Kurukshetra

A JOURNAL ON RURAL DEVELOPMENT

Vol. 63 No. 07 Pages 52 May 2015 ₹ 10

Rural Drinking Water

Strategic Plan – 2011- 2022
Ensuring Drinking Water Security In Rural India

This is a strategic plan for the Department of Drinking Water and Sanitation in the rural drinking water sector for the period 2011 to 2022. The Plan is broadly set out in the following parts

- Aspirations and Goals for the Strategic Plan of the Department of Drinking Water and Sanitation and the rural drinking water sector as a whole.
- The current situation, and challenges concerning the rural drinking water sector.
- The Strategy and Implementation Plans for different objectives: The Department of Drinking Water and Sanitation has identified five Strategic Objectives (Source Sustainability; Water Quality Management; Sustainable Service Delivery (O&M), Strengthen Decentralised Governance, and Build Professional Capacity to achieve its overall objective of providing improved, sustainable drinking water services in rural communities.
- The Implementation Plan under each Strategy provides options from which each State can formulate its own Implementation Plan depending on its needs, capacity and resources, and establish a timeframe for achieving transformation.
- The Learning Agenda, Resources Required and Key Performance Indicators to monitor progress against the Strategy and Implementation Plans.
- The Government of India, through the Department of Drinking Water and Sanitation, has already taken significant steps to meet this challenge through the National Rural Drinking Water Programme (NRDWP).
- To help operationalise the NRDWP by setting out a Strategic Plan in terms of aspirations, goals, objectives and strategic initiatives for the sector for the period 2011-202

Aspirations

All rural households have access to piped water supply in adequate quantity with a metered tap connection providing safe drinking water, throughout the year, that meets prevalent national drinking water standards, leading to healthy and well nourished children and adults and improved livelihoods and education. Continuous uninterrupted water supply is an aspiration and efforts should be made to cover increasing numbers of habitations with 24x7 water supply.

Goals

To ensure that every rural person has enough safe water for drinking, cooking and other domestic needs as well as livestock throughout the year including during natural disasters. By 2022, every rural person in the

Contd. on Cover III

The Monthly Journal

Kurukshetra

MINISTRY OF RURAL DEVELOPMENT

Vol. 63 No. 7 Pages 52

May 2015

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SUBSCRIPTION :
INLAND
1 YEAR : ₹ 100
2 YEARS : ₹ 180
3 YEARS : ₹ 250
ABROAD (AIR MAIL)
ONE YEAR
₹ 530 (SAARC COUNTRIES)
₹ 730 (OTHER COUNTRIES)

CONTENTS

Sales Emporia : Publications Division: *Soochna Bhavan, CGO Complex, Lodhi Road, New Delhi -110003 (Ph 24365610) *Hall No.196, Old Secretariat, Delhi 110054(Ph 23890205) * 701, B Wing, 7th Floor, Kendriya Sadan, Belapur, Navi Mumbai 400614 (Ph 27570686)*8, Esplanade East, Kolkata-700069 (Ph 22488030) *'A' Wing, Rajaji Bhawan, Basant Nagar, Chennai-600090 (Ph 24917673) *Press road, Near Govt. Press, Thiruvananthapuram-695001 (Ph 2330650) *Block No.4, 1st Floor, Gruhakalpa Complex, M G Road, Nampally, Hyderabad-500001 (Ph 24605383) *1st Floor, 'F' Wing, Kendriya Sadan, Koramangala, Bangalore-560034 (Ph 25537244) *Bihar State Co-operative Bank Building, Ashoka Rajpath, Patna-800004 (Ph 2683407) *Hall No 1, 2nd floor, Kendriya Bhawan, Sector-H, Aliganj, Lucknow-226024 (Ph 2225455) *Ambica Complex, 1st Floor, above UCO Bank, Paldi, Ahmedabad-380007 (Ph 26588669) *KKB Road, New Colony, House No.7, Chenikuthi, Guwahati 781003 (Ph 2665090)

Editorial

It is a huge challenge to provide potable water to over 85 crore plus people living in rural India. Despite investment of massive sums since the first five year plan, inadequate water supply to rural areas continues to be a major national problem. The gravity of this could be understood by the fact that about 3.7 crore people are affected by waterborne diseases annually and 15 lakh children die due to diarrhoea alone. About 8 crore people are at risk, due to excessive fluorides and arsenic in the groundwater, the main source of drinking water in the country.

However, in order to accelerate the pace of coverage of problem villages with respect to provision of drinking water, the Government introduced the Accelerated Rural Water Supply Programme (ARWSP) in 1972–73. To address the major issues like sustainability, water availability and supply, poor water quality, etc., the Rural Drinking Water Supply Guidelines were revised in 2009 and known as National Rural Drinking Water Programme (NRDWP). This programme focuses on moving from habitation level coverage to household level drinking water coverage, from dependence on single drinking water source to multiple sources, ensuring sustainability in drinking water schemes and preventing slip back ,encouraging water conservation methods including revival of traditional water bodies. Convergence of all water conservation programmes at the village level and ensuring household level drinking water security through water budgeting and preparation of village water security plans are some of the major initiatives. It made an effort to move away from high cost treatment technologies for tackling arsenic and fluoride contamination to the development of alternative methods. It also encouraged handing over of management of rural drinking water schemes (RWS) to the Panchayati Raj Institutions.

Yet, with a large population living in rural areas more needs to be done , so that every rural household enjoys clean and safe drinking water.

In the Twelfth Plan, while the ultimate goal is to provide households with safe piped drinking water supply at the rate of 70 lpcd , as an interim measure , the goal would be 55 lpcd under NRDWP . By 2017, it is targeted that at least 50 per cent of rural population in the country (as against 35 per cent today) will have access to 40 lpcd piped water supply within their household premises or within 100 metres radius. By then, it is also targeted that at least 35 per cent of rural population have individual household connections as against 13 per cent today.

Further the government's Strategic Plan for ensuring drinking water security in rural India by 2022 , aims at providing 90 per cent of rural households with piped water. It is hoped that all Government's efforts will go a long way in providing access to clean drinking water to every rural household in near future. ❑

WATER AVAILABILITY-THE CHALLENGE

M.A. Haque

In India most of the precipitation is in monsoon. During other months there is little precipitation. But the tragedy is that large fraction of the water is not captured. Neither does it percolate underground nor is it stored on surface. It goes to the oceans or evaporates. Average annual rainfall in India is about 1170mm varying widely from about 100mm to about 10,000mm in different regions. The total precipitation is about 4000bcm (billion cubic metre). About 1869bcm remains available for use but all cannot be utilized due to topographic constraints. About 1123bcm remains utilizable. If we talk of per capita, the utilizable water is 1086m³. By 2050 it will come down drastically to 760m³. That is why World Bank says that India will exhaust its fresh water by 2050.

That may not be true but needs introspection. Unfortunately, only 48% of country's rainfall ends up in rivers. Only 18% remains utilizable. Due to storage crunch it is not possible to capture more. In fact we should have concentrated towards better storage infrastructure. The reality is opposite. We are destroying historical ponds, lakes, other wetlands and even rivers and streams in the lust for more land.

The main rivers, Ganga, Bramhaputra, Mahanadi, Godavari, Krishna, Kaveri, Indus, Narmada, and Tapti, flow into the Bay of Bengal or Arabian Sea. These rivers fall into four groups: Himalayan, coastal, peninsular, and inland drainage basins. The Himalayan rivers depend on snow and glaciers, therefore have continuous flow year round. The coastal rivers, especially on the west coast, are short in length with small catchment areas. The peninsular rivers, which include the Mahanadi, Godavari, Krishna, and Kaveri flow inland and greatly increase in volume during the monsoon. As far as the rivers of the inland drainage basins are concerned, such as the Mahanadi and the Godavari, they dry out or are lost in the sands.

Water Is Scarce: About 70% of the earth's surface is covered by water. It could mean that there is more than enough water on the earth. But we rarely consider that about 97.5% of the total water is saline. Only about 2.5% is "Fresh Water" i.e. not saline can be directly consumed by us and most of the land organisms. Further out of the total fresh water on earth around about 68.9% is in the glaciers and about 30.8% is groundwater. Only about 0.3% is in rivers, lakes, ponds, streams and few other sources where we can access easily. Certainly, this quantity, about 0.007%, is too small. This water is

readily available for about 7.3 billion people and for other land organisms. Living organisms always need water. Certain organisms have more than 95% water. Human body has about 60% water. These levels cannot vary much although water is regularly lost. That is why organisms require regular water replenishment.

Apart from direct consumption, water is required by us for producing food, for dilution and treatment of wastes, and to maintain health of the environment. Both Industry and Agriculture too need water. For example, 800 to 4000 lts are needed for producing one kg of wheat; 2000 to 8700 lts for one kg of cotton; about 100 lts for one apple; about 2400 lts for one average sized hamburger. Thus agriculture and related activities consume huge quantities of fresh water. Still there is large scale wastage of food all over the world. Another issue is that water intensive crops like rice, cotton, sugarcane etc. are regularly cultivated in water deficient areas. This explains why during the last century water use has grown at more than double the rate of population growth. Estimates indicate that during the last 50 years world-wide water withdrawal has grown three times.

Water Scarcity and Contamination: Presently almost 1/3rd of the total earth's population is not able to get sufficient water for drinking requirements. By the middle of the current century 2/3rd of the world could face water scarcity. United Nations confirms that by 2025, about 1.8 billion people will live in water scarcity areas and two-thirds of earth's population will live in water-stressed regions due to overuse, increased activities, and also due to climate change. Climate change and consequent rise in earth's temperature will lead rains becoming uncertain and water evaporation faster.

People living in the developing countries are the worst sufferers. They have to compromise not only by way of quantity but also by way of quality. Most of the water sources are polluted and contaminated. Providing safe water is costly.

India

For India this issue has immense importance. An important reason is that ground water is the most important source of water supply, especially for the rural areas. Rural culture has developed historically utilizing ground water through dug wells or tube wells. Successive governments have been talking about safe drinking water but that too means pumping underground water and supplying the same. Purification and treatment etc, are almost non-existent in rural areas. Till a few decades back this kind of arrangement was acceptable as the ground water was generally uncontaminated and free from toxic pollutants. Precipitation water percolated down, naturally filtered and stored. In last five or six decades industries have developed at an unprecedented pace. Parallel to that, urbanization is expanding fast. Both of these i.e. industries and urban areas overuse water and also dump wastes in water and on land. The wastes carry different pollutants, including highly toxic substances.

Sadly only 10% of the country's industrial effluents and municipal sewages are treated before dumping. As a result not a single river or lake in the country is free from pollution and contamination. Even the ground water is unsafe. Contaminants and pollutants, percolating down, degrade the ground water making it unfit for consumption. In large cities and towns some treatment is given before the water is pumped for consumption. In small towns and rural areas water is used directly. That is why water related health problems are enormous.

More than 1.5 million children are estimated to die of diarrhea alone every year. Estimates are that the country loses 73 million working days due to waterborne disease every year. People suffer economically in a big way at individual and community levels. People in rural areas suffer much more on account of factors like use of untreated water, inadequate health facilities, poverty, low level of education and awareness etc. Contamination of water due to natural chemicals adds another dimension. Fluoride, arsenic and iron present in the substratum contaminate ground water. About two lakh habitations face this kind of problem in the country, especially in rural areas. Open defecation prevalent in large areas of the country adds to contamination of water sources. Only 14% of the rural population has access to latrine of some kind. Obviously, the rest defecates in open. Where latrines are present if they are not properly built, they also lead to contamination of the ground water.

There are other sources of water contamination which are generally ignored. One such source is the use of fertilizers. India is the world's second largest consumer of fertilizers, consuming about 26.5 million tonnes per year. At the time of the Green Revolution (1966-67) consumption of fertilizers was only about 1 million tonnes. There

is nothing wrong in the use of fertilizers if done scientifically. But the tragedy is that in India most of the farmers apply fertilizers without any proper assessment of the requirements. Large fractions of the nutrients remain unused. With irrigation or rain water the nutrients reach surface water bodies or to the ground water causing eutrophication and contamination. Also, pesticides are regularly used in agriculture. In 2009-2010 consumption in the country was about 41,822 metric tonnes. In 1991-1992 the consumption was as high as 75,000 metric tonnes. Thus there is reduction in consumption due to Integrated Pest Management, use of bio-pesticides and ban on Heptachlor, Chlordane and BHC etc. Still the quantity is quite high. If the pesticides are not utilized correctly, the chemicals contaminate the environment including water. There have been frequent reports of pesticides poisoning. Muscle degeneration, organs failure, cancer etc. are commonly caused by the toxic chemicals. In affected areas a special terminology, "the devil's water" has been coined for that.

Another dimension is the animal waste. Only a third of the nutrients fed to animals are utilized. Excess nutrients are most pronounced in poultry production operations. Consequently, animal and poultry wastes are important sources of pollution of land and water sources. Studies from China, India, the United States and Denmark have proved this. Phosphorus excretions may be about seven to nine times that of humans, affecting the environment, including water.

Water Use in Agriculture: India needs to boost agricultural production for its growing population and the rising aspirations of people, who now spend more on food. As a result water consumption is increasing. But large quantities of precious irrigation water go waste. Over-irrigation is common. Also, there are seepages and leakages at different stages, resulting in over-extraction of water. In several states power is subsidized for agriculture which indirectly encourages over-irrigation. This fact is obvious from the fact that as per the assessment of the National Commission for Integrated Water Resources Development (NCIWRD) about 83% of available water in the country is used for irrigation. The rest 17% meets the demand for domestic, industrial and other sectors. For the year 2050 the Commission has estimated that the demand will grow to 1180bcm. This estimate takes into account possible improvement in efficiency of surface water and ground water systems and also better and more efficient water use in different sectors, which may happen or may not happen.

Stressed Ground Water: Ground water is the most important source of water supply in the country for very large areas, more so for the rural areas. Total static groundwater available in India is about 10,812bcm. The average groundwater recharge rate of India's river basins is about 260m³/day. Estimates suggest that India has about 432bcm of groundwater which is replenished annually through rain and river drainage. Out of that about 395bcm is utilizable. About 82% of it is used for irrigation and agriculture. The remaining i.e. only about 18% is available for domestic and industrial use. With growth in demands groundwater is increasingly being pumped from lower levels and at much faster pace than precipitation can replenish it. As a result in most of the areas, water tables are dipping fast. There are approximately 20 million individual wells in India that are contributing. Owners of these wells do not have to pay for water, so there is no incentive to conserve or recycle water. Estimates suggest that India is pumping out some 190km³ of underground water a year. Nature is refilling only 120km³. So, there is shortfall of 70km³ per year. The consequences are obvious. In large parts of the country the water table is sinking. Agriculture is a big sufferer. Crops fail or give less than expected production. The poor and marginal farmers are the worst affected. They cannot upgrade pumps regularly. The rich ones do so. The surface water sources which were traditionally used by smaller farmers have mostly vanished or dry up fast. As a result at many places the small farmers have committed suicides. Also, in several areas farmers have started opposing utilization of water by industries.

In addition to agriculture drinking water is a problem in large areas. We need to remember that the rural population of India is more than 700 million living in about 14.2lakh habitations. The rural population does not have enough clout to get water supply from outside. Lack of education, poverty, socio-economic differences further complicates the matter. Under the circumstances women, have to work harder to meet the water requirements for their families. They may have to trudge for several km for one or two buckets of water. Even in a place like Cherrapunji there is scarcity of water after rains

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MEETING DRINKING WATER NEEDS

Rasmita Sahoo

Clean water isn't a luxury. It is a basic human right. Rural India has more than 700 million people residing in about 1.42 million habitations spread over 15 diverse ecological regions. Meeting the drinking water needs of such a large population can be an unnerving task. The non-uniformity in level of consciousness, socio-economic development, education, poverty, practices and rituals and water accessibility add to the complexity of the task. Inspite of an estimated total of Rs. 1,105 billion spent on providing safe drinking water since the First Five Year Plan was launched in 1951, lack of safe and secure drinking water continues to be a key obstacle and a national economic burden. Access to safe water is necessary for lives and livelihoods.

In India, a mid-term assessment reveals that the country has already met its MDG (Millennium Development Goal) in terms of expanding access to water substructure, although in the parallel subsector of sanitation progress is falling far short of the mark. Actually most basic observations indicate that water supply coverage is not as good as the figures show while national sanitation continues to be poor even after almost six decades of efforts to eradicate open defecation. It argues that economic, technical, institutional as well as social factors constrain access to safe drinking water and proper sanitation in India for both the urban and rural poor, and that coverage figures do not reflect this restricted access. It finds that, increasingly, communities are being required to manage their own water and sanitation schemes, not just in rural areas but in urban ones as well.

In India around 37.7 million people are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhoea alone and 73 million working days are lost due to waterborne disease each year. The subsequent economic burden is estimated at $600 million a year. While 'traditional diseases' such as diarrhoea continue to take a heavy toll, 66 million Indians are

at risk due to excess fluoride and 10 million due to excess arsenic in groundwater. In all, 1,95,813 habitations in the country are affected by poor water quality. It is clear that the large investments have not yielded comparable improvements in health and other socio-economic indicators.

