The Status of Water in Rishi Valley

A Team of Students and a Teacher

The state of water availability in India is rapidly deteriorating with only 30% of Indians having access to clean, potable water. A study in 2009 indicated that total water demand in India is projected to increase by 89% from 1997 to 2050 with an estimated decrease in per capita availability of ~44% during the same period.

Water availability and the reasons for its shortage are very different in the rural and urban areas of India. In this paper we would like to assess the water situation in Rishi Valley in Andhra Pradesh. Rishi Valley School has a campus of 350 acres and a population of about 500 that live on the campus. The valley has a largely rural population and lies in a rain shadow region with no major river flowing nearby, resulting in dire water shortage. These two factors result in the community having to deal with the resource more mindfully. Recently, the AP government has given the status of a 'Special Development Area' to the entire valley, which includes the school and neighbouring villages. Both the school as well as the 'Special Development Area' have taken the issue of water conservation and recycling very seriously. Despite the initiatives taken on campus, there is still a lot of pressure on the water table with 5 borewells drying up in 3 years. Our aim is to study the conservation, management and reuse of water here in the past 15-20 years. A unique data source we have access to is the statistics on water usage compiled by students of Rishi Valley School in the last 5 years, as part of the school curriculum. Water usage and conservation measures are well studied subjects on campus as part of Environmental Education, a compulsory subject for all classes. We will also conduct interviews with staff members as well as people from the local communities to get a broader perspective on the water problem.

We hope to make note of the patterns or trends through the past years and come up with informed solutions that will be applicable to the current situation. We believe that our analysis of Rishi Valley's water problem and the proposed solutions could serve as a model for other communities of similar size across India.

Rishi Valley : The Community

Rishi Valley is located in Chittoor District of Andhra Pradesh, about 160 km northeast of Bengaluru (Figure 1). Situated in a drought-prone area, it has a largely rural population with agriculture and livestock being the main sources of livelihood. The valley lies in a rain shadow region with no major river flowing nearby resulting in complete dependence on groundwater for all uses.

The Rishi Valley Education Centre(RVEC) and residential school was established in 1931 by the renowned philosopher, J. Krishnamurthi. The campus is spread over approximately 350 acres with a population of about 500.

In 1980, the Government of Andhra Pradesh delineated a 150 acre hillock to the RVEC for the purpose of afforestation. This land has been successfully wooded since, through efforts

at re-vegetation by the students of RVEC and construction of percolation tanks and check dams to ensure soil and moisture conservation.

The Government of Andhra Pradesh declared Rishi Valley and its surroundings, including 33 villages, a 'Special Development Area' (5176.97 acres) in 2008. The RVEC and the Andhra Pradesh Government have carried out pioneering efforts to conserve natural resources and manage water better in the Valley.

Recent History of Water in the Valley

Groundwater serves as the primary source of water for agriculture, livestock and domestic use. Historically, in the Valley, water was extracted through dug and open wells till the late 1970s.

With the advent of borewells in the 1980s, water levels started receding. The Groundwater Department of Andhra Pradesh in 1970-71 reported water levels of about 30 – 50 feet below ground level. Since 1996-1997 there has been a sevenfold increase in the number of borewells. It appears that the water situation grew increasingly worse over the years, as indicated by the 2006-2007 survey of the Groundwater Department that showed a total of 203 borewells in the area, of which 150 had dried up due to seasonal conditions. Today the levels are anywhere from 500-800 feet below ground level.

Situation Analysis of Water Resources in the Valley

Rishi Valley receives both the southwest and northeast monsoons. The average annual rainfall in the last ten years was nearly 880 mm with an all time high of 1170 mm in 2005-06, and a significantly low total of 460 mm in 2003 [7].. As it is in the rainshadow region, rainfall in the valley is erratic and unpredictable. Historical records suggest that droughts are a regular feature in the region, with the last major drought in the 1980s when the water table fell below 200 ft. Interviews with teachers and staff who have been at Rishi Valley School since the 1980s indicate that water was a scarce resource even then and the school had started measures to conserve it.

