Chapter Four

Safe Drinking Water Scheme in Villages: A Sustainable 4P Model

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Over the course of the past few years, the Byrraju Foundation (BF) has found that water sources are still polluted in the villages they work in. Even after the filtration and chlorination of water under the Rural Water Supply (RWS) Scheme, water tests have shown that this drinking water does not even meet the most basic standards. To address this issue, BF came to the conclusion that the most viable option is to separate the drinking water from the rest of the quantity supplied by RWS. Towards this end, 52 community-based plant is supported by the Gram Panchayat (local village governments), the local communities, BF and a Panchayat-Public-Private Partenership (4P) model. This plant produces 1000-2000 liters of purified water an hour and provides access to safe drinking water for 800,000 people in 160 participant villages.

Appropriate treatment processes to purify water have been implemented to suit the characteristics of input/raw water. The purified water is delivered at a user charge of one cent a gallon which ensures its sustainability. The overarching concepts and technologies have been modified to allow the community to operate this plant. Based on this successful experiment, BF plans on setting up similar plants, as sustainable rural enterprises, in a cluster of three villages with a population of 8,000-10,000 people. A few agencies, including the United Nations-Human Settlement Program, have replicated this model and set up 12 plants within and outside Andhra Pradesh, providing

access to safe water to 100,000 people. This paper, presents a case study that includes the features of this scheme, in terms of community participation, operation, sustainability, impact and lessons learned.

About Byrraju Foundation and Its Activities

BF, a not-for-profit organization dedicated to rural transformation, was been set up in July 2001. The Foundation seeks to build progressive self-reliant rural communities, with a holistic approach, by providing services in the areas of healthcare, school education, adult literacy, drinking water, environment, sanitation, livelihoods, agri-advisory services and disability rehabilitation. The Foundation currently works in 185 villages spread over 6 districts in the state of Andhra Pradesh. BF specifically works in the East Godavari, West Godavari, Krishna, Guntur, Ranga Reddy and Visakhapatnam areas. The Foundations aims to positively transform the lives of nearly a million people directly and double that number indirectly.

BF, since its inception, made rapid strides in implementing rural transformation programs, with active involvement and support of community, in the participant villages. BF distinguishes itself from other such organizations by its holistic approach with the emphasis being on creation of "soft infrastructure" to capture knowledge processes that are used in rural initiatives. These practices are perfected by starting with the identification of needs and the customized design appropriate to the areas and the communities that we work with. The experience gained from every initiative allows us to make dynamic changes to our efforts so to ensure optimum delivery. These experiences create knowledge processes that are replicated thereafter with minimal customization. BF has used it core values which embrace 6-Sigma as the tool for designing new processes and making improvements in the existing processes by involving people, applying knowledge and making things happen. All the programs of BF are divided into modules, which are well-defined value creation activities, each one having a detailed process map with clear-cut methodologies and outcomes ensuring the realization of objectives in successful implementation.

Drinking Water Situation in Villages

Safe water, though very important for maintaining proper health, is unfortunately a low priority for social health programs. In most of the villages, where BF is working, 63% of villages are dependent on irrigation canals and the remaining 37% of villages use ground water. Under the RWS scheme, most of the villages, especially in delta region,

have a pond that is fed by the irrigation canal at regular intervals, which stores the required quantity of water. The water in the pond is passed through Slow Sand Filters (SSF) followed by an occasional process of chlorination, before being pumping into an overhead tank for distribution. This distribution is conducted by system of pipes that reaches a few homes having individual connections but gives access to the majority of population through common stand-posts.

Over the years water bodies are polluted due to various contaminants. The quality of raw water in the pond is extremely poor, resulting in frequent clogging of SSF's, which are designed for the raw water turbidity up to 30 NTU. But the actual turbidity is much higher, especially during the monsoon, going up to 130 NTU. The SSF's are designed for 16 hours of operation with 3-phase power, so as to supply 40 litres of treated water per capita daily. But the 3-phase power is available only for 6-7 hours a day in most of the villages which restricts the operation of SSF's to produce the specified quantity. In many instances, this leaves people to resort to pumping of untreated (raw) water. Further, the lack of adequate funds does not allow proper maintenance of the SSF's.