It is predictable that by around 2020, India could be a 'water stressed' state with per capita availability falling to 1600 cu m/person/year. A country is said to be water stressed when the per capita availability of water drops below 1700 cu. m/person/year.

Availability of drinkable water in rural areas is strongly interlinked with rural development and growth and displays direct, positive results for human health and well-being, especially for women and children. As the burden of obtaining drinking water is shouldered by young girls, stress-free availability results in better school attendance among girl children. Women tend to benefit from the reduced drudgery and improved quality of life. Therefore, effective policy attention to the drinking water sector has the singular positive distinction of being biased towards women and girls. Sanitation facilities expand the health of rural inhabitants and their quality of life. The rural environment also benefits from better drainage and waste management practices.

The main issue in drinking water, now is not so much setting up schemes for safe drinking water but sustaining the schemes through a maintenance mechanism.

Issues in Rural Drinking Water

The main issues are institutional development, financial viability, and protection of water sheds for water sources besides the leakages in distribution system.

The main issue in drinking water, now is not so much setting up schemes for safe drinking water but sustaining the schemes through a maintenance mechanism. Reforms in the rural drinking water sector were adopted in 1999 through Sector Reform Project (SRP) on a pilot basis and scaled up all over the country in the form of *Swajaldhara* launched on 25 December 2002. The programme is a paradigm shift from supply driven to demand driven, centralized to decentralized implementation transforming the government's role from service provider to facilitator. The fundamental reform principles in *Swajaldhara* are adhered to by state governments and fulfilling agencies through a strategy to develop a vision, mission, and approach to sector development through multi-stake holder participation process. Demand-responsive approach with community participation is based on empowerment of villagers to ensure full participation in the project in a decision-making role, in the choice of the drinking water scheme, planning, design, implementation, control of finances, and management arrangements including full ownership of drinking water assets. The community has to share partial capital cost either in cash or kind or both, taking on 100 per cent responsibility of operation and maintenance (O&M).

The demand-responsive approach is a move towards more decentralised rural water supply, based on the micro-demand for rural water and line up coverage. Methodologies exist that help villages to select the appropriate water supply scheme based on socio-economic and technical criteria. A key part of the institutional strengthening for more efficient and sustainable water supply is the necessity to ensure the centrality of Panchayats in planning and implementation. Since Constitutional status was given to Panchayati Raj, the culmination of first generation reforms can be seen. But, the political empowerment and the formal devolution of matters to Panchayats through state legislations, with the supply of drinking water, have not been very effective excluding in certain states,because of the lack of concomitant transfer of funds and functionaries to the Panchayats. Nevertheless, there is increasing realization that only large-scale involvement of the Panchayats can ensure sustainability. This is also matched by increasing booms from the large number of elected representatives of Panchayats, who feel disillusioned by the mismatch between

the formal transfer of powers to the Panchayats and the continuing de facto hegemony of technical departments who are neither subordinate to nor accountable to the Panchayats.

Rajiv Gandhi National Drinking Water Mission (RGNDWM)

The Accelerated Rural Water Supply Programme (ARWSP) was introduced in 1972-73 by the Government to assist the States and Union Territories to accelerate the pace of coverage of drinking water supply. To ensure maximum inflow of scientific and technical input into the rural water supply sector to progress the perfomances,cost-effectiveness of the on-going programmes and ensure adequate supply of safe drinking water, the entire programme was given a Mission approach. The Technology Mission on drinking water and related water management was launched in 1986. It was also called the National Drinking Water Mission (NDWM) and was one of the five Societal Missions launched by the Government of India. The NDWM was renamed Rajiv Gandhi National Drinking Water mission (RGNDWM) in 1991.

> one of the most important aims of the government is to ensure safe water supply to the rural areas.

Sanitation and drinking water for all in rural India

Conventionally water supply in India was inadequate to the major cities within the spread of the process of urbanization. Declining health standards in the rural areas urged the post-Independence government to take serious initiatives to improve the rural drinking water and sanitation. Now, one of the most important aims of the government is to ensure safe water supply to the rural areas. This initiative was first taken up by Accelerated Rural Water Supply Programme (ARWSP) in 1972-73. Between the years 1972 to 1986, the goal of ARWSP was to ensure safe water supplies to rural zones. ARWSP was renamed Rajiv Gandhi National Drinking Water Mission in 1991-92 with additional stress on rural water supply coupled with community planning and management of drinking water. Five factors that were kept in mind were:

(i) Sustainability of water supply
(ii) Portability
(iii) Suitability
(iv) Accessibility
(v) Equity and Affordability

Based on these considerations, the National Rural Drinking Water Programme (NRDWP) evolved in 2010. According to the NRDWP report, 2010 more than 5.6 million hand pumps and over 1.2 lakh piped water schemes have been installed in the country under the "Rural Drinking Water Supply Programme". However, the majority of the schemes have become non-functional and many other permanently defunct due to non-availability of funds.

According to recent statistics, 44 million are affected by degraded water quality with the excess of fluoride, arsenic, iron, nitrate, heavy metals and salinity. Only 18.7% of villages have safe water supply while 51.1% depend on wells, tanks and other sources. 32% of the villages do not have any water supply.

According to a recent UNICEF report, 638 million (54%) people still defecate in the open and only about 50% of Indians regularly wash their hands with soap after contact with excreta. It is therefore evident that rural sanitation is a Herculean task.

Poor sanitation and lack of toilets cost India nearly three lakh crore rupees because of hygiene related illness resulting in poor productivity. The problem is not only economic but of human dignity also. The practice of manual scavenging still exists very much in our country which is the worst violation of an individual's right to life with dignity.

Water and Sanitation tracks percentage of population with access to improved drinking water sources and improved sanitation, including pit latrines and toilets. There are two indicators: Access to Drinking Water and Access to Sanitation.

Access to Drinking Water measures the proportion of a country's total population with access to an "improved drinking water source" as a key source of drinking water. An improved drinking water source is defined as a facility or delivery point that protects water from external contamination particularly fecal contamination.

Access to reliable, safe water reduces exposure to pollution, disease, and harmful contaminants, thereby promoting health and wellbeing. For example, diarrhea is the leading cause of death among children, and is directly caused by consumption of contaminated water. Access to Sanitation is vital for maintaining healthy drinking water supplies, minimizing contact with dangerous bacteria and viruses, and minimizing environmental threats associated with improper waste management.

Implementation of Rural Water Supply Programme

The prime objectives of this programme are-

(i) To ensure coverage of all rural habitations with access to safe drinking water.

(ii) To ensure sustainability of drinking water systems and sources.

(iii) To tackle the problem of water quality in affected habitations.

(iv) To institutionalize the reform initiatives in rural drinking water supply sector.

Rural water supply is a state subject. States have been taking up projects and schemes for the provision of safe drinking water from their own resources. Nonetheless, recognizing the importance of providing safe drinking water in rural habitations, Government of India has been providing financial back up to state governments.

Implementing Agencies

State governments decide the implementing agencies for the programme. The agencies may be the Public Health and Engineering Department (PHED), Rural Development Department or the Panchayati Raj Department.

Implementation is also taken up by the Government Boards/Nigams/Agencies in a few states, for example, the Gujarat Water Supply and Sewerage Board is the implementing agency in Gujarat. Uttar Pradesh Jal Nigam is the agency in Uttar Pradesh and Tamil Nadu Water and Drainage Board in TamilNadu.

***Swajaldhara*:** The Government has been emphasizing the need for taking up community-based rural water supply programmes, and now has decided to open up the reform initiatives in the rural drinking water supply sector throughout the country. This programme is called *Swajaldhara*.

The key elements of the Programme are:

(i) Demand-driven and community participation approach

(ii) Panchayats/communities to plan, implement, operate, maintain and manage all drinking water schemes

(iii) Partial capital cost sharing by the communities upfront in cash

(iv) Full ownership of drinking water assets with Gram Panchayats

(v) Full operation and maintenance by the users/ panchayats

Beneficiary Groups, Gram Panchayats and Blocks adopting the reforms principles will be eligible for *Swajaldhara* Projects. The 10% community contribution of the estimated capital cost of the schemes upfront (5 percent in case of predominantly SC/ST habitations as per 2001 census) will be integral part of the project. The cost of the project excluding community contribution will be abundantly met by Government of India.

National Rural Drinking Water Programme (NRDWP)

In the Eleventh Plan the major issues identified in the drinking water sector were the problem of sustainability, water availability and supply, poor water quality, need for decentralized approaches and financing of O&M cost while ensuring gender and social equity. Taking cognizance of these issues, and in an effort to address the emerging issues, the RGNDWM has modified the existing rural water supply guidelines. The major changes in approach are in respects to:

- Source sustainability, community managed programmes and recognition of the gap between infrastructure created and service available
- Installation of a water source will not be considered as the criteria for fully covered habitation, but adequate water supply received by all household of the habitations will be the criteria.
- Change the lpcpd (litres per capita per day) standard as a mean of measuring availability of water, but look at larger and various indicators of water security;
- Focus on ensuring household level drinking water security through preparation of village water security plans and household level water budgeting.
- Conjunctive use of surface and groundwater and focus on rainwater harvesting for recharge. For old and new ground water schemes, recharge mechanisms will be made compulsory;

Conclusion

India's demand for water is growing even as it stretches its supplies. Water infrastructure is crumbling, averting the government from being able to supply drinking water to its citizens. Pollution is rampant by unfettered economic growth, poor waste management laws and practices. Although many analysts believe that demand will outstrip supply by 2020, there is still hope for India. Water scarcity in India is mainly a manmade problem; therefore if India makes significant changes in the way it thinks about water and manages its resources soon, it could ward off, or at least mollify, the impending crisis.

Apparently, India needs to make water supply a national priority the way it has made food security and economic growth priorities in the past. India's need for a comprehensive management program is severe because of its rapidly depleting water supply, environmental problems, and growing population. If this continues India will see a sharp decrease in agricultural production, which will negate all of the previous efforts at food security. The water crisis will have a big effect on India's industrial sector, possibly rotting many industries. India has the power to avoid this dark future if people take action immediately: start conserving water, begin to harvest rainwater, treat human, agricultural, and industrial waste effectively, and regulate how much water can be drawn out of the ground.

Government has made a Strategic Plan for providing drinking water supply in rural areas of the Country. Under the Strategic Plan for rural drinking water supply for the period 2011-2022, covering the two Five Year Plan periods, the interim goal till 2017 is to cover 50% of all rural households with piped water supply, and 35% of rural households with household tap connections. By 2022, the goal is to cover 90% of rural households with piped water supply and with 80% having household tap connections.

(The author is a Research Scholar at Academy of International Studies, Jamia Millia Islamia Central University, New Delhi)

INNOVATIVE GOVERNMENT INITIATIVES FOR RURAL DRINKING WATER SUPPLY

Dr. Arpita Sharma

"An improved drinking-water source is one that by the nature of its construction adequately protects the source from outside contamination, in particular from faecal matter."-WHO.

Drinking water is water safe enough to be consumed by humans or used with low risk of immediate or long term harm. Over large parts of the world, humans have inadequate access to potable water and use sources contaminated with disease vector, pathogens or unacceptable levels of toxins or suspended solids. Drinking or using such water in food preparation leads to widespread acute and chronic illnesses and is a major cause of death and suffering worldwide in many different countries. According to WHO in 2010, 89 per cent of the world's population, or 6.1 billion people, used improved drinking water sources, exceeding the MDG target (88 per cent); 92 per cent are expected to have access in 2015. In 2015 the WHO/ UNICEF JMP projects that 605 million will still not have access. To provide safe drinking water; Government has taken some urgent actions, some new projects and programmes related to drinking water have been initiated. This paper presents a bird's eye view of budget allocation for drinking water supply, recent initiatives for drinking water, new technologies for drinking water supply, future plan of Government for drinking water supply.

Budget allocation for Drinking water supply: [A] Budget 2014-15: The National Rural Drinking Water Programme (NRDWP) is a flagship programme of the Government and a component of the Bharat Nirman with the objective of ensuring provision of safe and adequate drinking water supply through handpumps, piped water supply etc. to all rural areas, households and persons. The NRDWP (formerly Accelerated Rural Water Supply Programme ARWSP) subsumes the programme of ARWSP, Swajaldhara and National Rural Water Quality Monitoring & Surveillance. Under this Centrally Sponsored Scheme financial assistance is provided to States/ UTs for coverage of all rural habitations, including quality affected habitations with safe drinking water provision; Sustainability measures for drinking water sources and systems; Operation and Maintenance of existing rural water supply schemes, Support activities like IEC, training, MIS and Computerization etc. and Water Quality Monitoring and Surveillance. A provision of ₹11,000 crore has been made for

NRDWP and the rural water supply sector including ₹ 1100 crore earmarked for North-Eastern Region and Sikkim. Further, 22 per cent of the total allocation i.e. 2420 crore and 10 per cent amounting to ₹1100 crore is earmarked for meeting expenditure on Scheduled Caste Sub-Plan and Tribal Sub-Plan respectively for the year 2014-15. **[B] Budget 2015-16: Many of our drinking water sources have excess impurities like flouride, arsenic and manmade contaminations due to untreated sewage, industrial effluents and leaching of pesticides and fertilizers. Total ₹ 3,600 crore has been earmarked under National Rural Drinking Water Programme for providing safe drinking water in approximately 20,000 habitations affected with arsenic, fluoride, heavy/toxic elements, pesticides/ fertilizers through community water purification plants in next 3 years**.

Recent Government Initiatives for Drinking water supply

[A] Updates in National Rural Drinking Water Programme [2014-15]: Provision of safe drinking water is a basic necessity. Rural drinking water supply is a State subject and has been included in the Eleventh Schedule of the Constitution of India, among the subjects that may be entrusted to Panchayats by the States. To accelerate the pace of coverage of problem villages with respect to provision of drinking water, the Government of India introduced the Accelerated Rural Water Supply Programme (ARWSP) in 1972–73, to support States and UTs with financial and technical assistance in implementing drinking water supply schemes in such villages. In order to address the major issues like sustainability, water availability and supply, poor water quality, etc., the Rural Drinking Water Supply Guidelines have been revised w.e.f. 1.4.2009. The revised program is known as National Rural Drinking Water Programme (NRDWP). The recent updates in NRDW programme are given as follows: [**i] Safe Drinking Water [2015]:** In year 2015 government through the National Rural Drinking Water Programme has adopted the goal to provide every person in rural areas with adequate safe water for drinking, cooking and other domestic basic needs on sustainable basis. In next eight years, 90 per cent of the household will be covered and provided with safe drinking water. **[ii] Domestic water tap connections [2014-15]:** The objective of the whole programme is to provide pure drinking water to rural people to protect them from water borne diseases. To fulfill this objective one major step from the Government side is to provide domestic tap connections in all the households**.** Chhattisgarh has bagged the top position in the country for providing the highest number of domestic water tap connections in 2014-15 under the National Rural Drinking Water Programme (NRDWP). About 88,000 domestic tap connections have been provided so far in the current financial year. This is the state's second major achievement after bagging first position in the country for installing solar pumps. The Central Government had given a target of 30,000 water connection for the year 2014-15 under the programme, Chhattisgarh is ahead of all the States in providing water supply with the help of solar pumps. **[iii]Potable drinking water supply** Government has decided that [i] by 2022, at least 90 per cent of households are provided with piped water supply; at least 80 per cent of rural households have piped water supply with a household connections; less than 10 per cent use public taps and less than 10 per cent use hand pumps or other safe adequate private water sources at present: [ii] provide enabling support and environment for all Panchayati Raj Institutions and local communities to manage 100 per cent of rural drinking water systems.

[B] Drinking Water and Sanitation Awareness Week [16-22 March 2015]: In view of low awareness in villages on use of toilets and safe handling of water, Government has decided to launch a "National Rural Drinking Water and Sanitation Awareness Week" across all states. The week from March 16 to March 22, was observed as World Water Day, to "accelerate awareness in villages" across the country on sanitation and rural drinking water. The focus of the campaign was to "create total awareness on Swachh Bharat Mission to keep villages clean, build and use of toilets, importance of hand washing with soap, safe handling and storage of drinking water and water conservation. The States also conducted a week long 'state elocution contest' on subjects like use of toilet, clean India mission and water conservation.

[C] Swachh Bharat Mission: Swachh Bharat Mission was launched on 2 Oct 2014 which aims at attaining a 100 per cent open defecation free India by 2019. Swachhta or Sanitation includes: [i] Safe disposal of animal and human excreta. [ii] Safe storage and handling of drinking water. [ii] Personal Hygiene [iii] Food hygiene [iv] Safe disposal of waste water.