Water needs of the campus are varied and extensive. Over the years the RVEC has put energy into developing a sustainable community and this has led to the growth of a 100 acre farm (called 'The Estate'), a 16 acre organic vegetable garden and a dairy. Therefore apart from human needs, there are also significant demands on water because of cultivation and livestock. To determine the water outlay in RVEC we have relied on data collected by students. Water usage and conservation measures has been a well studied subject on campus as part of Environmental Education projects. (Environmental Education is a compulsory subject across all classes)

A summary of the data collected and averaged over 8 days from one study in 2009 is presented in Table 1. Nearly one-third of the consolidated water consumption is of the people on the campus for bathing, dishwashing, cooking, cleaning etc. The Estate, with the highest number of borewells, uses water only for cultivation. Although water-intensive crops such as sugarcane and turmeric are grown to reduce our food miles [distance travelled by food to reach a consumer, one part of the entire cost to the environment of food], the

cultivation methods used are water efficient. Sugarcane is grown using the Madagascar system of cultivation where spacing between the rows of the crop are increased to reduce water consumption by 50%. In addition, all the irrigation on the Estate is through drip irrigation which further increases water-use efficiency. The Vegetable Garden, providing approximately 60% of fruits and vegetables to the School, uses drip irrigation nearly 200 days of the year to regulate use of water, but consumes 40,000 litres of water a day. The Dairy used 36,000 litres of water a day to provide milk to the RVEC campus from high-breed Holstein-Friesian cows. As of June 2012, the Dairy has been closed resulting in a significant reduction in water consumption.

While examining the consumption within the school you notice that two of the hostels have the same number of residents but one consumes more than twice the amount of water than the other 32 litres per person per day in the first case and 69 litres per person per day in the second case. Of the 31 staff homes it was found that two houses showed numbers as high as 220+ litres per person per day.

A total of 1,00,000 litres of water is used by the School per day that includes consumption in all hostels, residences, guest houses, the Dining Hall, the laundry service and the hospital.

Coming to water storage on the School Campus, there exist around 21 overhead tanks with a total storage capacity of 268,000 litres which meets about 2.7 days of water consumption by the School. Usage and recharge happen simultaneously and there has never been a case of overhead storage tanks of water being completely depleted.

Awareness and Attitudes of People in the Valley

Many of the remote villages in the Valley do not have clean and hygienic water for their daily consumption. Also, taps in the streets are left open, when water supply is released. Leaking taps are common and the general awareness regarding the need for water conservation is limited – this may be compounded by the fact that nobody on campus and outside in the community pays for water!

We interviewed the *Sarpanch* of the *Thettu Panchayat* (to which RVEC belongs) and some local residents regarding water shortages and attitudes towards water. The interviews show that many people are not aware that they are living on the edge of their fast-depleting water supply. According to some farmers, they try to fix leaking taps and close open taps, but this only addresses a small part of the problem.

Before borewells, water was fairly well managed and shared among all farmers (large and small) through community-based management practices in the Valley. People called *neergattis* allocated water to farmers for agriculture depending on the water levels in the community tanks that were filled by rainwater. Largely dry-land crops were grown which were drought-resistant and depended on rainfall or water from open wells or tanks. The animals were also local breeds which are much less water-intensive than the exotic breeds of cattle maintained these days for milk production. As a result the stress on the groundwater was much less and people had adequate water for potable use and for their livelihoods.

On RVEC campus, students tried to spread awareness through different means. One example is by putting up posters near taps which were used on a regular basis and in excess which asked the users to be careful and reduce consumption of water where possible – mostly near bathrooms and toilets. This worked to some extent and when a follow up was done on attitudes, it appears that this was not enough and there needs to be serious action taken on the unnecessary usage and wastage of water.

Critical Analysis of Water Usage in the Valley

The water stress on the RVEC Campus is due to three main factors: (i) the geographical position of the Valley and its low rainfall. One cannot alter this fact, one of the main reasons that the rain water input in our water cycle is always low; (ii) poor infrastructure in the form of inefficient fixtures and water utilities around the campus. A lot of water is lost in a casual way through faulty water meters, leaky taps, rusty or broken pipes, or leaky tanks. Most often the maintenance staff are notified but students must take more responsibility in this context; and (iii) inadequate awareness among campus residents – students, staff and other residents. Awareness has grown over the years but still water is lost due to the carelessness of people.