BF has found the presence of coliform, turbidity, chlorides and other physical and chemical impurities in excess of permissible levels in the water supplied through the RWS scheme (though this water has passed through filtration and chlorination.) On account of the above mentioned parameters, it has been observed that RWS water in 78% villages does not meet the safe water requirements. If the need for 0.2 ppm of residual Chlorine is also considered, 96% villages failed in meeting such norms. In case of upland areas, which depend on ground water, in a few pockets, high levels of TDS, including fluorides, in excess of WHO norms, have been observed.

To address the issue of providing safe drinking water, the Byrraju Foundation came to the conclusion that one viable option is to separate the drinking water from the rest of the water supplied through RWS in villages. Towards this end, a small plant, producing 1000-2000 liters an hour pure drinking water, supported jointly by community, Gram Panchayat and BF was set up. The product water, free from harmful bacteria and other impurities, is delivered in a 12-litre food-grade HDPE. User are charged US$ 0.035 in order to run the unit on sustainable basis.

Efforts of Byrraju Foundation in Providing Safe Drinking Water

Strategy

Reducing levels of pollution in the irrigation canals is a gigantic task, which needs a lot of resources, time and effort. BF, having realized the problems, has developed a strategy to address the situation on a long-term sustainable basis.

Out of 40 liters of water per capita daily supplied by RWS, about 2 litres is used for drinking purpose, which comprises of 5% of the total quantity to be supplied in villages. It is much easier to treat 5% of water supplied to drinking water standards rather than the entire quantity. So, the Foundation came up with the idea of setting up of a small community based plant producing 1000-2000 litres an hour pure water, for every 3 villages, using the best technology, to be operated by the trained youth from the village whenever normal power is available. Its sustainability is ensured by the collection of user charges for operation and maintenance. Quality of the product water is monitored strictly and local Science Colleges are involved in regular testing and quality control.

BF, involves Gram Panchayat, the community, individual donors, corporates sponsors and philanthropic organizations, in setting set up water plants. This collaboration makes it a panchayat-public-private partnership. Gram Vikasa Samiti (Village Development Committee) (GVS), a nine-member team of volunteers, representing different sections of society, including women and youth, formed and institutionalised by BF in all the participant villages, monitors the activities, on behalf of community, at the village level. Amongst donors were a few non-resident Indians as well, who contributed for this venture in the villages where they and/or their parents were born/lived. The following responsibilities are discharged by various stake-holders in this initiative:

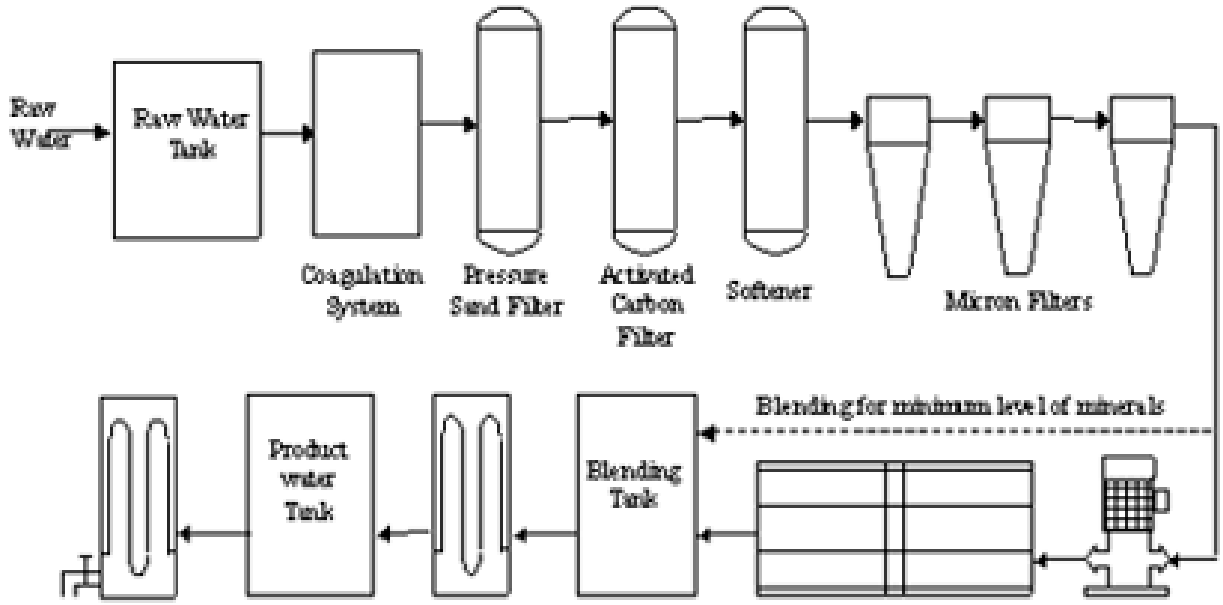
Gram Panchayat	Community (GVS)	Byrraju Foundation
Permission to draw raw water	Minimum 50% cost of equipment	Up to 50% cost of equipment
Allotment of land	Construction of Building	Selection of vendors For equipment, Technical guidance in setting up of the plant

Power Connection at Concessional tariff	Participation in operation of plant and distribution of water	Testing of water and quality assurance

Purification Process

Initially, a pilot plant, jointly supported by Gram Panchayat, Community and BF, was set up in Gollalakoderu (near Bhimavaram in West Godavari District of Andhra Pradesh), in July 2004.

A schematic diagram indicating broad outline of the purification process is given below:



Operation and Maintenance

The quality of input water is continuously checked in a thorough fashion for various parameters, like, turbidity, physical and chemical impurities, bacteria and dissolved solids in order to ensure 100% satisfactory performance. Based on the levels of impurities/ bacteria, the process parameters are set for its effective removal. To overcome the power-cuts, plant is operated on single-phase, as it is available for 12-16 hours a day in village, on flexible timings, using voltage stabilisers for maintaining quality of power. 100% standby for all the critical components, like, Pumps, Motors, UV Lamps, Voltage

Stabilisers, Multi-port Valves and adequate stocks of consumables are maintained within the close distance to the Plant.

The suppliers of the Plant are ensured trouble free operation by abiding by an annual maintenance for the initial 5 years. For every 5 plants, a maintenance team is deployed within close vicinity of a cluster of villages by the supplier of equipment, so as to attend to regular preventive and break-down maintenance. Layout of Plant and components have been standardised so that the plants, operating on similar conditions, can effectively share inventories for proper operation. The GVS member identified for water programme oversees the operation and maintenance of the plant.

Capacity Building

The operational capabilities of a program are enhanced by the capacity building aspect of the community. This process identifies and solves problems by systematic community participation. To facilitate this, BF imparts skills to the community/GVS on self-reliance in setting up and meeting operational expenses for various services through user charges and/or mobilization of funds and also leadership development for its efficient and systematic implementation. For operation of Water Plant, unemployed youth, identified by GVS, are imparted adequate training on various issues, such as, technical aspects, operation, hygiene and cleanliness, testing of water quality, account keeping, marketing, simple repairs, distribution of water, etc. Initially, BF through its field staff, oversees operation and maintenance of water plant. After stabilizing the unit, creating an awareness on drinking safe water, planning of logistics for delivery of water and ironing out any deficiencies in the operational and distribution matters, the running of the plant is handed over to GVS or an entrepreneur or a self-help group. The first option given to plant operators is to form an entrepreneur or Self Help group. BF has already handed over maintenance of 9 plants to local entrepreneurs under the close supervision of GVS and more are in the pipeline to be handled so. The surplus generated is used for common good of the community in the village.

