. Here, models have been developed exclusively for tribal schools and hostels. Exposure visits for the Government officials from Karnataka can be arranged to understand the process.

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**J. Geetha, Gramalaya, Tiruchirappalli**

I would like to share our experience with regard to the coastal region in the Nagapattinam District of Tamil Nadu that was hit by the tsunami and has a severe water problem. Gramalaya with the grant assistance of WaterAid, UK, and technical help from Mr Vardharajan, installed 30 roof water harvesting structures in schools, temples and the panchayat office, as well as 90 households in Kameswaram, Serudhur, Pudupalli and Nambiar Nagar. The type of houses includes tiled, thatched-roof and concrete houses. The technical diagrams with monthwise rainfall data in the region are painted in the community buildings to inform people about the technicalities involved.

The recent rains in the region helped Gramalaya field test the technology. The families who installed rainwater harvesting structures had enough rainwater for their own needs and sold the surplus at Re.1 per pot. The technology is very simple yet provides safe water to the community. If the roof is thatched, a tin sheet is placed over it, from where a pipe conveys water into a plastic tank after filtration. The water has been tested and found safe for drinking. Now there is a great demand among neighbouring communities and the project can be upscaled to benefit larger population in the region.

Recently, people from Arghyam, WaterPartners International and WaterAid visited the project, as did a team from Himachal Pradesh comprising 9 District Collectors who will replicate the concept in their districts.

Gramalaya is willing to share the documents like the drawings, cost estimates and other technical details and encourages members to visit the RWH structures.

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**Avinash Zutshi, Feedback Ventures Pvt. Ltd. (FVL), New Delhi**

Under a Dutch-assisted programme, FVL has constructed different RWH systems. Our experience shows that for communities, the cost works out to Rs 1,000-3,000 for common storage structures. Ferro-cement tanks (costing Rs. 0.85-1.20/ litre) have found wide acceptance as the cost per family remains within Rs. 2,500-3,000. Another community-based roof rain water harvesting structure (in Mallapuram of Kerala) collects water from the roofs of a group of houses that is filtered and conveyed to an existing well. Most wells have either been abandoned or are in need of a reliable water source as groundwater levels have fallen. The cost per family is lower, at Rs. 1000-1200.

Individual residential roof rainwater harvesting structures cost much more, at Rs. 8000- 10,000. Some households in the Ernakulum district (Win foundation, Sr. Alice), have opted for these systems, but could not be extended to other areas owing to the high costs, without heavy donor or government subsidy. However, in the same area, the same system has worked well as a community-based one as the costs are shared.

In Gujarat, the performance of an NGO-supported rain water harvesting intervention was appalling. The tanks were larger than required, the families selected for constructing the systems did not always deserve support (some were rich enough to pay for the system themselves), the units were constructed to meet project targets without beneficiary contributions and the tanks were sometimes filled by tankers. We would have wished to evaluate the effectiveness of these systems, after servicing of these assets. In the light of these findings, it is necessary to find a modest, cost-effective and lasting model for development.

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**Ajit Seshadri, The Vigyan Vijay Foundation, New Delhi**

The Vigyan Vijay Foundation (VVF) has been working with many institutions in the NCR of Delhi to set up RWH systems and create awareness through eco-clubs. We have found youth are excellent communicators and can become powerful agents of change. In 2004 we organized 5-day environment camps at the Bharati College to create awareness about water, waste and greens. Three schools and their parent-teacher associations as well as people from nearby settlements were invited for the camps.

In 2007, the students organized an eco-club mela at which they demonstrated models of RWH systems, solid waste management and tree plantation.

In 2007-2008, VVF worked with many institutions associating youth as innovators for water conservation, the project was catalysed and supported by Science and Communication (NCSTC-Network) Department Of Science and Technology, Government of India.

Our experience shows there is a definite need for rain harvesting, wastewater recycling, bio-waste composting, and plantation of plants and trees. Awareness and participation requires to be accelerated in schools and colleges with involvement of youth and teachers.

As a result of our drives, we implemented a RWH system in the college with support from the University Grants Commission. The students are involved in cleaning the system and filtration beds, and continue with efforts to raise awareness on water conservation.

Along with RWH, we started solid waste management through collection and segregation, and bio-composting of organic waste on the college premises. This was implemented with assistance from the Environment Department of the Delhi government. Now the Department considered Bharati College as a lead eco-club and similar eco-clubs from other colleges come for interactions on RWH, SWM and plantation.

This has addressed the issue of involving the youth and maintaining RWH systems. We have also found where RWH is done on small campuses; it is appropriate to channelize the water for aquifer recharging

using larger structures or through dried out water-bodies. We have also observed that RWH provides an effective alternative drainage mechanism for storm-rain water at low lying sites to avoid flooding and cesspools during the rainy season.

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***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: Rooftop Rainwater Harvesting for Rural Schools in Karnataka -Experiences. Additional Reply."*

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