Future Plans of Government: Jal Suddhi: A major plan to provide clean and purified water to

over 21,000 habitations will be launch in the next three years. At least 17,000 such habitations get contaminated water with dangerous pollutants including uranium, fluoride, iron, nitrate, toxic elements, pesticides and fertilizers. To be named as " Jal Shuddhi" the programme will benefit around 47 million people in several districts of states including Punjab, Rajasthan, Andhra Pradesh and Karnataka where water contamination is acute. According to sources, under this scheme community water purifiers will be installed in villages affected due to contaminated water. The plan aims at providing eight litres of purified water per person per day for drink and cooking purpose. Though initial estimate for this project was around Rs 3,600 crore, the final amount is yet to be worked out. According to government data, barring nine small states and urban territories, all other states are affected by contaminated water. Among states, West Bengal reported a maximum of 11 million people getting water with chemical contamination, followed by Rajasthan where the affected population size is over 99 lakh. Other states include Bihar, Assam, Maharashtra, Karnataka and Kerala. In Punjab, there are reports of uranium being found in drinking water, which is very serious. **People getting contaminated water:** Total: 4,77,40,220, Fluoride: 1,17,70,593, Arsenic: 29,45,091, Iron: 2,31,36,993, Salinity: 63,64,201, Nitrate: 35,23,342.

Innovative Technologies for Rural Drinking water [2015]: An Exhibition cum workshop was organized by the Ministry of Drinking Water Supply in Janurary, 2015. Many exhibitors presented innovative rural drinking water technologies in this workshop. Some innovative technologies were: **[1] PurAll online water purification device:** PurAll solutions are online NON-ELECTRIC water purification solutions which work on a simple chemical based technology. It has an online Chlorine CPU with replaceable water purification cartridges, for continuous operation. PurAll solutions use NSF approved and certified chemical (NSF– National Science Foundation, USA) for drinking water, which delivers an appropriate dose of chlorine and controls disease-causing organisms in water systems. **[2] Capacitive Deionization Technology (CDI) using carbon aerogel:** Untreated water flows through an unrestricted capacitor type module consisting of numerous pairs of high-surface area carbon aerogel electrodes. Carbon aerogel contains a very high specific surface area (400-1100 m2/g BET) and a very low electrical resistivity (< 40 m-ohm-cm). The positive and negative electrodes respectively adsorb anions and cations in the water solution upon polarization of each electrode pair by a direct current (DC) power source. The water is re-circulated in the module until ions are removed up to the desired level after which the purified stream is collected and the next stream of untreated water is introduced. The module holds the ions until the material is saturated, and at this stage the power is disconnected and the electrodes are washed with a small quantity of water/acid. The washed out water/ acid is collected as waste stream and the entire cycle is repeated. **[3] Water on the Wheels – Jal Doot:** This is integration of following three technologies. [a] UF-Membrane based surface water filtration technique. [b] PTO shaft drive to meet the power required where no power is available. [c] Multistage filtration – sand filtration > water softener > silver impregnated coconut shell carbon > micro filtration > ultra filtration. Solar Operated/Stand Alone Ground Water Treatment Plant: This system also works using solar Energy. [a] Suitable for treatment of Arsenic, Fluoride and TDS . [b] Arsenic is removed using disposable granulated media. [c] Fluoride is removed by using regenerative / disposable type Granular Media. [d] Surface water is treated with micro and ultra filtration. [e] Saline water is treated with RO system. **[4] Jal-TARA Water Filter:** Sand filters commonly used for water treatment are of two types a slow sand (2 to 6m3/ m2/day) and rapid sand (100 to 150 m3/m2/day) filters. Though there are many other ways of treating water, no single process is as effective in simultaneously improving microbiological and physio-chemical qualities of water as slow sand filtration. It is for this reason that slow sand filters are very much favoured in developing countries where land and labour constraints are not pressing, and the ease of operation, maintenance and cost are most important. Jal-TARA filter has been developed by Development Alternatives, New Delhi. These filters are now marketed by TARA Technology and Action for Rural Advancement, a social enterprise of the Development Alternatives Group. The Filter is designed to treat drinking water contamination with pathogenic bacteria, turbidity (dust, dirt and suspended material) and iron using slow sand filtration technique. Jal-TARA filter is a community level system, which can provide 2000-3000 litres of safe drinking water per day. It doesn't require electricity and is also suitable for hilly region. The main principle of Jal-TARA water filter is based on the traditional process of slow sand filtration system Jal-TARA filter is standardized in 1000 litres water tank with the output water supply of 2500-3000

litres per day. The filter contains pebbles and sand of different sizes. System is provided with a synthetic fabric filter designed with advanced technique of fabric protection. The system can be fed under gravity flow or through conventional pumps or operated by solar photo-voltaic. **[5] Aqua+ and Antenna WATA Technology:** The current standard of sodium hypochlorite as per IS: 11673: 1993 reaffirmed 2003 prescribe strength to be at 4 % concentration. The beauty of Aqua+ is that it treats the water and makes it safe for drinking even at a lower concentration of 0.6 %. Therefore a new grade need to be added to the existing BIS standard to encourage electro-chlorinator based sodium hypochlorite production. This was discussed by the developer of Aqua+ with BIS and the initiative has been appreciated by BIS. Aqua+ was developed by Developed Alternatives, New Delhi in partnership with Antenna technologies, Switzerland. WATA Technology uses a simple, manageable process of electrolysis to convert a measure of salt and water into sodium hypochlorite. It is available in 3 models. The difference in the 3 models is the scale of operation. Although the standard WATA device produces 1 litre Sodium Hyp. Solution per hour, the maxi WATA produces 12.5 litres of sodium hypochlorite. 1 liter of water + 25g of salt+ 1hour of electrolysis=1liter of sodium hypochlorite =treatment of 4 000 liters of water = daily consumption of drinking water by 1 000 people. **[6] Supremus Aqua standalone water purification system:** Supremus Aqua is stand alone water treatment systems having capacity of 1000 LPH/ 600 LPH and based on low pressure Ultra –Filtration technology conforming to WHO requirements for safe drinking water. It operates without electricity and only requires daily back wash as part of its maintenance. There is no replacement of parts and no wastage of water. Low pressure ultra - filtration membrane technology is highly effective in removing all non dissolved elements in feed waters. The system removes Pathogens. Total Suspended Solids and Turbidity from water. **[7] Disinfection by Electro chlorination**: The process is based on the partial electrolysis of sodium chloride (brine solution). The direct current is applied on and brine is dissociated into Na+and CL-ions, causing chemical reactions. The chlorine and hydroxide ions react to form hypochlorite. By adding sodium – hypochlorite to water, hypochlorus acid (HOCL) is formed. This hypochlorus acid dissociates into hydrogen ions and Hypochloride ions (OCL-). The free available chlorine is Hypochlorous acid and Hypochlorite ions. This free available chlorine is highly reactive and reacts with bacteria, virus and fungi. This method is applicable for treating ground water sources for the removal of Arsenic, Fluoride and Pathogens also. [**8] Water Treatment using nanofiltration (NF) membrane:** This technology simplifies RO treatment by mitigating the effects of membrane fouling. It uses nano filtration (NF) membrane which is selective form of an RO membrane. NF rejects bacteria and viruses completely similar to RO, but it selectively removes hardness salts to a greater extent than NaCl salt and therefore requires far less pressure than RO. This system lowers the effect of fouling and eliminates the need of process chemicals and reduces membrane cleaning significantly. The operation and maintenance is very minimal in this technology as there is no requirement of addition of any chemicals. The membrane life cycle is very long and under normal circumstances last for more than 5 years. **[9] Iron Removal by using Iron Specific Resin (INDION ISR):** INDION ISR iron removal technology which is far superior to the existing technologies finds application in hand pump, tube well and tap as source of water. As compared to the existing technologies, this technology is robust and can handle greater iron load per cubic feet. It is very simple to use wherein no pre-treatment is required and has zero operating cost. Being completely indigenous, this technology removes the dependence on foreign technologies and its superiority ensures tremendous potential in the foreign markets as well.

Best Practices in Rural Drinking water supply [2015]

[1] Nashik Village Goes High Tech on Remote Control Meter reading of individual households: Payment for pipe water supply to individual households remains a challenge in the majority of villages across the country. However in Nashik district of Maharastra, the dynamic leadership of Malegaon Panchayat has not only led to the installation of water meters in every households that has a piped water supply, but also the introduction of accurate remote controlled water meter readers. The gadget records water consumption data from a number of household meters from a distance of 100 m. Subsequently bills are generated for each household, utilizing data record on a remote controlled meter reader. Using the device and software provided to each water meter in household with a water connection, the designated person can record water consumption data within a radius of 100 m, without manually reading individual water meters and with the help of remote meter,

mobile and matching software. **: [2] Mitigation of Arsenic Contamination:** In West Bengal, Arsenic contamination of ground water was the first detected during early eighties in different districts adjoining Bhagirathi/Hooghly river. Investigation showed that the same is due to presence of Arsenic beyond permissible limit of 0.05 mg/l in groundwater. The Arsenic problem was found to be GEOGENIC. i.e, due to presence of excess quantity of Arsenic in geological formation. Groundwater was the main and staple source of drinking water in such areas due to its ease, inexpensive and location specific abstraction. Therefore, the drinking water supply system in the affected areas received a serious setback owing to arsenic contamination of groundwater. Mitigation measures have been taken up to tackle this problem of contamination. **[3] Chhattisgarh Scales up solar pump based water supply schemes in remote areas:** since uninterrupted electricity supply in uncertain in most of the rural areas of eastern India , in Chhattisgarh it has been demonstrated by PHED that solar energy based water supply is the only remedy for getting uninterrupted water supply in small villages. Since availability of uninterrupted electricity was uncertain; the PHED has decided to introduce "solar energy" powered ground water based water supply scheme. The solar pump scheme of Onakona is the first ever solar pump based scheme of Chattisgarh.

Need for: there is an urgent need for participation of stakeholders, proper funding arrangement and proper monitoring and evaluation system in the rural drinking water programmes. Some suggestions are

1] **Participation of stakeholders:** Emphasis must be laid on the participation of stakeholders at all levels, from planning, design and location to implementation and management.

2] **Village Water Committees:** 'Village Water Committees' should be actively involved in the maintenance of drinking water supply schemes and a system of beneficiary participation introduced.

3] **Funding Arrangement:** Suitable institutional and funding arrangements through community participation need to be evolved to get the installations working.

4] **Participatory Communication**: Participation of village women and NGOs, voluntary organisations should also be encouraged.

5] **Information, Education and Knowledge:** Information, education and knowledge should be given on the health and hygiene issues. The community has to be made conscious about water quality through health education and awareness campaigns and water testing kits shall be made available to a range of institutions, including schools and colleges and qualified NGOs in the area.

6] **Water quality monitoring and surveillance systems:** In view of the increasing problem of water quality and the resultant health hazards, it is necessary to institutionalise water quality monitoring and surveillance systems. Water quality surveillance should be done by an independent organisation, more appropriately by the Health Department which should be provided with adequate funds for the task.

7] **Water Quality Management:** The choice of technology in case of schemes related to water quality (detection of fluoride, iron, arsenic), shall be district/block specific. Further research is required to improve available technologies for treatment of chemically contaminated water, in terms of their simplification and increased cost effectiveness.

Conclusion: Drinking water has been included as flagship program of the Government. In India, investments in community water supply projects have increased steadily from the 1st plan to the 12th plan. However, the health benefits in terms of reduction in waterborne disease have not been commensurate with the investments made. Though health sector is bearing the burden of water related infectious diseases, presently it does not have adequate institution or expertise for monitoring and surveillance of community water supply programmes in the country. The country has witnessed significant improvement in rural water supply with increasing coverage of areas and a large volume of financial resources made available. A series of schemes are aimed at improving the supply of drinking water for rural habitations. However, lack of awareness, surveillance, monitoring and testing, mitigation measures, shortage of alternate water sources and unhygienic practices continues to remain. There is a need to promote inspection along with the community based water quality monitoring and surveillance at the grass root level as a mechanism to identify problems and to take corrective measures.

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SAFE DRINKING WATER: CHALLENGES AND INNOVATIONS FOR RURAL INDIA

Keshav Chaturvedi

Drinking water is an essential element for living. Article 47 of the Constitution of India makes it a top priority for the governments to provide safe and clean drinking water to every citizen of the country.

According to various government estimates the disease burden created in the rural areas due to poor water quality is huge. Close to 37.7 million people are affected due to water borne diseases annually, 1.5 million children die due to diarrhoea and 73 million working days are lost to illness. In monetary terms the cost is $600 million annually.

For ages, securing water holes, wells, oasis or river fronts were a matter of life and death for nomadic tribes. Things haven't changed over millennia and even today, quest for drinking water is one of the prime concerns for the people in general and policy makers in particular.

In a country like India where more than 67 percent of the people still live in rural areas the challenge of providing drinking water is in itself a daunting task. It becomes even more onerous when there is an insistence that the drinking water should be of a certain quality deemed safe.

Traditionally villagers and their community leader took the task of securing whatever water that was available and conserved it to meet their year round needs.

This led to the development of a number of techniques unique to the terrain and social practices. Water ponds, large tanks, covered wells, small bunds (*johads* as they called in Rajasthan) or bamboo networks (In Mizoram and other North Eastern states) all developed over the years in various geographical areas of India to meet the need for water in the rural areas.

Late Anil Aggrawal, founder of Centre for Science and Environment, had compiled a book of various techniques prevalent in India that were under severe stress, in his seminal work – Dying Wisdom. Similarly, Anupam Mishra of Gandhi Peace Foundation documented the technology and the culture of making and preserving ponds in the central, north and south India in his book – *Aaj bhi khare hain talab* (Ponds are still valid).

However, as the population grew and the demands on land increased the water sources were usurped and the rural areas started facing the twin problems of shrinking water resources and declining quality of water available for drinking.

According to the National Sample Survey Organisation (NSSO) study in 2012, 54 per cent of rural households had no supply of drinking water. This was actually an improvement over the four year period as the same survey conducted in 2008 had

shown that 60 per cent rural population was lacking this amenity.

The problems of providing safe drinking water to rural areas have many facets. The first and the foremost is economies of scale. The modern water supply systems are capital intensive and work relatively better in urban setting. Here, compact and large population which is ready to pay a nominal tariff makes large investments in water works viable.

However, scattered and low density population of rural areas make it nearly impossible for the governments to invest in such mammoth undertakings. In the absence of piped water systems the rural population depends heavily on the underground water. Close to 85 percent people in the rural areas depend on underground water.

Normal wells, bore wells and tube wells serve the needs of the locals. However, due to excessive usage severe stress on underground water has been witnessed. As its quantity decreases it is being contaminated due to rising salinity, discharge of wastes and pollutants from farms all around.

According to the Ministry of Water Resources, India would be a water stressed nation by 2020. An area is declared water stressed if the per capita availability of water is less than 1700 cubic metre per person per year. The estimates show that the availability of water for an average Indian will reduce to 1600 cubic metre per person per year by that time.

So what are the options available for people living in rural areas? Is there a way out or will they have to suffer? The answer lies in thinking out of the box and the good news is individuals, state governments, research organisations, NGOs and corporate entities are all working in this direction to provide succour to the rural masses.

They are all working towards creating solutions that address the specific needs of rural areas. Solutions are emerging across the value chain from conserving and improving water resource, storage, cleaning and providing it to the last person in the queue.

An obvious initiative is in the field of water conservation which also aims at increasing the supply and quantum of water. For this purpose the innovators have looked towards the sky. Rainwater harvesting is an age old technology which is being revived to save this precious water resource which is clean and pure and has the capacity to meet the drinking water demands of a growing population.

According to Bhabha Atomic Research Centre (BARC) scientists, India receives 4000 billion cubic metres of rainfall every year and 3000 or 75 percent flows back to the sea. Rainwater harvesting technology aims to harness this resource.

In India traditionally water scarce regions like Rajasthan and Tamil Nadu had long traditions of building water tanks to save as much rainwater as they could. However, at the turn of the century in 2001, the Tamil Nadu State government made it mandatory for all the new buildings to install rainwater harvesting systems to decrease the dependence on groundwater.

In the last 14 years in the town panchayats out of a total of 23,92,457 building 22,94,342 buildings have already installed rain water harvesting facilities. It has had a dramatic effect on the recharge of the groundwater in Chennai and other areas including the rural areas of water stressed region of the state like Madurai, Ramanathapuram, Theni, Tiruvallur and Kancheepuram.

Ground water recharge is an aspect which is closely linked to the issue of safe drinking water. Once the underground resource of water is healthy, providing safe drinking water to the local population becomes much easier.

Water Recharge

Like Tamil Nadu, Gujarat too suffers from chronic water problems and to offset this they have taken to ground water recharge and roof top water harvesting in a big way. With the help of many programmes, 87,179 check dams, 35,479 *boriband* and 1,71,400 *khet-talavadi* (farm ponds) have been constructed for ground water recharge and dilution of contaminants. The State has built 3,585 recharge structures which have resulted in rise of ground water levels from 0.5m to 12m in and around the recharge structures.

In Karnataka, roof-water harvesting is implemented by Bharatiya Agro Industries Foundation (BAIF) in fluoride affected habitations of Kolar and other two districts.