Sustainability

Sustainability of the project is ensured as (a) Project is demand driven, (b) Users are involved right from the beginning of the project implementation, (c) Empowering the Management and Users' Committee in taking responsibility of operation and management of the scheme, and (d) Cost recovery mechanism with participation of consumer. The Project is designed as a financially sustainable model, involving community in the

investment. BF believes that, in the absence of an effective taxation mechanism, the community need to generate their own economic surplus to achieve financial sustainability for social initiatives. The key factors required to realize economic potential are (a) Financial deepening, (b) Market access or the crucial link to generate revenues and sustain growth, and (c) Knowledge management which is the exposure to modern systems and process driven approach. The water project connects the formal financial markets with community thus becoming a working evidence for link between social capital and financial intermediation. The economics of operation, which is result of improvement over the years, is depicted below:

No	Item	Non-RO	RO
1	Capital Expenditure (including building US$ 10000)	17500	20000
2	Production of water per day in liters (average)	7000	7000
3	Distribution of water per day in liters (average)	6000	6000
4	User Charges @ US$ 0.035 for 12-liter can per year	6400	6400
5	Annual Recurring costs in US$:		
	- Manpower (3 persons)	2700	2700
	- Power, Consumables, Maintenance, Depreciation and miscellaneous expenses	1900	2900
	TOTAL expenditure per year US$	4600	5600
6	SURPLUS per year in US$	1800	800

BF facilitates the economic sustainability of community in poorer sections so that the social leadership can implement holistic transformation programs effectively. Water Plant is a profit-oriented enterprise, a part of the surplus generated is ploughed back for implementing various activities to benefit the community. It can also be run as an enterprise, which breaks even at distribution of 4000-4500 liters daily. Unemployed youth from village are provided training for operating the plant. One helper is engaged, for delivering 120-150 water cans, by rickshaw at the door-step of consumer, charging additional amount of 1-3 US Cents per can, depending on the distance. A van is deployed for carrying water cans to little far away places, say beyond 4-5 km from the plant. In all, employment for 5-6 persons is ensured per each plant.

Impact

Access to clean drinking water has transformed the village landscape in many ways as its consumption has improved health leading to reduced expenditure incurred otherwise towards treatment of water borne diseases, reportedly accounting for 80% of ailments, thereby enlarging productive time. The impact is quite perceptible among the children, in regards to the reduction in absenteeism in attending school due to sickness leading to improved learning, as water from these plants is supplied free of cost to the schools and health center. The initiative benefited the community in the following aspects:

- 52 water plants in BF villages and 12 plants in other places were set up (as on February 2008)
- Access to safe drinking water provided to nearly 800,000 people in BF's 160 villages and about 100,000 people in other places
- About 46% of people on regular basis and 5-10% people on and off consume BF water
- Over 300 million liters of safe water distributed to the poorer sections of the society, covering old age pensioners, destitutes, Orphanages, Anganwadi (nursery) Centres, Schools, etc.
- Number of patients visiting BF health clinics in the villages with access to BF water dropped by 15-30% and the expenditure on medicines declined by 10-22% after consumption of BF water, leading to improved quality of life, attributed due to relief from water borne diseases
- Provided livelihood opportunities to nearly 250 youth within villages

Lessons Learned and Challenges

Initially, the pilot plant at Gollalakoderu did not foresee high levels of suspended matter. These impurities increased during monsoon period and also summer months when canals feeding fresh water are closed for 6-8 weeks for repairs and also due to reduced water in the reservoir. A small scale coagulation unit to remove most of suspended solids was set up thus reducing load on sand filter and micron filters. Further, ozonation was also introduced to improve shelf life and quality of product water. In some villages, which distribute higher quantity of water, a diesel generator has been installed to meet the requirement of electric power.