A long-term issue is also the overexploitation of groundwater through innumerable borewells. As the data shows, drilling borewells maybe doing more harm than good as each time the we have to go deeper into the water table to extract water.

Innovative Measures for Water Management

For a problem as complex as water, there have to be solutions at all levels. In a community like Rishi Valley that has been around for 80 years, people have identified the problem in the past and come up with solutions for improved water management. But with changes in water usage patterns due to changes in livelihood practices, increased exploitation of the groundwater and the increasing unpredictability of the rains, water has become the most critical and stressed resource in the Valley. As many of the staff and teachers have said in interviews, Rishi Valley has to try and recycle all of its wastewater and see how the existing resources can be used more sustainably. Rishi Valley like any community has a water cycle (Figure 2). At each stage in the water cycle it is possible to implement water saving, reuse or better management as we would like to suggest and hopefully implement.

Water Conservation at Source

Rishi Valley has two main water sources, groundwater and rainfall. A major way of conserving rainwater and run-off is in the form of percolation tanks. Two large percolation tanks were created on campus in the period 1984-86 to collect rainwater and enable groundwater recharge. Further, 52 check dams and 36 percolation tanks constructed across the Valley with assistance from RVEC has resulted in capture of as much rainwater as possible to recharge the groundwater. As a result there is virtually no surface flow of water leaving the valley.

Another effective conservation measure at source is rooftop rainwater harvesting. According to a study by the school, rainwater harvesting could contribute to around 25% of our daily water requirement. An attempt has been made to collect rainwater but there is not an

extensive rooftop rainwater harvesting system functioning in the community. Of the two functional systems, only one of them has a storage tank at the point of rainwater collection due to the cost implications for large secure, storage tanks. Efforts are however underway, to try and cover as many rooftops on campus as possible under the rainwater harvesting scheme. The valley also receives short spurts of rain which are followed by intense sunlight, and most of the water harvested in percolation tanks during these spurts of rain is evaporated due to the intense sunlight. This is where rooftop harvesting could be effective.

The RVEC community also has a student run activity called 'Getting Your Hands Dirty!'. Students (Classes IX to XII) set up check dams and contour trenches to help collect water. They clear water channels by de-silting them as well as removing vegetation that may interfere with water flow to the percolation ponds or tanks. Therefore one of the ways in which the community can collect rainwater more efficiently would be by setting up storage tanks at the point of collection.
The water from the rooftops and borewells is conveyed to overhead storage tanks on the RVEC campus. From here the water is sent for the various uses such as domestic consumption, laundry, kitchen and dining hall, agriculture etc. Drinking water is passed through a reverse osmosis plant where the water is purified to meet the drinking water quality standards by the Bureau of Indian Standards. At all of these stages water can be reused and/or recycled.

Water Conservation through Maintenance
One of the most critical issues that need to be addressed is timely and effective maintenance of leaky taps, broken pipes or disused tanks. The Building Department on campus when notified addresses any complaint immediately. Students must take more responsibility and participate in notifying the authorities as soon as they notice any loss of water due to poor fixtures.

This also applies to water meters used to measure the amount of water used in a day. There are 40 working meters while 22 malfunctioning ones. There are 7 or more structures completely devoid of water meters. If this situation is attended to, at least we will have a clear idea of the water consumption within campus.

Water Conservation during Consumption
At the consumer's end e.g. in the school kitchen, residences, hostels, water saving devices could be installed in a phased manner. These could include water saving taps with small nozzles, dual mode flushes in toilets (so you don't always flush using the entire stored water), etc.

RVEC has an efficient water storage system which apparently has not gone dry in the past 15 years. Therefore, it appears that there are no major improvements, apart from routine maintenance, that need to be made in this part of the water cycle.

Drinking water is treated prior to use by using a reverse osmosis system. Some percent of the input water is discharged as waste since it contains a very high concentration of salts extracted from the water. The percentage of water recovered for drinking varies with the

quality of the membrane used in the system, the back pressure and the quality of input water. In most households, due to low back pressure, recovered water is as low as 15%. In large industries with high back pressure but low membrane quality, the yield of recovered water increases by 45%. In RVEC the 75% of the water is recovered because of the high quality of the membrane and the input water also being of good quality apart from the moderately high level of total dissolved salts.