In the neighbouring Andhra Pradesh a law has been enacted for water conservation. The Andhra Pradesh Water, Land and Tree Act 2003, specifies that permission needs to be taken to drill a bore hole if drilling is within 250m radius of a drinking water source. The state government has also tied up with National Geophysical Research Institute, CSIR, to create water sanctuary and MGNREGA funds are being utilised to restore at least one tank in every village.

While the hinterland in plateau region, suffers from water shortage and brackishness the coastal areas deal with the challenge of saline water. To deal with the twin challenges Central Salt and Marine Chemicals Research Institute (CSMCRI), CSIR laboratory, Bhavnagar, Gujarat has worked on many innovations to desalinise water and treat brackish water to meet the needs of safe drinking water in coastal and nearby regions.

The laboratory has developed a technology called thin film composite reverse osmosis membranes. These reverse osmosis plants are used for potable water production in rural areas. They have been further improved to use animal power and solar power. It has increased their scope and scalability in region where electricity or other source of energy is not available.

Till date CSMCRI has installed 24 such plants across Gujarat, Tamil Nadu, Andhra Pradesh, West Bengal and New Delhi with a capacity of 39000 LPH.

India's top atomic research institute, Bhabha Atomic Research Centre (BARC) of Department of Atomic Energy (DAE), has thrown its might in dealing with the challenge of safe drinking water. It is also engaged in research, development and installation of desalination and water purification technologies.

The technologies developed by BARC include sea water Reverse Osmosis (RO) plant for coastal areas and brackish water RO plant for various areas with different levels of salinity. It has also developed Multistage Flash (MSF) plant and Low Temperature Evaporation (LTE) plant for seawater desalination. Both the technologies are based on using low grade waste heat generated from manufacturing plants. This way without using a new source of energy they utilise the low grade energy which was going waste to ensure safe drinking water. It's a win-win technology for rural and peri-urban areas.

BARC's other technologies include Membrane (Ultra-Filtration) based Water Purification Technologies for domestic and community use, Waste Water Recycle and Reuse plants for the effluents.

The centre has put up 31 projects involving these technologies across water scarce states of Rajasthan, Gujarat, Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh.

While the government and its scientific laboratories are working towards a holistic approach to deal with the issue of safe drinking water, NGOs and individuals are working on local single aspects to do their bit. Their efforts are equally important and path breaking.

Another low hanging fruit that will ensure quick access to safe drinking water is repair and maintenance of already existing water systems in the rural areas. According to a NGO study around 50000 rural water points are either broken or unused. Looking at this glaring problem and knowing that fixing it will immediately provide relief and much needed clean water to the users it initiated a programme called *jalbandhu.* It was a band of mobile repair units that would fix the systems. The idea was that the trained manpower would not only bring down the down time of fixing the problem but in the long run the number of breakdowns would decrease due to high quality workmanship of the mechanics.

Another technology – water ATM – has been successfully launched in 11 states over last few years. Brainchild of an Andhra Pradesh resident Karunakara M Reddy, it produces clean water in few minutes at a rate of 10 paise per litre and produces 1000 litres of clean water with the help of just a few units of electricity. Till date 2800 water ATMs in 11 states have benefitted 75,00,000 people.

India is a vast country with plethora of challenges, yet it is also a country of brilliant minds and committed individuals and organisations. These technologies mentioned above are operating in many different agro-climatic zones for a long period of time. A lot of feedback is now available about their limitations as well as scalability in other regions. Their collective genius can help address all the challenges of drinking water supply to rural areas.

(The author is a communication consultant working in the field of Sustainable Development)

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RAIN WATER HARVESTING AND DRINKING WATER MANAGEMENT

Dr. K. Baby

Potable water is critical for improved health and for the pursuit of various socio-economic activities. Despite its immense usefulness, rural communities in India lack adequate access to potable water. Rainwater harvesting, which has the potential of providing potable water for rural communities can be undertaken largely with local resources is rarely utilized. In India, as a result of development, the demand for water is increasing both in urban and rural areas. This may increase tensions and disputes over sharing of water resources.

Drinking water being the basic requirements of life plays an integral role in maintaining and promoting public health. To meet the targets of Millennium Development Goals India needs roughly Rs. 380 billion. Given the pattern of investments, states are making large investment. However, due to lack of coordination cost of investment is increasing and inefficient use of funds is taking place. If the same process continues at the grass root level, the possibility of achieving the set goals is difficult. There has been a debate on the question of whether water is a 'merit or normal good' and it was agreed that it depends on the nature of the use of water. However, it is argued that access to safe drinking water should be recognized as basic human right and allocating high levels of public finance and subsidies in developing countries are usually justified on this account. In

fact, this was 'being necessary because poor people cannot afford to pay' they end up heavily favoring the rich with the inequity directly related to the degree of rationing of the service. But now it has been realized that in the long run this approach cannot be sustained for two reasons.

- First, governments are finding it difficult to mobilize the required resources to improve or extend the service.
- Second, lack of appropriate pricing policy has led to inefficient use of water, posing threats to sustainability.

Further, state's traditionally dominant role in the sector has been rationalized based on the public good characteristics of water. However, the problem with poor quality of service has led to search for alternatives, particularly drawing on organized user participation and emerging market mechanisms. Thus, over the years there was a change in the concept of water as merit good or commodity. There is a general agreement that the funding to the drinking water supply has to be mobilized through various alternative sources not depending mainly on state.

Role of the Government

To respond to a growing population and rising demand for higher quality services, such as piped water supply with household connections, the government is expanding its financial and technical support to help local governments and communities better plan, implement, operate, maintain, and manage drinking water supplies. In 2009, the government launched a new National Rural Drinking Water Programme (NRDWP) to transform the rural water sector from one focused mostly on creating infrastructure, to one that provides improved and sustainable services. NRDWP provides financing to ensure water security in terms of source sustainability, water quality and operation and maintenance, and provides recommendations for institutional arrangements to support local governments and communities. In 2010, the government embarked on a national consultation process with stakeholders from every state to get ideas and consensus which resulted in a Strategic Plan for 2010 – 2022. The Strategic Plan provides further guidance to states to operationalise the NRDWP and ensure that all citizens living in rural areas have access to safe, clean water for drinking, cooking, and other domestic needs with the intention of eventually providing piped water to every rural household. The Strategic Plan mandates that each village prepare a Drinking Water Security Plan. The plans should include water harvesting and groundwater recharge measures, as well as conjunctive use of groundwater, surface water, and rainwater sources.

Rain Water Harvesting

Rain Water Harvesting (RWH) is a simple low-cost technique that requires minimum specific expertise or knowledge and offers many benefits. For drinking water purposes in rural areas, the most common technique is small-scale rooftop rainwater harvesting: rainwater is collected on the roof and transported with gutters to a storage reservoir, where it provides water at the point of consumption. The technology is flexible and adaptable to a very wide variety of conditions.

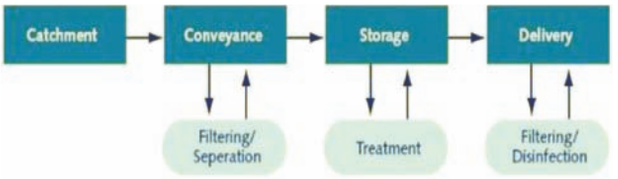
To reduce the consumption of groundwater, many people around the world are using rainwater harvesting systems. This practice has been around for thousands of years and has been growing at a rapid pace. Even to this day, rainwater is used as a primarily source of drinking water in several rural areas. The best thing about rainwater is that it is free from pollutants as well as salts, minerals, and other natural and man-made contaminants. In areas where there is excess rainfall, the surplus rainwater can be used to recharge ground water through artificial recharge techniques. Rainwater harvesting is the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to run off. Its uses include water for garden, water for livestock, water for irrigation, water for domestic use with proper treatment, and indoor heating for houses etc. In many places the water collected is just redirected to a deep pit with percolation. The harvested water can be used as drinking water as well as for storage and other purposes like irrigation. The collection and storage of rain water for later productive use is defined as rainwater harvesting. It is simply collecting, storing and purifying the naturally soft and pure rainfall that falls upon your roof. Today, scarcity of good quality water has become a major cause of concern. However rain water which is pure and of good quality is lost as run off.

Rooftop Rainwater Harvesting

Rooftop rainwater harvesting (RTRWH) is the most common technique of rainwater harvesting (RWH) for domestic consumption. In rural areas, this is most often done at small-scale. It is a simple, low-cost technique that requires minimum specific expertise or knowledge and offers many benefits. Rainwater is collected on the roof and transported with gutters to a storage reservoir, where it provides water at the point of consumption or can be used for recharging a well or the aquifer. Rainwater

harvesting can supplement water sources when they become scarce or are of low quality like brackish groundwater or polluted surface water in the rainy season. However, rainwater quality may be affected by air pollution, animal or bird droppings, insects, dirt and organic matter. Therefore regular maintenance as well as a treatment before water consumption is very important.

Basic Design Principles



Rainfall

Average Annual Rainfall in different Regions

Region	Annual rainfall (mm)
Desert	0-100
Semi-Desert	100-250
Arind	250-500
Semi-Arind	500-750
Semi-Humid	900-1500
Wet-Tropics	Over 2000

Source: Hatum & Worm (2006)

The rainfall pattern over the year plays a key role in determining whether RWH can compete with other water supply systems or not. Tropical climates with short (one to four months) dry seasons and multiple high-intensity rainstorms provide the most suitable conditions for water harvesting. In addition, rainwater harvesting may also be valuable in wet tropical climates (e.g. Bangladesh), where the water quality of surface water may vary greatly throughout the year. As a general rule, rainfall should be over 50 mm/month for at least half a year or 300 mm/year to make RWH environmentally feasible.

System Setup

Rainwater harvesting systems can be installed with minimal skills. The system should be sized to meet the water demand throughout the dry season since it must be big enough to support daily water consumption. Specifically, the rainfall capturing area such as a building roof must be large enough to maintain adequate flow. The water storage tank size should be large enough to contain the captured water. Rainwater harvesting is the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to run off. Its uses include water for garden, water for livestock, water for irrigation, water for domestic use with proper treatment, and indoor heating for houses etc. In many places the water collected is just redirected to a deep pit with percolation. The harvested water can be used as drinking water as well as for storage and other purpose like irrigation.

Applicability

Small-scale rooftop rainwater harvesting in rural areas can be applied everywhere: the technology is flexible and adaptable to a very wide variety of conditions. It is used in the richest and the poorest societies, as well as in the wettest and the driest regions on our planet. Collected rainwater can supplement other water sources when they become scarce or are of low quality like brackish groundwater or polluted surface water in the rainy season. It also provides a good alternative and replacement in times of drought or when the water table drops and wells go dry.

Rainwater harvesting provides an independent water supply during regional water restrictions and in developed countries is often used to supplement the main supply. It provides water when there is a drought, can help mitigate flooding of low-lying areas, and reduces demand on wells which may

Rain Water harvesting Methods

enable ground water levels to be sustained. It also helps in the availability of potable water as rainwater is substantially free of salinity and other salts. In the state of Tamil Nadu, Kerala, Rajasthan etc. rainwater harvesting was made compulsory for every building to avoid ground water depletion. It proved excellent results within five years, and every state took it as role model. Since its implementation, Chennai saw a 50 percent rise in water level in five years and the water quality significantly improved.

Benefits

- Can supplement other sources of water supply such as groundwater or municipal water connections
- Helps to build or farm in areas with no other water supply
- High quality water - pure, free of chemicals
- Lower water supply cost
- Reduced flood flows and hence reduced Soil Erosion

Suitability

- Places where
- Groundwater is scarce
- Groundwater is contaminated
- Terrain is rugged or mountainous
- Seismic & flooding events are common
- The aquifer is at risk of saltwater intrusion
- Population density is low
- Electricity & water prices are rising
- Water is too hard or mineral laden
- Utility
- Drinking, cooking, bathing (potable quality)
- Toilet flushing
- Washing clothes
- Irrigation
- Livestock requirements

Disadvantages

- **Unpredictable Rainfall:** Rainfall is hard to predict and sometimes little or no rainfall can limit the supply of rainwater. It is not advisable to depend on rainwater alone for all your water needs in areas where there is limited rainfall. Rainwater harvesting is suitable in those areas that receive plenty of rainfall.
- **Initial High Cost:** Depending on the system's size and technology level, a rainwater harvesting system may cost anywhere between Rs.12000/- to Rs 120000/- and benefit from it cannot be derived until it is ready for use. Like solar panels, the cost can be recovered in 10-15 years, which again depends on the amount of rainfall and sophistication of the system.
- **Regular Maintenance:** Rainwater harvesting systems require regular maintenance as they are prone to rodents, mosquitoes, algae growth, insects and lizards. They can become breeding grounds for insects, if they are not properly maintained.
- **Certain Roof Types may Seep Chemicals or Animal Droppings:** Certain types of roofs may seep chemicals, insects, dirt or animal droppings that can harm plants if it is used for watering the plants.
- **Storage Limits:** The collection and storage facilities may also impose some kind of restrictions as to how much rainwater can be used. During the heavy downpour, the collection systems may not be able to hold all rainwater and this may end up going to drains and rivers.

Concluding Remarks

Rainwater harvesting is a system that is gaining speed over time. Areas that experience high amounts of rainfall will benefit the most from the system and will be able to distribute water to dry lands with ease. However, the beneficial environmental impact of the system is what is driving it further. Since the 1950's national and state governments in India have invested more in expanding water services to rural communities. Today, scarcity of good quality water has become a major cause of concern. However rain water which is pure and of good quality is lost as run off. The collection and storage of rain water for later productive use is defined as rainwater harvesting. Water harvesting has been practiced successfully in various parts of the world – and some recent interventions have also had significant local impact. It is a fact that, if we implement this technology properly, then we would be able to solve our drinking water scarcity to a great extent.

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DRINKING WATER QUALITY IN RURAL INDIA
ISSUES AND APPROACHES

Sabita Kumari

In 2009, the Accelerated Rural Water Supply Programme was modified as the National Rural Drinking Water Programme (NRDWP) with major emphasis on ensuring sustainability of water availability in terms of potability, adequacy, convenience, affordability and equity, while also adopting decentralized approach involving PRIs and community organizations.

However, experiences learnt in the process of implementing the NRDWP Framework of Implementation, and on the basis of the analysis of the results of the successes achieved and deficiencies that remain with the NRDWP, have brought out the fact that certain modifications are needed in some components and further clarity is need on some other issues of the programme. After consultations with States, amendments have been brought about in the framework, some of which have already been implemented while others are being implemented.

The major changes in approach are with regards to:

- Source sustainability, community managed programmes and recognition of the gap between infrastructure created and service available
- Installation of a water source will not be considered as the criteria for fully covered habitation, but adequate water supply received by all household of the habitations will be the criteria.
- Change the lpcd (litres per capita per day) standard as a mean of measuring availability of water and a look at larger number indicators of water security;
- Focus on ensuring household level drinking water security through preparation of village water security plans and household level water budgeting.
- Conjunctive use of surface and groundwater and focus on rainwater harvesting for recharge. For old and new ground water schemes, recharge mechanisms will be made mandatory;
- Need for social regulation of agricultural water for meeting the demand of drinking water;
- Revival of traditional systems of water conservation and introduction of catchment protection schemes for surface water;
- Convergence with National Rural Health

Mission (NRHM) on aspects of water quality and health indicators. The guidelines also call for health based targets as an improvement in water supply;

- As a part of ensuring sustainability of sources and systems, incentivizing good behavior in Gram Panchayats to create drinking water security in their jurisdictional areas Swajal Gram Puraskar to be launched.
- Linkage of National Rural Drinking Water Quality Monitoring & Surveillance Programme with the recently approved *Jalmani* guidelines for implementation of Standalone drinking water purifications systems in rural schools.

The following main changes have been incorporated in the Rural Water Supply Programme :

- Awarding performance rather than non-performance of States. This is done by removing the weightage for the number of uncovered/ partially covered habitations and water quality affected habitations in the allocation criteria for central assistance to the States.
- Introduction of an incentive of 10% of the NRDWP allocation for the States that transfer the management of rural drinking water schemes (RWS) to the Panchayati Raj Institutions.
- Increasing the percentage allocation for "Sustainability" component from 5% to 20% for implementing sustainability measures in RWS projects by the States. This component is funded on a 100% Central share basis as against the 50% Central share in regard to other components.
- Introduction of a new component of Support Fund with 5% allocation. Setting up of Water and Sanitation Support Organisation by each State to take up support activities focusing on software activities like awareness generation, capacity building, water quality testing, MIS etc.
- In order to encourage the States of North-East and J&K, that have limited resources, the fund sharing pattern for them has been liberalized from the existing 50:50 (Centre to State) to 90:10 (Centre to State).