Though BF desires that the poorest of the poor can afford to consume safe water, the main challenge is to reach them effectively. Although BF is creating awareness and educating the community by demonstrating the contamination levels in present water systems, their mind set is something very difficult to change in a short span of time. Added to it is the cost element, as vast majority in the community want drinking water at no cost and at or very near to their doorstep. Despite realizing the importance of consuming safe drinking water, the common practice of drinking from available sources for years inhibit them from wanting to pay for product water, no matter how safe it may be. But the reality that the naturally available resource is polluted does not strike them immediately. Continuous and constant persuasion can only motivate them to switch over to safe water.

Distribution of product water is another issue. While those in close vicinity of the plant collect the water, people living far from it need to put in extra effort or spend on transport. The poor condition of roads, more so in monsoon time, distracts transporter to carry the water for door delivery. To improve distribution system, mobile units to process water at different locations, including hamlets, which are far from main water source, are another option for ensuring higher levels of penetration. However, the realization and need for safe options is increasingly felt and the trend is towards searching for better sources.

Replication

Based on the experienced gained, BF is confident of setting up of small community-based water purification systems for a cluster of 2-3 villages/locations, having 8000-10000 population, as a sustainable enterprise. The concept and technology have been proved to make the community to operate the Water Plant on their own because (a) The technical design of the plant, the process and the choice of equipment are very sound (b) The recurring cost of running the plant is not a burden on the donor/sponsor, and (c) Willing participation of the community is possible. Appropriate treatment processes have been put in place to suit different situations and the model, with incipient potential of generating income, is replicable across other regions/countries in a sustainable manner. BF guided and assisted quite a few organizations agencies in implementing the scheme. United Nations-Human Settlement Program (UN-HABITAT), under Water for Asian Cities Program, signed a Cooperation Agreement with BF in setting up one plant each in Indore (installed in Dec 2007), Jabalpur (both in Indian State of MP), Laos, Nepal and Uganda.

Environmental Issues

BF's water initiative addresses environmental issues through treatment of contaminated water thus providing safe water for drinking purpose. The refuse and wash water, after purification (usually 4% of total production in case of conventional process and up to 50% in case of RO system), is recycled to charge the ground water table or used for irrigation purpose or in its absence let into drain. In case of Kandlakoyya Plant, the reject water is used to irrigate kitchen garden and lawns in an old age home thereby following the practice of conserving the water. The product water is distributed in food-grade HDPE cans safe for storing water. These cans last a year and can be recycled without posing problem of degrading the environment. BF developed a low cost H2S vial, costing 20% of market cost, for testing bacteria and the glassware used for this is recycled thus reducing generation of more waste. In summer months, effective micro-organism solution, made locally in the Laboratory, is sprayed for controlling growth algae, which increases due to intense sunlight and also restricted supply of fresh water, in the pond instead of other chemicals thus following environmental friendly practice. The yarn of used/discarded micron filters, is used to making products, like door mat, swing, muffler, cushion cover, floor mopper, thus not wasting this material either.

Quality Assurance and Control

Quality of product water is tested everyday at plant for key parameters, like, bacteria, TDS, residual chlorine, pH, etc. Elaborate tests are carried out in a well-equipped Laboratory in a Degree College for these as well as other chemical and physical parameters on weekly/fortnightly basis. In addition, the presence of crucial parameters, like fluorides and nitrates, which require costly and sophisticated apparatus with high level of skill, is analyzed in other laboratories accredited by National Board of Accreditation for Laboratories and Test Houses(NABL) on six-monthly basis. Based on these test results, it has been observed that the water samples passed quality tests, 99.8% times across all the plants, during the last one year, against the a set target of 99.5%.

Recognition

The experience gained, technological and social outcomes obtained through this intervention, are widely disseminated through presentation/publication of papers (listed below), consultation/guidance extended to other NGOs, etc. Process Document, listing out treatment processes, operation and maintenance, and management issues in running the Plant, has been developed and distributed amongst interested agencies.