One of the best ways to improve the water situation in the Valley is by reusing and recycling the grey water and sewage to the maximum extent possible. Wastewater from the residences, hostels, dining hall and other places can also be reused / recycled completely. Estimated quantity of sewage per day is 24,500 litres and washwater (from bathrooms and kitchen) is about 30,000 litres per day. On campus all the sewage (black water) is treated in septic tanks except for a block of boys' hostels. Here the sewage and the washwater from the bathrooms (grey water) is treated using a Decentralised Wastewater Treatment System (DEWATS) which is a combination of physical and biological treatment methods. The treated water is used to irrigate fruit trees in the Estate. The performance and viability of this system is being examined for replication in other parts of the campus.

At present the grey water from most hostels, and residences is being re-used (without treatment) for the irrigation of fruit trees including the mango grove. Some staff members too use their waste water for plants and not leaving it to join the sewage.

While researching possible solutions for better water management, we looked at another community that has learnt to use water efficiently – Auroville in Pondicherry. Auroville uses 'Planted Filters" - natural functioning systems where grey water passes through the root zone area of a series of plants that clean the water and deliver a high quality effluent. Planted filters use a large amount of space, but in Rishi Valley, this would not be a disadvantage - they could be beautifully landscaped into almost any environment.

A similar root zone treatment system is used as part of the DEWATS plant for treatment of sewage at RVEC. Here canna and gladioli are grown and the sewage that has been treated by a microbial treatment system passes through the root zone of these plants to emerge as quality water for irrigation. This kind of root-zone treatment could be used for all the buildings on campus so that potentially all the black water could be partially cleaned up and reused.

At present our washwater is used un-treated for irrigation. However, RVEC intends to cover all agricultural areas on campus with drip irrigation to reduce losses due to evaporation. To enable this, the washwater will have to be treated to remove any suspended solids. Various options including Root Zone Treatment are being explored in this regard.

Another promising option is the concept of Living Machines. These systems are constructed wetlands with several different plant and animal species actively filtering the water. A conventional wastewater recycling unit produces toxic by-products that then need to be segregated. In the living machine concept, heavy metals and other manmade chemicals can be converted into and segregated as biomass. It can be an efficient way of letting nature

clean sewage and grey-water. We do not know of any community in India that has incorporated this concept as part of water recycling. We feel that Rishi Valley could be enormously benefited if this system was implemented here and could also serve as an important pilot test for other communities.

Another way to significantly reduce water usage would be to procure milk from farmers outside the campus and shift the dairy to local breeds that have much less water needs and are also hardier.

In summary, the points in the RVEC water cycle where recommendations for better management are being suggested include:
(i) more widespread rooftop rainwater harvesting and collection;
(ii) timely and routine maintenance of water fixtures and replacement with more efficient structures;
(iii) gradual replacement of the septic tanks with Planted Filter systems like DEWATS for treatment of sewage and recycling using the Living Machines concept.

Critical Summary

Water is the most precious resource in Rishi Valley – not just for the school, but for the entire Valley that is dependent on it for its life and livelihood. Water is a common property resource that all of us in the Valley share and must therefore be managed by and for all the communities in the Valley!

Given this interdependence, efficient management of this resource is not just important but essential for our existence. RVEC is possibly the largest community in the Valley and therefore consumes a significant share of this resource. Hence it is our responsibility, as a community to take all the necessary measures to reuse, recycle and reduce water consumption to the extent possible.

We need to lead by example. While we are conscious of the way we use water, as shown in the essay, there is a lot more that we can do to use this resource sustainably so that the livelihood of the community around us is not compromised.

Through this essay we have tried to present simple, yet innovative practices through which water can be used judiciously. We have also tried to show how by mimicking natural systems “Living Machines” can be set up to reuse and recycle water. We hope to implement the various measures recommended in our essay effectively so that we can be a model community where the water cycle functions as a “closed-loop.” This is the only way forward for the Valley and its people whose lives are intricately shaped by WATER.

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Note: This article is an abridged version of the report submitted to Earthian. For the complete, original report, with references, please visit:
http://www.wipro.org/earthian/documents/1001148_Rishi%20Valley%20School_WATER_AND_THE_VALLEY.pdf