Paradigm Shift in NRDWP

The following paradigm shift has been made in the National Rural Drinking Water Programme guidelines for ensuring sustainable and environmentally friendly drinking water supply projects:

- Move forward from achieving habitation level coverage towards household level drinking water coverage.
- Move away from over dependence on single source to multiple sources through conjunctive use of surface water, groundwater and rainwater harvesting.
- Focus on ensuring sustainability in drinking water schemes and prevent slip back.
- Encourage water conservation including revival of traditional water bodies
- Achieve household level drinking water security through formulation of proper water demand and budgeting at the village level.
- Convergence of all water conservation programme at the village level.
- Move consciously away from high cost treatment technologies for tackling arsenic & fluoride contamination to development of alternative sources in respect of arsenic and alternate sources/dilution of aquifers through rainwater harvesting in respect of tackling fluoride contamination.
- Treatment of catchment area of drinking water sources through simple measures, such as fencing and effective implementation of TSC programme, prevention of sewage/animal waste reaching into surface/ underground water sources, promoting ecological sanitation to reduce use of inorganic fertilizers so as to prevent nitrate pollution in drinking water sources.
- Promoting use of simple such as terracotta based filtration systems, solar distillation and dilution through rainwater harvesting for tackling iron, salinity and suspended particulate matters.
- Linkage of water quality monitoring and surveillance with the *Jalmani* scheme for implementation of standalone drinking water purifications systems in rural schools.
- The five grass root level workers trained for testing water quality to be the ambassadors

for achieving household level drinking water security in rural India.

- Move away from offline unconsolidated figures to online data entry and linkage with Census village codes.

Monitoring Mechanism

Online monitoring system has been introduced to strengthen monitoring mechanism and ensure transparency. State Governments have been urged to report the physical and financial progress online on a monthly basis and update the habitation wise data on an annual basis. State officials responsible for online data entry have been imparted training to undertake this task. Besides, periodic review meetings are conducted to review the physical and financial progress in the implementation of schemes in all the states. Monitoring visits are also conducted for the purpose.

After the launch of Bharat Nirman Programme, from 2005 onwards, there was a fundamental change in the monitoring process whereby villages/ habitations have been targeted by names for coverage (and not in terms of cumulative numbers as before). Their physical progress in terms of asset creation are being monitored.

The Integrated Management Information System (IMIS) is a comprehensive web based information system that enables the states and the center, to monitor the progress of coverage of habitations, rural schools and anganwadis, through a common monitoring format. In addition to this, the progress of Sustainability projects and Sub-Mission projects (for tackling quality affected habitations) can also be monitored. This system also gives the list of quality-affected habitations and the list of slipped back habitations along with reasons for slippage. The list of Government, Government Aided and local body aided schools and *anganwadis* in all villages is displayed indicating the status of drinking water and sanitation facility that is available. Linking of habitations covered with potable water supply with census villages on the IMIS platform is underway.

Involvement of PRIs

As per the 73rd Amendment to the Constitution, the responsibility for drinking water may be devolved to the panchayati raj institutions (PRIs). In many States, rural drinking water schemes have been transferred to PRIs for operation and maintenance. To encourage this aspect and involve PRIs in O&M, the Government of India has revised its guidelines for the rural water supply scheme to provide for a 10% weightage in allocation of funds to States. This weightage is given for the rural population managing their water supply schemes. Also, to reduce the tendency of State Departments to operate schemes on their own and not transfer them to PRIs, the O&M component has been reduced from 15% to 10%. The States are also advised to set up corpus O&M funds at the PRI level, in which funds of 12th Finance commission, user charges and tariffs, and O&M funds of Center and State can be put and used by the PRIs.

Norms for Providing Drinking Water in Rural Areas

The norms recommended for providing drinking water to rural population in the habitations are:

- 40 liters per capita per day (lpcd) of safe drinking water for human beings.
- 30 lpcd additional for cattle in the Desert Development Programme Areas
- One hand-pump or stand post for every 250 persons.
- The water source should exist within the habitation / within 1.6 km in the plains and within 100 mtrs. elevation in the hilly areas.

These norms prescribe the basic requirement per capita, taking into account the requirement for drinking, bathing, abolution and washing clothes and utensils.

Criteria for State wise Allocation of NRDWP Funds

Under the NRDWP guidelines the criteria for inter-state allocation of NRDWP funds are given below:

Sl. No.	Criterion	Weightage (%)
1.	Total Rural Population 2011 Census	40
2.	Rural SC and ST Population 2011 Census	10

3.	Rural population managing drinking water supply schemes	10
4.	States under DDP, DPAP, HADP and special category Hill States in terms of rural areas	40

The 20% of NRDWP allocation meant for "Sustainability" will be used to encourage states to achieve drinking water security through sustainability of sources and systems. The states will be asked to prepare district-wise Drinking Water Security Plans to take up sustainability structures by convergence with MNREGS, Integrated Watershed Management Programme and fund the gaps in the plan from the Sustainability component of NRDWP. This component will be implemented in the form of decentralized, community-managed, demand-driven programme on Sector Reform/ *Swajaldhara* principles.

Support Activities under NRDWP

Under NRDWP certain concurrent activities are required to be taken up along with commissioning of water supply schemes. These are called Support activities and are brought under one head called "Water and Sanitation Support Organiation (WSSO). WSSO include WQM&S, R&D, State Technical Agency, MIS, IEC and HRD, M&E programmes. With effect from 1/4/09, 5% of funds allocated to States can be utilized for taking up these activities after obtaining approval of the State Level Scheme Sanctioning Committee. Every State has to maintain separate bank account for Support activities so that they are not diverted for any other purpose.

Sustainability of Rural Water Supply Sources

The Department has accorded highest priority to "Sustainability" of drinking water sources and systems to prevent slippages. Sustainability measures like water conservation and rainwater harvesting leads to *in-situ* remediation of water quality and as such will have to be a priority in water supply sector. For this purpose under NRDWP, allocation will be 20% for projects to be implemented on Sector Reform/ *Swajaldhara* principles for which 100% grants-in-aid will be made available to States. These projects are to be implemented in a demand driven, decentralized, community-managed mode to achieve long term drinking water security by ensuring sustainability of sources and systems.

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DRINKING WATER IN RURAL AREAS OUR PROBLEM, OUR SOLUTION

Santosh Gawale

I initiated work in my home village Manyali which is located near the Penganga Wildlife Sanctuary in the Umarkhed tehsil of Yavatmal district of Maharashtra. Over the past three years we were able to solve the problem of water availability in two different ways. One was entirely through people's participation and the other through people participation along with the right use of government schemes.

When I began the work, we started off addressing small issues and finding opportunities to get people together. I realized that people are willing to address personal issues as they feel that they are their own, but when it comes to larger issues which are faced commonly by all, the general perception is that they are the responsibility of the administration. Therefore people do not come together to address these issues.

We initiated regular meetings in the village where people would discuss domestic problems. After two years of such regular meetings, participation of women also increased and the activities in such meetings shaped up in the form of common reading of good articles in newspapers, sharing poems, stories, songs and other local folklore. During these meetings, women regularly raised the issue of drinking water scarcity and the efforts and pain they have to take, to fulfill the household water requirements. Although I was aware of the problem, I patiently waited for it to emerge from the people. Unless people realize the gravity of the problem themselves they are not ready to take up action to resolve it. I shared this idea that, since it is our problem we should step up to resolve it rather than wait for the government or administration to do something about it. Earlier, building of a well had been sanctioned and ground water level had been tested, but as there was no consensus on the location, this well did not see the light of the day.

I proposed that it is possible to dig the well on our own, through participatory *'shramdaan'*. The men were skeptical and laughed off this idea but the response from the women was encouraging. Naturally so, as they were the hardest hit due to this problem. Like most villages in our country women in my village also carried water on their heads from a distance of 1.5 km and hence related to it immediately.

I explained the math of solving the water problem: "on an average we spend 4 hours a day to fetch water for our family, which means we spend about 100-120 hours in a month which means on a yearly average we spend about 60 days of our time

to just fetch water! Instead if each of us gives only 2 days of their valuable time for digging up the well, we can have a source of water for ourselves which can be easily accessible! Also with all that time saved, we can engage in other activities, to earn income for our family!" On understanding the situation with such clarity, the community agreed to take up well construction in the village.

The Gram Panchayat was not very keen about this idea. The site where the well was to be constructed was encroached upon by a person from the village. When he was asked to give up the land, he refused. The villagers were adamant to have the well-constructed at the same site, so they staged a demonstration in front of his house as a result of which he vacated the land.

Initially, only women participated in this since they felt the importance of such an initiative. Gradually, men too started participating and worked laboriously. In one and a half month, a 30 foot deep well had been dug. When I shared about this in my network, people agreed voluntarily, to contribute financially. We were able to raise about Rs 1.5 lakh through contributions, which was used to construct the walls of the well.

Though the issue of source of water was resolved yet the distribution of water in the village was a challenge.

There is a government scheme where an overhead tank is constructed and water is taken to every house through a pipeline just like in cities. I was thinking on the same lines and figuring out how to do the necessary paper work to begin this scheme in my village. I shared this idea with the villagers in a meeting and Pandurang Mahajan came up with a very innovative solution. He suggested that a 3 HP capacity pump could support a sprinkler set of 12 to 15 nozzles. The same logic could be applied to distribute this water through a piped water system. So a cheaper option of having such multiple faucets in different parts of the village was arrived at.

In order to set up this system of pump and pipes, a voluntary contribution of Rs. 1000 was collected from the families in the village and the system was put in place. A pipe was put up across the village and about 9 valves were fitted. Each valve has about 12 to 15 faucets which go directly into the house. Even today, three years down the line, water is supplied though these 135 faucets in the village, which is then used for drinking, domestic and livestock. Due to such an interactive and consultative participation, the huge cost of constructing a storage tank (which was the general practice) was saved.

Not limiting only to solving their own problems, the people in the village came together to solve the problems of the Banjara community. This community with a population of 1000, stayed in a small settlement called *tanda* about three kilometres away from the village.

Although the problem of water supply for the village was resolved, that for the *tanda* was not. Being 3 km away from the village, it proved very costly to cover the tanda under the water supply from the same well. Through discussions, the residents were successful in persuading a farmer to donate 3 guntha (3000 sq feet) to the Gram Panchayat. It was on this land, which was right next to the forest, where a well was constructed though MGNREGA (Mahatma Gandhi National Rural Employment Guarantee). The people got income from the employment guarantee scheme as well as a drinking water well for the tanda! This is the first of its kind in my taluka, wherein a drinking water well has been taken up under MGNREGA, so that water can be made available to all!

Thus, in one case we solved our problem entirely through people involvement and in the second case we took the help of a government program along with people involvement. As a result of this entire exercise, we all gained the confidence that we should make efforts at resolving our questions and problems on our own. At the same time, if people are willing, then Government programs can also be used to reach our objectives.

The next challenge we have taken up, is to fulfil our water need for agriculture at the village level. For this in collaboration with two organisations- Maharashtra Knowledge foundation, Pune and Aquadam, Pune we are conducting a 2 year study and preparing a water budget for our village. We are studying the recharge and discharge areas, and the ground water flow, based on which we are going to make specific interventions to conserve water. People participation is going to be our biggest asset to fulfil this dream of water independence at the village level!

If we can initiate work in the village, that truly addresses the needs of the village, we can definitely succeed in all our endeavours!

(The author is a social worker in Maharashtra. He is a recipient of Yashavantrao Chavan Yuva Samajik Karyakarta Puraskar 2013, sgawale05@gmail.com)

TOWARDS SAFE DRINKING WATER

Sarita Brara

Monutosh Biswas from Bishnupur village and Swapan Das of Teghoria village in the remote Gaighata Block in West Bengal, close to Bangladesh border, are among a number of people suffering from skin and other ailments. This is due to the high level of arsenic prevalent in the ground water in the area. Till six months back most of the people in the region were dependent to a large extent on the contaminated tube well water for drinking. But now they have an option in the form of 'potable bottled water' that could hopefully see an end to their quest for clean drinking water. Thanks to an initiative by Sulabh International Social service Organisation which has set up a Water Treatment Plant at Madhusudankati village, in collaboration with International Academy of Environmental Sanitation & Public Health, 1001 Fontaines of France and a local NGO Madhusudankati Krishak Kalyan Samity.

The supply of purified water from the water treatment plant at Madhusudankati will benefit nearly 2000 families under Sutiya Panchayat in Gaighata block and two municipal areas.

The packaged water is being sold at the rate of fifty paise a litre. According to Haladhar Sarkar , Chairman of the Madhusudankati Krishi Unnayan Samity the production cost is only 30 paise while other costs like transportation, storing, and manpower comes to 20 paise.

Having become aware of the consequences of drinking arsenic contaminated water, the villagers do not mind spending Rs 10 for a container of 20 litres of water meant for drinking and cooking purposes. (villagers feel that it is better to spend money on bottled water than risking health). Mr. Sarkar says this is evident from the fact that more and more people are buying *'Sulabh Jal'* and they are now transporting 2400 litres every day to nearby villages. He says, in fact people from neighbouring Bishnupur, Faridkati and Tegharia villages, now queue up at the plant to buy the packaged 'Sulabh Jal .' The NGO has also put up a distribution system in place.

Subhash Das who shows scars of damaged skin on his body from the arsenic contaminated water says that with the clean potable water now available, people will not have to suffer like him. At a medical camp held this month, 15 arsenic affected patients turned up, six of who were severely affected.

According to W.H.O, drinking arsenic-rich water over a long period results in various health hazards, including skin problems, skin cancer, and cancer of the bladder, kidney and lung, besides other diseases.

Women in the village like Reba say that ever since they started drinking the purified water they do not fall sick and cases of diarrhea and stomach upsets

are much less frequent. But more importantly , they are now aware about the hazards of contaminated water. The packaged water is also being supplied to schools and anganwaadis in the area free of cost.

The capacity of producing potable water from plant is 8000 litres a day, if it is operational for eight hours. So once the awareness level increase, leading to rise in demand, supply of the bottled water would not be a problem says Haldhar. He says that youth are being roped in to spread awareness about the hazards of drinking arsenic contaminated water and how crucial clean drinking water is for health.

Apart from the water purifying plant at Madhusudankati in North 24 Parganas , two more such projects have been set up at Murshidabad in Murshidabad district and Mayapur in Nadia district. Another one is expected to be commissioned soon.

Selection Criteria for Setting Up the Water Treatment Plant is:-

- Availability of Perennial water resource like a pond or a river.
- Provision of land for the construction of water treatment plant.
- Willingness by an active and reliable, local NGO to participate in the project. The NGO is expected to ensure running the project and maintaining the water supply chain after a specified period of 18 months.

The Four Stage Purification Process Consists of:-

1. The water from the pond or the river is pumped into an over-head reservoir from where it is delivered into a flocculating tank where chemicals (alum and bleaching powder) are mixed with the water.
2. The settled water is then passed through a slow sand filter.
3. The filtered water is then collected in a clear water reservoir, from where the water is passed through fine membranes of different sizes to remove the finest contaminants from the water.
4. The water is then treated with UV ray to make it totally bacteria free.

The treated water which is free from all pathogenic micro-organisms is then poured into 20lt bottles and sealed. The consumers either collect the bottle from the kiosk or the same is delivered to their houses.

This process is followed in principle in all the three sites.

The cost per project is Rs 20 lakh approximately. While the 1001 Fontains is funding 60 per cent of the cost ,Sulabh International is contributing 25 per cent and the rest is being met by the local NGO in the form of land, material, labour, transportation etc.

Sulabh founder Bindeshwar Pathak says that the water purification technology had been tested in Cambodia and Madagascar but is being used on a larger scale for the first time in the village.

"This is the first time in the world that we have succeeded in producing pure drinking water at a very nominal cost by this new technology."

- For the programme to sustain, it is first of all designed to create local management and infrastructure for operation and Training & capacity building of the local workers.
- Transforming the Community Based Organization (CBO) into a real entrepreneur by ensuring that a production level that makes sales high enough even with a very low selling price – to cover for all operating costs including the entrepreneur's income.

Sulabh international has shared details of the project with centre. Dr Pathak says his organization is willing to share the technology.

According to the latest official data available with the Ministry of Drinking Water and Sanitation , while the quality of ground water in 1991 habitations across the country is arsenic affected , 1124 out of them are in West Bengal alone and 1063 of these are in the three districts of North 24 Parganas, Nadia and Murshidabad.

It is difficult to say whether scars of the damaged skin on the hands , feet and other body parts of the arsenic affected people like Monutosh Biswas and Swapan Das will ever heal but the packaged 'Sulabh Jal" from this innovative initiative has given hope to over 25 million people exposed directly or indirectly to the arsenic hazards in West Bengal, to access the basic requirement of clean drinking water.