BF has been rated 'Best Water NGO-Water Quality' in India by Water Digest (A global magazine for water solutions) and UNESCO for the successive years 2006-07 and 2007-08. Global Development Network, conferred Japanese Award for 'Most Innovative Development Project-2007 (2nd prize) for the water scheme. The project (working model), exhibited during the 95th Indian Science Congress held at Visakhapatnam during January 3-7, 2008, has been rated Outstanding Display by the delegates. The work has been reported in a few publications and a couple of them are mentioned below:

1. "The Byrraju Foundation's 4P model of Quality Drinking Water in Villages" published in 'India Infrastructure Report-2008: Business Models of Future' by Oxford University Press (Edited by 3i Network: Indian Institute of Management-Ahmedabad, Indian Institute of Technology-Kanpur, and Infrastructure Development Finance Company Limited), February 2008, pp 183-185.
2. "Pro-poor Water Purification and Bottling" published in 'Local Actions for Sustainable Development: Water and Sanitation in Asia-Pacific Region' by UN-HABITAT, Asian Development Bank and Asia-Pacific Water Forum, December 2007, pp 99-102.

The Greatest Barrier to Clean Water Access

Though many issues concerning water distribution have been receiving attention of governments, the real problems in supplying safe water are not addressed to adequately. High levels of contamination and unsanitary conditions make water non-potable causing water borne diseases. Growing scarcity and rapid degradation of the water bodies will pose a greater threat for well-being of people. Grant of heavy subsidy on consumption of electrically operated pump sets not only results in wasteful use depleting water table but also contaminates due to leached pesticides, fertilizers, etc. The conflicts on sharing of waters in flowing rivers, between neighboring states, are flaring up often, leading to many habitations in the down stream opting for drawl of sub-surface water from deeper levels having higher amounts of undesirable impurities.

Ineffective distribution system driven by heavily subsidy driven system of water supply is another cause for not meeting the demand. A proper pricing mechanism for supply and distribution of clean water needs to be evolved which can prevent its misuse to a large extent. Like energy security, which is well recognized by the policy makers, water security needs greater attention which encourages industry to recycle used water and reduce waste in the domestic front. A policy that encourages conservation, efficient use of existing resources, minimum level of wastage, prevention of leakages, proper

purification, strict compliance of quality standards, and enforcement of regulatory measures will go a long way in minimizing the water scarcity to a great extent. Privatization or corporatization of water purification and its effective distribution needs to be seriously considered to prevent the above situation. Creation of greater awareness and an informed public opinion can make a huge difference for proper and efficient use of water.

Testing of water and the infrastructure required thereof is inadequate, especially in village situations. A proper system, with the involvement of community, local institutions and health agency, for water testing at habitation level needs to be advocated. A reliable, user friendly and simple to use kits to test water samples in rural areas should be made available.

Future Goals of Byrraju Foundation

In addition to 52 plants in operation, 9 more plants are under various stages of construction and the same will be commissioned (in stages) within next 2 months. With this, all the 185 villages will have access to purified water. This proposition means one water plant for every 3 villages, each with a total population of 5000.

Due to various reasons, attributed mainly to lack of awareness, affordability and accessibility, about 45-50% of the people are only consuming BF water, with the remaining continuing to depend on the existing sources, how unsafe it may be. With continuous and constant efforts in educating the community on ill-effects of drinking un-safe water, it is expected that more and more people will switch over to safer options, leading to increased levels of penetration of BF water. In such a scenario, BF would like to eventually have one plant for every two villages or of every village to have a plant in the long run. This allows cutting down the costs on transportation of BF water besides resolving the issues related to distribution, especially in summer months, when demand goes up. This will also lead to possible reduction in the user charges and also generation of higher amounts of surplus. To meet the demand, BF intends to set up 30-35 more plants, in public-private partnership mode, within the next few years.

BF would also like to continue extending help to other NGOs and Corporate Social Responsibility arms of organizations in establishing such units in villages and also slum locations within urban areas. BF would also like to play an active role in advocacy to influence the government and policy makers in opting for most reliable and effective safe drinking water schemes on sustainable basis. BF strongly believes that consump-

tion of safe water will lead to children growing in a healthy environment and community contributes to the well being of its own people.