(The author is a freelance journalist based in Delhi)

WATER- ORDINARY WOMEN AS USERS

These are some stories from Gujarat which are worth sharing: In village Varshamedi of Kutch district after a lot of consultations in Gram Sabha the Sarpanch Shri Sajubha Jadeja expressed that if women of the village were ready to take up decentralised water supply programme in the village, he would hand it over to them. Few of the active women offered to be the members of the Pani Samiti, constituted an all women members Pani Samiti in the village and elected Sitaben as Chairperson. Each hamlet had a representative and took up the responsibilities of collecting contribution from each household. The difficult task gradually moulded them in to an efficient team, and they not only collected contribution from each household but efficiently managed the office work including dealing with bank. As the work progressed their confidence grew and they ensured quality construction work, by active supervision. They are proud of their achievements, and enthusiastically show their work to Pani Samiti members visiting from other villages. Their example has motivated others. Sitaben says, "We have learnt to take lead in other development work, we are confident that we are building our children's future. We have changed the behaviour of men towards us. "

Gelada village also like other villages of Kutch district saw destruction by a massive earthquake that struck the area on 26th January, 2001. The rehabilitation process brought out discord in the village, and it was an uphill task for Vivekanand Research & Training Institute – an Implementation Support Agency (ISA) of WASMO – to introduce the community-managed water supply programme in this village. The Panchayat and its members were not interested in the programme. In one of the Gram Sabhas, the active Mahila Mandal took the lead and its chairperson Monghiba, inspired the women of the village to form a Pani Samiti, as the problem of drinking water affected them the most. They constituted an all women's Pani Samiti. Monghiba took up the lead and now she says, "In the beginning two members were active, but as we progressed, the team gelled together and took up the full responsibilities for supervision of works. The times when we had to run for collecting water at night have passed. Now we have adequate and regular water supply at our doorstep." She further says, "Women save at least two to three hours a day and that time is utilised in making 'papads', which gives us a regular income." The women say that, "This income has given us an opportunity to contribute for O&M of the systems, which Sudadharo Moti village in Kutch has women in majority in the Pani Samiti. These women believe that since water is their 'problem', they should be included in managing this resource. In fact, the locals say that with the inclusion of women, they feel more comfortable in talking about their problems. Although the Pani Samiti is a part of the village Panchayat, the general feeling is that this sub-committee is more participatory and less political than the Panchayat.

In Varli village of Kutch, recalling the adverse times faced by the villagers due to water shortage, Bhalbai a member of the Pani Samiti says, "From the wee hours of the morning till afternoon we used to be engaged in collecting water from 'virdas' in the village pond and often we were unable to even take care of our children's needs. The water shortage was very acute and posed problems particularly during social functions like marriages etc. It was very difficult for us to even perform last rites for the people who passed away."

Although the villagers were skeptical about the community contribution and participation concept initially, their confidence was gained as the work progressed. The tradition bound women who found it difficult to participate in community issues, have gradually opened up and become more confident. Bhalbai says, "The situation has changed with the implementation of water supply and sanitation programme in the village. We get adequate water at our doorsteps now and are spared of performing the back-breaking task of fetching the water from far. Although the women of the village are not literate they are able to understand the duties and responsibilities of Pani Samiti as well as importance of sanitation and good health."

Babyben of Mamsa village in Bhavnagar district says, "All responsible work in the village is looked after by males, women's view is never taken seriously. But with WASMO's intervention everything has changed. Women now monitor even the construction work of water supply structures apart from being active in all meetings and decision making." All this could be possible due to a series of training and exposure visits arranged for them to learn from observing the changes that took place in nearby villages and districts. Babyben says, "It is not that we have never faced any difficulties, but we are together now and that strength helps us overcome all the difficulties."

Women Pani Samiti members of Aanda village of Jodiya taluka, in Jamnagar, have always been a great support to complete all the procedural work of programme implementation. Active participation in discussions and meetings is synonymous with the women Pani Samiti members. Noteworthy is the fact that it is not only the Pani Samiti members who are active, but other women are also as active as these members.

Alang village of Bhavnagar district is a small coastal village and also known as Asia's largest ship breaking yard. It faced problems of water scarcity and salinity for several years. A few Darbars owned tankers, and water was supplied without charges to their own households and those of the neighbours. However some inhabitants had to spend long hours on the road, waiting for some tanker to arrive.

Although Alang was covered under the Ghogha project, it was difficult to begin construction for as long as two years. The men were reluctant to raise the community contribution. The issue was discussed at the Gram Sabha where the women silently witnessed the reluctance of the men.

The next day, ten women met at the village temple. They reasoned that if men could raise Rs.7 lakhs to construct a temple, then it was certainly within their means to raise Rs.30,000 for solving their water problems. Despite their logic, solutions were not that simple. The women had never set foot outside their homes without their husband's consent. Yet, determined, they went ahead to raise money from their village. For one of the women, who had come to Alang as a bride and had lived there for 12 years, collecting the contribution gave the opportunity to step out of the house and she saw the entire village for the first time. Within few days, the women collected the stipulated amount and entrusted it to the men to pay the contribution for the project.

Reaching Out to the Impoverished in Odisha

The demography of village Similita under Reamal Block of Deogarh district in Odisha represents a section of population mostly impoverished. Their innate tendency to consume contaminated water from traditional sources clearly inhibited their access to good health and hygiene. They were handicapped to ventilate legitimate grievances before the Government machinery even in exercise of their basic rights to get clean drinking water.

The whole situation for the tribals of village Similita took a turn when a motivation camp organized by the Gramvikash, a voluntary organization for setting up of a Rural Piped Water Supply Scheme and Sanitation facilities. The method of participatory approach was adopted to establish tribal ownership over the project. The mode of interpersonal communication with the members of village level committee yielded dramatic result. With the support of all tribals the water supply project was launched even eliciting their contribution of 10% of the estimated cost.

Executed to cater to the water need of around 30,000 liters a day, this project intends to cover a prospective population of 500 in near future. A cozy tribal habitation of 65 is now supplied with clean drinking water through public stand posts erected near their door steps. Implemented with an approximate expenditure of over Rs.8 lakh, this water supply project has brought smiles on the face of tribals.

They express in their dialet that God has been kind to save their life by making available safe drinking water. They also express sincere gratitude to RWSS organization of Rural Development Department for providing such a gift to their impoverished life style.

(Source : Ministry of Drinking Water and Sanitation)

INTERNATIONAL YEAR OF SOILS
ADDRESSING SOIL HEALTH MANAGEMENT IN INDIA

Dr Amrit Patel

The United Nations' General Assembly declared 2015, as the *International Year of Soils* to create awareness among all stakeholders and promote sustainable use of soil. On this occasion, UN Secretary General, Ban Ki-moon said that soil is the foundation for agriculture. He urged all Governments to pledge to do more to protect this important yet forgotten resource. According to the Director General of the FAO, Jose Graziano da Silva, population growth will require 60 per cent more food output when 33 per cent of global soil resources are under degradation and human pressures on soils are reaching critical limits, Soil Health Management [SHM] is one of the important interventions of the Government of India under National Mission for Sustainable Agriculture. Against this background, this article briefly highlights the health of soils in India, Government's initiatives on and programs of Soil Health Management and suggests aspects of Strategic Action Plan in this regard.

Health of India's Soil

Intensive agriculture for increasing food production has caused problems of nutrient imbalance, greater mining of soil nutrients to the extent of 10 million tons annually depleting soil fertility, emerging deficiencies of secondary and micronutrients, declining water table level and its quality, decreasing organic carbon content, promoting soil erosion and degradation leading to overall deterioration of soil health.According to ICAR [2010], out of total geographical area of 328.7 million hectare in India about 120.4 million hectares (37%) are affected by various kinds of land degradation. This includes water and wind erosion (94.9 million hectares), water logging (0.9 million hectares), soil alkalinity/sodicity [3.7 million hectares], soil acidity (17.9 million hectares), soil salinity (2.7 million hectares) and mining and industrial waste (0.3 million hectares). Frequent droughts, floods and climatic variability/aberrations, also, impact soil fertility and cause land degradation, thereby, affecting/ threatening crop production across the country..

Use of Fertilizers

India is the second largest consumer of nitrogenous and phosphaticfertilizers in the world. India consumed 24.482 million tons of nutrients comprising 16.75 million tons of nitrogen, 5.633

million tons of phosphorus and 2.099 million tons of potash in 2013-14.

The Task Force on Balanced Use of Fertilizers (2005) and National Academy of Agricultural Sciences [2009] estimated requirement of 36 million and 45 million tons [including 10 million tons of organic manure] of fertilizers in nutrient terms respectively by 2025.

Substantial use of chemical fertilizers in 1970s and 1980s increased food output from 74.0 million tonnes in 1966-67 to 209.8 million tons in 1999-2000. The rate of growth of food production, however, has shown a declining trend, in spite of increase in fertilizer consumption during recent times, due to the adverse impact of imbalanced use of fertilizers on food grain productivity. The ICAR studies indicate that partial factor productivity of fertilizers (i.e. additional kg of food grain production per kg of nutrient applied) has been continuously declining.

NPK Ratio

Generally, NPK consumption ratio of 4:2:1 in India is considered desirable based on recommendation of 120:60:30 NPK kg/ha for wheat/rice. There is, however, a widevariation in the NPK use ratio in different geographical regions of the country. As for example, the Northern region exhibits the ratio as wide as 13.5: 4.3:1, whereas it is narrower in Southern region (2.9: 1.6: 1) and it is 5.6: 3.3: 1 in Western region and 5.0: 2.4: 1 in the Eastern region. Following Table indicatessignificant variation in the NPK ratio from 2001-02 to 2013-14.

Micro-nutrient Deficiencies

Indian soils in general are deficient in major nutrients (N,P&K) and in minornutrients (Sulphur, Calcium and Magnesium) and in micronutrients (Boron, Zinc, Copper and Iron etc.) in most parts of the country. A comprehensive study by ICAR on Micronutrients, Toxic and Heavy Metals, involving analysis of 2,51,547 soil samples revealed deficiency of zinc in 48 per cent of soil samples followed by boron [33%], molybdenum [13%], iron [12%], manganese [5%] and copper [3%].Also, ICAR experiments to study the crop response to micronutrients confirmed that 300 kg to 600 kg/hectare additionalyield was obtained in cereals and vegetables. Besides, under micronutrient-deficient situations, the application of major nutrients alone does not give expected results.

Use of Organic Manures

Use of chemical fertilizers alone produces adverse/unfavourable effects on physical, chemical and biological properties of the soil and environment. ICAR studies on cereal- based cropping systems revealed that use of adequate organic manure from any source reduces 25-50 per cent fertiliser requirement in terms of NPK for kharifcrops.ICAR experiments on cultivators' fields, further, revealed that use of chemical fertilizers in combination with organic manures increased yields of cereals, oilseeds and cotton by 7 to 45 per cent over farmer's practices in different agro-ecological regions. In sugarcane, use of sulphitation press mud, cane trash and bio-fertilisers each with chemical fertilisers and green-leaf manure brought 20-50 per cent savings in nitrogenous fertilisers. Indian Institute of Soil Science, Bhopal and many State Agricultural Universities have, also, reported similar results.

Government Initiatives

Soil Testing: Soil testing is important to diagnose status of the physical, chemical and biological properties of the soil and to assess the quantum of available nutrients and productivityof the soils. Soil testing enables farmers to assess the suitability of land for agriculture, identify and quantify the constraining factors of crop-productivity that need remedial measures. Soil testing provides sound information for making recommendations on the use

Table 1
Year-wise NPK Ratio from 2001-02 to 2013-14

Year	N:P:K Ratio	Year	N:P:K Ratio	Year	N:P:K Ratio
2001-02	6.78: 2.63:1	2006-07	5.90: 2.37:1	2011-12	6.72: 3.07:1
2002-03	6.50: 2.51:1	2007-08	5.47:2.09:1	2012-13	8.15:3.23:1
2003-04	6.93: 2.58:1	2008-09	4.55:1.96:1	2013-14	7.98:2.68:1
2004-05	5.71: 2.24:1	2009-10	4.29:2.00:1		
2005-06	5.22:2.16:1	2010-11	4.71:2.29:1		

of specific types and amount of chemical fertilizers, organic manures and soil amendments for improving the soil health.In India, soil testing commenced in1955-56 when 16 STLs were established under the Indo-US operational Agreement for "Determination of Soil Fertility and Fertilizer Use." In 1965, five STLs were strengthened and nine new STLs were established under the Intensive Agricultural District Programme (IADP) in selected districts. By 1970, 25 new STLs were added. Besides, 34 mobile soil testing vans were provided under the joint auspices of the Technical Cooperation Mission of USA,and the Union Government to serve the farmers in remote areas..In 1980-81, there were 354 STLs with annual capacity of four million samples, Till 1980, STLs used to analyse soil samples for pH, texture, electrical conductivity, and available N, P & K but not for analysis of micronutrients.

Balanced & Integrated Use of Fertilizers: Government launched during 1991-92 a "Balanced and Integrated Use of Fertilizers" program aimed at promoting the balanced use of chemical fertilizers involving use of major, minor and micronutrient in conjunction with organic sources of nutrients and bio-fertilizers. The components of the scheme included establishing compost plants, increasing soil testing facilities, conducting training programs to enhance skills of staff of STLs, organizing seminars/ workshops on the use of fertilizers based on soil test. The scheme was continued during subsequent plan periods and since 2000 it has been merged with the Macro Management of Agriculture Scheme.

Soil Health Management: Soil health management [SHM] is important policy intervention under the National Mission for Sustainable Agriculture, whichaims at promoting integrated nutrient management and organic farming. The SHMincludes[i] balanced use of chemical fertilizers accompanied by secondary and micro nutrients in conjunction with organic manures and bio-fertilizers [ii] use of soil amendments to reclaim acidic/alkaline soils [iii] ensuring quality of chemical fertilizers, bio-fertilizers and organic manures under Fertilizer Control Order [iv] promotion of organic farming by adopting villages, organizing training programs and demonstrations, support to research for development of package of practices on organic farming and establishing separate Organic Agriculture Research and Teaching Institute [v] financial assistance for establishing / strengthening STLs and FQCLs,mechanized fruit/ vegetable market waste/Agro waste compost production units, State of art liquid/carrier based bio-fertiliser/ bio-pesticide production units, [vi] enhancing the skill and capacity building of the personnel of STLs and extension agency to effectively guide/help farmers [vii] creation of databank on location specific balanced use of fertilisers [viii] creation of district-wise digital soil fertility maps[ix] distribution of portable soil testing kits to field functionaries [x] promotion and distribution of micronutrients

Soil Fertility Maps: The State Governments are preparing district-wise and block-wise soil fertility maps whereas some States are preparing village-wise maps. Some States have commenced computerization of soil test data.

Soil Health Cards: Based on soil test and analysis Government is providing Soil Health Cards [SHC] to farmers indicating soil nutrient status of their farms and crop-specific recommendation on the amount of nutrients to be applied. SHC scheme enables farmers to make balanced use of fertilizers and integrated nutrient management practices. SHCs will be issued every three years to all farmers for all their land holdings. By 2016-17, Government expects to provide 140 million SHCs for which 100 mobile STLs would be established

Fertilizer Quality: To ensure availability of fertilizers of standard quality to farmers Government established 75 FQCLs with annual analysing capacity of 1,42,621 samples and had analysed 1,33,872 samples by end-MARCH 2013.

Program for 2014-15: For 2014-15, Government approved establishing five STLs, one new and strengthening three FQCLs, provision of 224 Portable Soil Testing Kits, organizing 358 training programs and demonstrations, one Liquid Carrier based Bio-fertilizer production unit, four Bio-fertilizer and Organic FQCLs , promotion of green manure for 30,000 hectares under organic farming, distribution of micronutrients for 25,700 hectares.

National Project on Management of Soil Health & Fertility: India has 120 million farm holdings which need soil analysing capacity of 40 million samples annually since each holding will require soil testing once in three years. As recommended by the Task Force on Balanced use of Fertilizers "National Project on Management of Soil Health and Fertility [NPMSF] was launched in 2008-09. The NPMSF aims at

implementing Integrated Nutrient Management and balanced use of fertilizers including minor and micro nutrients in conjunction with organic manures and bio-fertilizers. The NPMSF envisaged [i]strengthening 315 existing State STLs, establishing 500 new STLs and 250 mobile STLs during 2007-12.[ii] ensuring quality of fertilizers through strengthening FQCLs and training officers of State Governments for effective enforcement of "Fertilizer Control Order"[iii] creating site-specific data-bank for balanced use of fertilizers [iv] adoption of 10 village by each STL through Frontline Field Demonstrations [v] preparing digital district soil maps (using Global Positioning System) and soil fertility monitoring system by ICAR/State Agriculture Universities. Under the NPMSF, 134 new STLs, 123 mobile STLs and 16 new FQCLs were established and existing 173 STLs and 46 FQCLs were strengthened. .

As on end-March 2013, there were 1,206 STLs in the country, with annual analysing capacity of 12.831 million samples and SHCs issued to 40.8 million farmers.

Strategic Action Plan: Field studies of the NPMSF being under implementation since 2008-09 have revealed several shortcomings/deficiencies which should be remedied and implementation significantly improved during the year 2015 by formulating a Strategic Action Plan sharply focusing following aspects to yield expected results by end-March 2017.

- Often, soils are treated with excessive use of chemical fertilisers to extract more and more yields. Unfortunately, India's fertiliser policy is skewed against soil health. Farmers today use substantial amount of urea [a fertilizer carrying only nitrogen], because it has been significantly subsidized. Farmers like to be compensated more by the use of urea when they lose on phosphorus and potassium [which have higher market price]. In this process, they have already distorted and continue to distort the healthy nutrient balance in soil severely affecting the carbon balance, leading to all the subsequent soil-related problems. This calls for an immediate policy intervention.
- Bridge the existing wide gap in disseminating the scientific knowledge on soil health management from research institutions to STLs, extension personnel and farmers.
- Deploy adequate resources for providing well equipped STLs, & FQCLs and trained extension personnel to match country's needs.
- Creating massive awareness among all farmers to get soil tested and analysed; training them to use balanced fertilizers & Integrated Nutrient Management through field demonstrationsto make them properly understand and convince them of the economic benefits/gains of the SHM when excessive use of urea has done severe damage to their soils
- Provide soil health cards to all those who do not have yet; follow-up with those who have already been issued to assess the outcome and resolve if they have any problems
- Conductmonitoring-cum-concurrentevaluation studies through drawing plans village-wise to ensure that farmers are using the soil health cards and assess their economic benefits. .
- Install robust Management Information System to ensure effective implementation of the NPMSF, assess the economic benefits realised and initiating remedial measure if there are any problems.
- Make effective use of print and electronic media to create awareness for Soil Health Management in each village and ensure that targeted number of STLs, mobile STLs and FQCLs are established/strengthened, staff trained for capacity building,
- Conduct Action Research Project in each district to understand ground realities of the implementation of the NPMSF and prepare case studies on the successesand failures of the NPMSF at farmer's level which can be shared with farmers in other districts

The success of the NPMSF calls for effective institutional coordination [horizontal & vertical] at all levels right from the grassroots villages to the Union Ministries, concern & commitment of elected legislators, good governance & accountability of implementers and effective participation of media to launch aggressive campaign during ensuing Kharif& Rabi seasons to carry the right message to farmers.

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RURAL WOMEN
KEY TO SUSTAINABLE FOOD SECURITY

Tejinder Pal Singh

Gender inequality both leads to and is a result of food insecurity. Due to unequal and subordinate gender roles, rural women face lack of access to and control over critical livelihood and productive resources. Further, her contributions to food security are undervalued and undermined by implicit and explicit forms of gender discrimination at the household, community, market, national and global levels.

Concern for food security is a fundamental human right issue. The persistence of hunger threatens both national societies and the stability of the international community. There is more than enough food in the world to feed everyone, but the number of people affected by hunger and malnutrition is still 'unacceptably high' (FAO, 2014), with disproportionate impacts on women and girls.

- Even though the hunger target of the Millennium Development Goal 1c (MDG 1c) – of halving the proportion of undernourished people globally by 2015 – is 'within reach', however, conservative estimates indicate that the overall number of people in the world experiencing extreme, chronic malnourishment was at least 805 million between 2012 and 2014 (FAO, 2014). Further, these figures underestimate the true magnitude of hunger and malnutrition. In particular, they fail to reflect the micronutrient deficiency, or 'hidden hunger' (FAO, 2012) that affects 2 billion of the world's population, contributing to child stunting and increased rates of illness and death (IFPRI, Concern et. al. 2013).
- Describing malnutrition as India's silent emergency, the World Bank report says that the rate of malnutrition cases among children in India is almost five times more than in China, and twice than in Sub-Saharan Africa. The rural India witnesses more cases

of malnutrition among children less than 5 years of age as more cases of stunted, wasted and underweight children were reported from rural areas.

- According to UNICEF, malnutrition is more common in India than in Sub-Saharan Africa, and one in every three malnourished children in the world lives in India.
- The 2014 Global Hunger Index (GHI) ranked India at 55 among 76 emerging economies, but is still trailing behind countries like Thailand, China, Ghana, Iraq, Sri Lanka and Nepal. While no longer in the "alarming" category, India's hunger status is still classified as "serious".
- India ranked 114 out of 142 nations on World Economic Forum's 2014 Gender Gap Index. India scored below average on parameters like economic participation, educational attainment and health and survival. India has performed poorly in removing gender-based disparities and slipped 13 spots from its last year's ranking of 101.
- The 2014 Human Development Report introduced the Gender Development Index (GDI) which ranked India at 132 out of 148 countries.

> While no longer in the "alarming" category, India's hunger status is still classified as "serious".

Worldwide, an estimated 60 per cent of undernourished people are women and girls. The goal of eradicating hunger and poverty will only be achieved if the voice of the silent majority of human kind is heard, and that voice belongs to women. Rural women play a key role in supporting their households and communities in achieving food security, generating income, and improving rural livelihoods and overall well-being. They contribute to agriculture, rural enterprises and ultimately to sustainable rural development. As such, they are seen as active players in achieving the Millennium Development Goals (MDGs) as well as post-2015 development agenda.

Food Security – A Basic Understanding

Food Security, at the individual, household, national, regional, and global levels [is achieved] when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for a healthy and active life (FAO, 2001). Food security is a pre-condition for the full enjoyment of the right to food. The right to food is not simply a right to a minimum ration of calories, proteins and other specific nutrients, rather it is part of an overall goal of achieving right to development. The UN Special Rapporteur on the Right to Food in 2002 defined, "The right to have regular, permanent and free access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of the people to which the consumer belongs, and which ensures a physical and mental, individual and collective, fulfilling and dignified life free of fear."

There is a correlation between the right to food and the enjoyment of other human rights, such as the right to: live life with dignity, an adequate standard of living, health, water, adequate housing, education and information, work, livelihood, social security, social welfare, property, freedom of association, freedom from worst from of labour like bonded and child labour etc.

The dimensions/ pillars of the food security are availability, accessibility, adequacy, utilization and stability. Discrimination in terms of food availability, accessibility, adequacy, utilization and stability is inextricably linked to the poverty, hunger and undernutrition.

- *Firstly*, food availability includes sufficient quantities of food either from domestic production or imports; within their reach or within reasonable proximity.
- *Secondly*, food accessibility includes economic as well as physical access. Economic access means individuals should be able to afford food for an adequate diet without compromising on any other basic needs, such as school fees, medicines, rent or any other social security benefits. Physical access means food should be accessible to all, including to the physically vulnerable, such as children, the sick, persons

with disabilities or the elderly, for whom it may be difficult to go out to get food.

- *Thirdly*, food adequacy means: satisfying dietary needs, taking into account the individual's age, living conditions, health, occupation, sex, etc; safe for human consumption and free from adverse substances; and culturally acceptable, for example, aid containing food that is religious or cultural taboo for the recipients or inconsistent with their eating habits would not be culturally acceptable.
- *Fourthly*, food utilization means meeting the specific dietary and nutritional needs, proper food processing and storage techniques, and adequate health and sanitation services.
- *Fifthly*, food stability includes adequate food storage capacities or other means of savings for times of crop failure or other emergencies.

Though all these elements allow for a more comprehensive analysis of the complex dimensions of food security, yet they lack a comprehensive gender analysis.

Gender Dimensions of Food Security

The role of rural women in maintaining all dimensions of food security is indispensable: as food *producers* dedicate their labour; agricultural *entrepreneurs* who invest their meager savings; *gatekeepers* who dedicate their own time, income and decision-making to maintain food and nutritional security of their households and communities; and *managers* of the stability of food supplies in times of economic hardship as well as sustainability for next generation.

Gender inequality both leads to and is a result of food insecurity. Rural women continue to struggle under the double burden of production and domestic responsibilities, which inevitably affects her access to livelihood resources and has an impact on power dynamics within households. Rural women are related to hunger in a direct way. They are often the first to suffer food and nutrition insecurity in the family. This has repercussions on their health, their productivity, their quality of life, and their survival.

- Her role is not fully recognized and largely unpaid in generating family earnings. She has primary responsibility for maintaining the household and even performing drudgery tasks. She raise children, care aged and sick, grow and prepare food, provide on- and off-farm labour, manage family poultry and livestock, and collect water and fuel wood. Her work remains invisible in family enterprises.
- Rural women rarely own and/ control land, lack access to finance including credit, agricultural inputs and technology, training and extension services, and marketing services and their access to productive resources as well as decision-making tend to occur through the mediation of men.
- Women and men farmers have different roles related to crop production. Cultural definitions of 'men's' and 'women's' crops may be the outcome of gender inequalities in productive resources. Ghana, for instance, women view maize production as a productive, income-generating activity yet do not grow it because they lack the capital to purchase the required inputs or hire labour to plough the fields (FAO, IFAD, World Bank, 2008. *Gender in Agriculture Sourcebook*). Further, men have more control over the sale of cash crops while women are expected to look after the subsistence crops.
- Due to restrictions on mobility, she typically confronts a narrower range of labour markets than men, lower wage rates and harsh working conditions. Female hourly wage rates in agriculture vary from 50 per cent to 75 per cent of male rates, and are insufficient to overcome absolute poverty (12th Plan, GoI).
- Due to the low social status of women, their diet often lacks in both quality and quantity, thereby pushing girls more at risk of undernutrition than boys. Malnourished women give birth to malnourished children, which perpetuates this vicious cycle and its consequences transcend generations.
- The role of female children as unpaid contributors to household production is another labour phenomenon of agriculture and rural enterprises.

- Worldwide, women and girls are experiencing the impacts of food insecurity most acutely, with atleast 60 per cent of malnourished people are women and girls (UN ECOSOC 2007; WFP 2009).
- The World Food Programme (WFP, 2009) reported that women are shouldering the heaviest burdens in the food crisis, as they are the first to sacrifice their food intake to ensure the nutrition of their children and male head of household when food is unavailable. Yet their own food security and nutrition needs – and often those of their daughters – are being neglected at the household level, where discriminatory socio-cultural norms consider them of lower status and less of a priority than men and boys.
- According to 2011 Census, the literacy rate of male is 82.14 per cent and female 65.46 per cent. Further, the literacy rate of women is 79.92 per cent in urban area and is 58.75 per cent in rural area.
- According to National Sample Survey, the workforce participation rate of females in rural sector was 26.1 in 2009-10 while that for males was 54.7. Further, data of the 68th round of the NSS released in 2013 indicate that in comparison to 59 per cent men, 75 per cent women in rural areas work in agriculture.
- The agricultural sector is instrumental in ensuring national food security. Agriculture continues to be the main source of livelihood for most people in India. A very large proportion of this work is done by women.
- Only few women own land in their right due to male bias in transfer of land by families, the state and in the functioning of markets (Agarwal, 1994, 2003). Also few women have financial resources for leasing in land on their own. One the one hand, women are major contributors of agricultural production, and increasingly so as more men than women have moved out of agriculture; and on the other hand, they have little access to the means of production.
- Women workers who are counted as "cultivators" in national statistics tend to be largely unpaid workers on family farms. In 2004-05, 36 per cent of women farmers overall, and 39 per cent among marginal landholding households, were so counted (NCEUS, 2008). According to CSO's latest publication 'Women and Men in India 2014', 41.1 per cent of female main and marginal workers are agricultural labourers, while 24 per cent are cultivators.
- It is well known fact that small farms typify Indian agrarian economy and this predominance continues to increase. Agriculture Census 2005–06 reported the average size of an operational holding at only 1.23 hectare, with farms less than 2 hectares comprising 83 per cent of all holdings and 41 per cent of area. Also, 12 per cent of rural households are now female headed with even smaller holding, and the feminization of agriculture poses special problem (12th Plan document). In all developing countries, female-headed rural households are among the poorest of the poor.
- With the higher proportion of female labour as compared to male labour, we are witnessing 'feminization of agriculture'. Further, they often work as unpaid family workers, are involved in subsistence farming and represent about 43 per cent of the agricultural labor force in developing countries and 30 per cent in India (FAO, 2010). Despite their dominance of the labour force, their labour is limited to less skilled jobs, such as sowing, transplanting, weeding and harvesting, that often fit well within the framework of domestic life and child-rearing.
- The anaemia situation has worsened over time for women, with 57.4 per cent women in rural areas suffered from anaemia during 2005-06 (NFHS-III, 2005-06).
- The "HUNGaMA" (Hunger and Malnutrition) Survey Report 2011 highlighted that 42 per cent of children are underweight and 58 per cent are stunted by the age of 24 months. The awareness among mothers about nutrition is low as 92 per cent mothers had never heard the word 'malnutrition'. The rate of child underweight and stunting is proportional with mothers' levels of education.

Steps for Improvement of Rural Women

The Government of India has taken various policies and programmes not only the improvement of women in rural area but also to ensure the active participation in the development process in the country. The Ministry of Rural Development is implementing various poverty alleviation programmes, having special components for women. Some of the major scheme are the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), Swarnjayanti Gram Swarozgar Yojona (SGSY), now restructured as National Rural Livelihood Mission (Aajeevika) and the Indira Awaas Yojona (IAY). The implementation of these programmes is monitored specifically with reference to rural women. Mahila Kisan Sashaktikaran Pariyojana (MKSP) is being designed as a sub–component of the proposed National Rural Livelihood Mission (NRLM). The objective is to achieve socio-economic and technical empowerment of the rural women farmers, predominantly small and marginal farmers.

The recently enacted National Food Security Act (NFSA), 2013 entitles food and nutritional security, by ensuring access to adequate quantity of quality food at affordable prices. It also has special focus on nutritional support to women and children, as well as women empowerment. Pregnant women and lactating mothers during pregnancy and six months after the childbirth will also be entitled to maternity benefit it of not less than Rs.6000. Children up to 14 years of age will be entitled to nutritious meals or take-home rations as per prescribed nutritional standards. The eldest woman who is not less than eighteen years of age, in every eligible household, shall be head of the household for the purpose of issue of ration cards. Where a household at any time does not have a woman or a woman of eighteen years of age or above, but has a female member below the age of eighteen years, then, the eldest male member of the household shall be the head of the household for the purpose of issue of ration card and the female member, on attaining the age of eighteen years, shall become the head of the household for such ration cards in place of such male member. In case of non-supply of entitled foodgrains or meals, the beneficiaries will receive a food security allowance. There are provisions for reforms in the TPDS; setting up of grievance redressal mechanisms at district and state levels; separate provisions have been made for ensuring transparency and accountability etc.

Suggestions

Women play a critical and potentially transformative role in agricultural growth in developing countries. Empowerment is defined as a group's or individual's capacity to make effective choices, that is, to make choices and then to transform those choices into desired actions and outcome. In other words, expanding the rights, resources, and capacity to make decisions and act independently in social, economic and political spheres. World Bank identified empowerment as "the expansion of assets and capabilities of poor people to participate in, negotiate with, influence, control, and hold accountable institutions that affect their lives."

There is a linkage between gender empowerment and food security. Women smallholders play a vital role in household and community food and nutrition security. Therefore, women smallholders as groups should be involved in agricultural growth to achieve food security.

Women are the ones who combine work in the fields and work at home to provide for the basic needs of the family. Women play an indispensable role in addressing this challenge of decreasing world hunger.

Women tend to be responsible for food production, processing, distribution and marketing outside the family as well as food preparation, childcare and looking after sick and dependents within the family and are more likely to be spent their labour, income and time on their children's education and health needs. Research has shown that a child's chances of survival increase by 20 per cent when the mother controls the household budget.

Enhancing women's access to and control over productive resources, particularly land, would have a huge impact on food security and economic growth. Establish legal and other mechanisms, as appropriate, that advance land reform, recognize and protect property, water, and user rights, to enhance access for the rural women to resources.

If women had the same access to productive resources as men, women could boost their yields by 20–30 per cent, raising the overall agricultural output in developing countries by 2.5 to 4 per cent (FAO, 2011).

Ensure an enabling political, social, and economic environment designed to create the best conditions for the eradication of poverty and hunger, based on effective participation of women, which is most conducive to achieving sustainable food security for all.

Supporting self-help groups (SHGs), rural cooperatives, microfinance institutions (MFIs), various saving and credit associations, and the provision of financial intermediation services can empower women to compete in financial markets.

The magnitude of female malnutrition, particularly undernutrition, and its enormous social, economic, health, and developmental consequences demands strong actions. Actions need to focus on nutrients and energy intake, on disease prevention, and on strengthening the caring for women and adolescent girls, and helping women produce more food for themselves and their families. These direct actions together will complement and help the struggle for achieving long-term goals of gender equity and women's empowerment.

> Women play a critical and potentially transformative role in agricultural growth in developing countries.

Research system must also seek the inputs of women as they have historically been the source of much traditional knowledge, innovations and skill in agriculture. While appreciating the efforts of the National Agricultural Research System (NARS) for bringing women in the fore front of agricultural research and development, therefore, forming Mahila Kisan Mandals in every village to educate women on different aspects of agriculture and related activities.

Promote investment to benefit small-scale food producers, especially women, and their organizations, in food security programmes; strengthen their capacity to design, implement and monitor these programmes.

Improve the collection, dissemination and use of gender-disaggregated data in agriculture, fisheries, forestry and rural development.

Conclusion

Climate change and environmental degradation increases women's time for labour intensive household tasks and decreases agricultural productivity. Rural women play a critical role in management of natural resource and local biodiversity. Therefore, we must recognize the critical contribution to food security that is made by women around the world. They have multiple roles and responsibilities in agriculture and the entire food chain. A combination of public policy, legal reforms, and implementation of existing laws and structural transformation of the gender biased division of labour will help in the recognizing the unpaid contribution of women, especially in a society with deeply entrenched in feudal customs and patriarchal norms. A composite measurement tool to increase understanding of the connections between women's empowerment, food security, and agricultural growth should be developed. One such tool is the Women's Empowerment in Agriculture Index (WEAI) – developed by IFPRI, the US Government's Feed the Future Initiative, the USAID and the Oxford Poverty and Human Development Initiative – which measures the empowerment, agency, and inclusion of women in the agriculture sector, and measures the roles and extent of women's engagement in the agriculture sector in five domains: decisions about agricultural production; access to and decision-making power over productive resources; control over use of income; leadership in the community; and time use. It also measures women's empowerment relative to men within their households. Thus, the gender dimensions of food security should be given importance in ensuring food and nutrition security for all, paving a way for an equitable, inclusive and sustainable path in the post-2015 development agenda.

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SWACHH BHARAT ABHIYAN: ROLE OF INDIGENOUS TECHNOLOGIES DEVELOPED BY BARC

Swachh Bharat Abhiyaan was launched by Hon'ble Prime Minister of India on 2nd October, 2015, which caught attention of everybody not only in India, but also in the world. The Government has taken various steps to create awareness among the masses for keeping the area surrounding them neat and clean. Government is also paying special attention for cleaning of rivers, railway stations, tourist destinations and other public places.

To achieve the target of cleanliness, the technologies to treat the waste material should also be developed along with creating awareness. There are many technologies that are used to treat waste material. They are usually very costly, very complex to be understood and viable only for large size units. At the same time, indigenous technologies are low cost and easy to use and can be used by different size units.In India, they are particularly suitable for the small and medium units. In this regard, a National workshop on Indigenous water, waste water and Solid Waste Treatment Technologies was organised by the Department of Atomic Energy (DAE) in January, 2015 at Gujarat Technological University (GTU) in Ahmedabad. The objective of the workshop was to disseminate indigenous technologies for waste treatment developed by the **Bhabha Atomic Research Centre (BARC) under "Swachh Bharat Abhiyan"** and to bridge the gap between the research at the research centres and the practical application of the technologies.

The BARC is playing a pivotal role in the development of these technologies. Some of these technologies are as follows:

Indigenous water purification technologies

These technologies can improve the drinking water quality of smaller villages as well as larger cities. It uses the Pressure Driven Membrane Processes. These are suitable for all capacity units e.g. they are adaptable from household level unit or community level unit to large scale unit. Water purification technologies make use of the nuclear energy and solar energy also.

Environment friendly Plasma technologies

Solid waste dumping sites or landfill sites need more amount of land which is not available in urban areas. Incineration of solid waste pollutes the environment, if the incinerators are not designed or operated properly.Thermal Plasma Technology is ideally suited for waste treatment. By plasma technology hazardous & toxic compounds are broken down to elemental constituents at high temperatures; Inorganic materials are converted to Vitrified Mass; and Organic materials are Pyrolysed or Gasified, Converted to flue gases (H2 & CO) & Lower hydrocarbon gases when operated at low temperature (500 – 600OC). Disposal of carcass is also being thought of using plasma pyrolysis.

Unique Multi Stage Biological Treatment Solution

Multi Stage Biological Treatment Solution (MSBT)can be implemented on existing Sewage Treatment Plant (STP)

which are not able to process Sewage to optimum efficiency. MSBT can be implemented as a modular or container on the banks of rivers on Drains/Nalas which discharge waste water to the river. It can also be implanted in small urban societies and housing complex for better water management.Benefits of MSBT are: No Surplus of Organic Sludge, No odour problem, Drastic reduction of electrical power usage which minimizes operating costs, no need for return sludge pumping (minimizing electromechanical component which ultimately reduces operating cost).

Role of environmental isotope techniques in the water resources development and management

There are two type of isotopes,stable isotopes and radioactive isotopes. Isotope techniques are used to find out the type of contamination in surface water and ground water, the sources and origin of contamination, pollutant dispersion in surface water bodies, to assess thegroundwater salinity, to assess the changes due to long-term exploitation of groundwater, for hydro-chemical investigation and to carry out geochemical evolution of groundwater.

The BARC UF Membrane Technology for Domestic Water Purifiers

Water filters manufactured by Sondhka based on membrane based water Purification Technology has been developed by BARC. Benefits of BARC Polysulfone Membrane are high tech 0.02micron or 20nm, simple form factor, rugged (life of more than 1 year) and low maintenance (about Rs. 500 per year). It is very easy to use and very low cost solution for the water contamination.

Deployment of BARC Domestic Water Purifier in Rural Area through AKRUTI Program

Rural Human & Resource Development Facility (RHRDF) is disseminating BARC technologies, namely NisargrunaBiogas, Soil Organic Carbon Testing Kit, Seed Bank, Domestic Water Purifier, Weather Forecasting, LLL, RIA, FSD, VTD; under the AKRUTI(Advance Knowledge of Rural Technology Implementation) Program. Activities carried out under the AKRUTI program are surveys for safe drinking water, Interaction with the villagers, entrepreneurship development for domestic water purifier production and awareness programs for benefits of use of purified water. RHRDF has also launched a scheme for safe drinking water for villages under CSR.

Radiation Hygienization of Municipal Sewage Sludge

The sewage is the waste water generated from domestic premises and consists mainly of human waste. It typically contains 99.9% water and about 0.1% solid. The solid waste in sewage is typically organic in nature and is broken down in the sewage treatment plants resulting in sewage sludge as a byproduct. In Radiation Hygienization process dry sludge generated at STPs is hygienized using radiation technology using standard Gamma facility at a Dose of 10kgs. Such radiation plants are operating in India for sterilizing medical products.

Refuse Derived Fuel: An Emerging Processing Technology in MSWM

Refuse Derived Fuel (RDF) is a processed form of Municipal Solid Waste (MSW) and it can be a substitute to coal energy. The process of conversion of garbage into fuel pellets involves primarily drying, Separation of incombustible, sizereduction and pelletisation.

Conclusion

The above mentioned technologies can be of great help in the treatment of water and solid waste management. This shows that solid waste which is normally treated as the cause of concern, if treated properly can become a sustainable source of energy.

The aim should be to promote research work in these technologies. After the research is done, the gap between research and its implementation at ground level should be bridged. All stakeholders should be involved so that these technologies can be utilised by small, medium and large units, so that they can contribute to the Swachh Bharat Abhiyaan by making India clean.

(Courtesy Department of Atomic Energy)

(Source PIB)

FROM FOLK ART TO SUSTAINABLE LIVELIHOOD

Ruchika Bammi and Pooja Singh

This article discusses the evolution and journey of a woman entrepreneur involved in Madhubani paintings and other handicrafts who has not only fought poverty but has also impacted the lives of sixty local women of Muzaffarpur District of Bihar. It also aims to understand the role and potential of handicraft sector in improving and providing a sustainable livelihood option for local people specially women in the poverty ridden state of Bihar by strengthening the social capital linkages of women artisans, production in the homestead site, so that women could be economically active without leaving the home and empower them as they learn to deal with traders.

Handicrafts have been one of the major mainstays of the Indian economy and have subsequently acquired the status of a major livelihood opportunity for a large number of women in India. Madhubani paintings are one of the oldest art forms from Mithila region of Bihar. It is known as Mithila Painting. For centuries, women from the region of Mithila have been making ritualistic paintings and expressing their own social world around them through the medium of paintings. These handicrafts not only portray aesthetic and cultural dimensions but present various socio – economic characteristics, the major one being that the handicrafts sector is a home-based industry, which requires low capital and infrastructure investment. Moreover, it makes use of locally available skills and raw materials, thus can act as a major source of livelihood by creating home based entrepreneurship options. The current research is focussed towards understanding the role and potential of handicraft sector in improving and providing a sustainable livelihood option using a case based approach.

According to Carree & Thurik, (2003) entrepreneurship can be considered as necessary condition for sound long-term economic development. It is the entrepreneurs who introduce new products and new production processes in an economy. The term "Women Entrepreneurship" means an act of business ownership and business creation that empowers women economically, increases their economic strength as well as position in society. Patel (1987) classified three categories of women entrepreneurs-'chance', 'forced' and 'created' entrepreneurs-based on how their

businesses got started. Chance entrepreneurs are those who start a business without any clear goals or plans their businesses probably evolved from hobbies to economic enterprises over time. Forced entrepreneurs are those who were compelled by circumstances (e.g., death of a spouse, the family facing financial difficulties) to start a business; their primary motivation, hence, tends to be financial. Created entrepreneurs are those are 'located, motivated, encouraged and developed through Entrepreneurship Development Programs'. Based on the, in-depth interview conducted with the entrepreneur, this case tries to assess motives, obstacles, goals and aspirations, needs, and business identity of a women entrepreneur in the district of Bihar. It tries to bring forth how a women entrepreneur does not only innovate new products and production in the society but can also be a source of empowerment for other women's in the society. The paper tries to develop a model of challenges faced by a small time forced entrepreneur.

How it started

The organization "Aroona" which personifies spiritual power acts as a glow of rising sun to 65 women in its organization. It all started in the year 1993 when entrepreneur Aruna started her business of embroidery in Muzaffarpur district of Bihar. She was 28 year old, separated from her husband and two children to look up. Low confidence and no family support forced her to look out for a number of things for sustenance. She took up home tuitions, became a life insurance agent, but the compensation in these jobs was not enough to support her family. Then one day she decided to take over embroidery as her business as this was the only thing she knew as she grew up watching her mother do.

Organization

The entrepreneur does not use any form of advertising and works on the model of word of mouth for selling her products. This form of promotion itself seems to work for the organization as her customers belong to places like Delhi and Pune and ranges from teachers, professors, corporate to housewives. She started business with just one order while today her organization boosts of having various orders from

Developing Human Resource

Aruna, A very timid and introvert woman earlier is now gracefully working towards her art and helping 13 girls to learn this art. She picks up girls from nearby villages and trains them in madhubani painting and embroidery (Katha work, Applique, Chikankari etc) for three months and then starts giving them work. She provides training free of cost and the trainees are generally absorbed by the organization however, many women have started their own ventures of embroidery houses. The organization also provides part time work opportunity to women i.e. if some women want to work during the holiday season they can do so. The resource like sari, cloth, threads colors etc. are all provided by the organization. The payments are made on the basis of work done by the women. The monthly income is flexible both for Aruna and other workers as it depends upon sale.

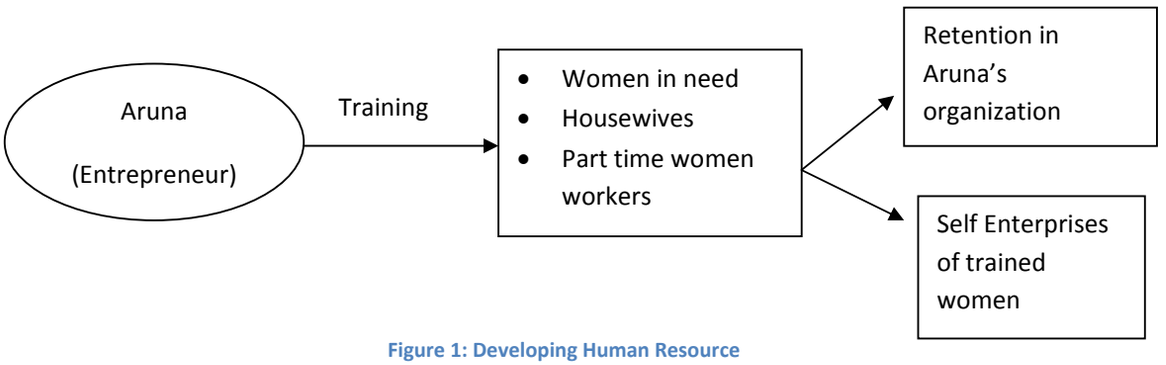

Figure 1: Developing Human Resource

far flung places for Saree, Suits, Dupatta's and wall hangings. The various marketing models used by the entrepreneur are:

- **Direct Marketing** – the entrepreneur directly engages with her customers for selling and customization of her products. This is the very first channel she used for marketing her products. The channel provides her an opportunity to interact with her customers to understand their requirement and customize products as per their needs. This also helps her understand the current fashion status thus helping her make her products according to market demands.
- **Participation in Trade Fairs** – the entrepreneur takes active participation in artisan trade fairs organized in her city in order to create awareness about her product. This marketing model has helped her create awareness for her venture and has grown to be one of the major revenue generation models for her firm. This has helped her create some high value loyal customers for her organization who not only buy her readymade products but also engage in customization of her art.
- **Chain Marketing –** Some of the customers, who buy from Aruna, buy products in bulk for reselling purpose. This is specially the case with customers belonging to far flung areas like Delhi, Mumbai and Pune.

Challenges

Low Productivity – The entrepreneur faces the challenge of low productivity for the reason being lack of professional infrastructure. The organization lacks essential infrastructure like work sheds, proper storage space and proper packing facilities. Lack of work sheds constraints the entrepreneur to recruit and train higher number of girls thus limiting the productivity.

Another problem faced by the entrepreneur relates to the lack of financial capability to upgrade technology in production and undergo specialized training from time to time.

Inadequate Inputs – The entrepreneur faces the challenge of inadequate inputs at two levels:

- Raw Material
- Finance

Raw Material – small raw material requirements results in low bargaining power to the entrepreneur thus many a times forcing her to buy sub standard material at high prices.

Finance – A major challenge faced by the entrepreneur relates to that of lack of finance which acts as a major hindrance to take up bulk orders, as it becomes difficult to buy raw material in high quantity, arrange for workers and simultaneously take care of her children.

Value Chain Problems – Increasingly due to high prices of handicraft products the customers are generally urbanized, while the artisans and small entrepreneurs still continue to sell in their local markets. Low level of training and formal education makes it difficult for the entrepreneur to make use of technology and make her products available through internet.

Lack of prior work Experience – lack of proper work experience and formal education in the field, the entrepreneur faces various challenges like determining the extent of stock to be maintained, maintaining relation with customers, other marketing and sales skills.

Family Situation – the entrepreneur has two dependent family members which hinders her from taking excessive risk of venturing to other markets thus resulting in her taking calculated risks and limited area of business.

Social Ideologies – belonging to a small place the entrepreneur faced challenge in starting up her own venture as the business required not only training girls but communicating with suppliers, customers' etc. The entrepreneur faced parental pressure to devote time taking care of her children rather than spending most of her time in growing her entrepreneurial activity, she also faced the pressure of keeping her business small and not getting into large scale activity as that would have meant going out and marketing her products and interacting with different kind of people. The pressure was to keep the business at a level at which it can be run from home and would not require her getting out and travelling.

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country will have access to 70 lpcd within their household premises or at a horizontal or vertical distance of not more than 50 meters from their household without barriers of social or financial discrimination. Individual States can adopt higher quantity norms, such as 100 lpcd.

It is recognized that States will adopt their own strategies and phased timeframes to achieve this goal. Three standards of service can be identified depending on what communities want:

- Basic piped water supply with a mix of household connections, public taps and hand pumps (designed for 55 lpcd) -with appropriate costing as decided by States taking affordability and social equity into consideration
- Piped water supply with all metered, household connections (designed for 70 lpcd or more) - with appropriate cost ceilings as decided by States, taking affordability and social equity into consideration.
- In extreme cases, hand pumps (designed for 40 lpcd), protected open wells, protected ponds, etc., supplemented by other local sources – preferably free of cost. Optimum use of rainwater should be an integrated element in all the three cases.

Timelines

By 2017

- Ensure that at least 55% of rural households are provided with piped water supply; at least 35% of rural households have piped water supply with a household connection; less than 20% use public taps and less than 45% use hand pumps or other safe and adequate private water sources. All services meet set standards in terms of quality and number of hours of supply every day.
- Ensure that all households, schools and *anganwadis* in rural India have access to and use adequate quantity of safe drinking water.
- Provide enabling support and environment for PanchayatI Raj Institutions and local communities to manage at least 60% of rural drinking water sources and systems.

By 2022

- Ensure that at least 90% of rural households are provided with piped water supply; at least 80% of rural households have piped water supply with a household connection; less than 10% use public taps and less than 10% use handpumps or other safe and adequate private water sources.
- Provide enabling support and environment for all PanchayatI Raj Institutions and local communities to manage 100% of rural drinking water sources and systems.

Source: **Department of Drinking Water and Sanitation**
Ministry of Rural Development
Government of India

Licensed U(DN) 52/2015-17 to post without pre-payment
At RMS, Delhi ISSN -0021-5660
Date of Publishing : 30th, 31st of previous month
Date of Dispatch : 2nd, 3rd of same month

Reg. Number DL(S)-05-3232/2015-17
RN 702/57-Delhi Postal

Printed and Published by Dr.Sadhana Rout, Additional Director General and Head, Publications Division, Ministry of I&B, Govt. of India
Soochna Bhawan, New Delhi-110 003 on behalf of Ministry of Rural Development, Govt. of India, New Delhi-110 011,
Printed at Chandu Press D-97, Shakarpur, Delhi-110092 and Published from Soochna Bhawan, New Delhi-110003.