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LEISA INDIA

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Water

Lifeline for livelihoods

LEISA INDIA

September 2015 Volume 17 no. 3

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A good crop growth is possible if rainwater is harvested
(Photo: Raghu for Bhoomi Farm and Ranchita Kumaran for Reliance Foundation)

The AgriCultures Network
LEISA India is a member of the global Agricultures Network. Seven organisations that provide information on small-scale, sustainable agriculture worldwide, and that publish:
Farming Matters *(in English)*
LEISA revista de agroecología *(Latin America)*
LEISA India *(in English, Kannada, Tamil, Hindi, Telugu, Oriya, Marathi and Punjabi)*
AGRIDAPE *(West Africa, in French)*
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The editors have taken every care to ensure that the contents of this magazine are as accurate as possible. The authors have ultimate responsibility, however, for the content of individual articles.

The editors encourage readers to photocopy and circulate magazine articles.

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Dear Readers

We are rapidly moving towards water crisis, with increasing and conflicting demands – drinking, agriculture, health, sanitation, construction etc. In India, the issue is seriously compounded with growing populations, multiplying needs and unabated wastages and pollution.

Water if used judiciously can meet the essential needs of the growing population. It is also important to conserve and recycle this scarce resource. Traditionally farming was based on the local agro-ecological situation, taking the rainfall pattern into consideration. While water intensive crops were grown only where there was copious rainfall, drylands focused on hardy crops. Farmers through generations knew that water was a common resource and had knowledge to conserve and nurture the resource. Its time we understand the seriousness of the issue and take note of such water management measures that preserve and protect our ecology. This issue of LEISA India includes a number of such initiatives promoted by individuals, communities and change agents.

The Editors

LEISA is about Low-External-Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the bases of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors, to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge and to influence policy formulation to create a conducive environment for its further development. LEISA is a concept, an approach and a political message.

ILEIA – the centre for learning on sustainable agriculture is a member of AgriCultures Network which shares knowledge and provides information on small-scale family farming and agroecology. (www.theagriculturesnetwork.org). The network , with members from all over the world - Brazil, China, India, the Netherlands, Peru and Senegal, produces six regional magazines and one global magazine. In addition, is involved in various processes to promote family farming and agroecology. The ILEIA office in The Netherlands functions as the secretariat of the network.

MISEREOR founded in 1958 is the German Catholic Bishops' Organisation for Development Cooperation. For over 50 years MISEREOR has been committed to fighting poverty in Africa, Asia and Latin America. MISEREOR's support is available to any human being in need – regardless of their religion, ethnicity or gender. MISEREOR believes in supporting initiatives driven and owned by the poor and the disadvantaged. It prefers to work in partnership with its local partners. Together with the beneficiaries, the partners involved help shape local development processes and implement the projects. This is how MISEREOR, together with its partners, responds to constantly changing challenges. (www.misereor.de; www.misereor.org)

AME Foundation promotes sustainable livelihoods through combining indigenous knowledge and innovative technologies for Low-External-Input natural resource management. Towards this objective, AME Foundation works with small and marginal farmers in the Deccan Plateau region by generating farming alternatives, enriching the knowledge base, training, linking development agencies and sharing experience.

AMEF is working closely with interested groups of farmers in clusters of villages, to enable them to generate and adopt alternative farming practices. These locations with enhanced visibility are utilised as learning situations for practitioners and promoters of eco-farming systems, which includes NGOs and NGO networks. www.amefound.org

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By efficient harvesting of water, the communities of Krishna Dehariya village in Madhya Pradesh are not only able to meet the current water requirement of the village but are also prepared to meet future water demands. Strong local institution helped transform this village into a water secured one, improving their lives and livelihoods.

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Water

Lifeline for livelihoods

Water is not just a naturally available 'commodity', waiting to be privatised. It is a collective resource and a prime driver for every source of life, for sustainable livelihoods, cultures, and landscapes. Access to safe water has a direct bearing on productivity and health of human and animal populations.

We are rapidly moving towards water crisis, with increasing and conflicting demands –drinking, agriculture, health, sanitation, construction etc. In a country like India, the issue is seriously compounded with growing populations, multiplying needs and unabated wastages and pollution. India sustains nearly 17 per cent of the world's population but is endowed with just four per cent of global water resources. About 50 per cent of annual precipitation is received in just about 15 days in a year. Leakage and inefficiencies in the water supply system waste nearly 50 per cent of usable water. The ground water level is declining at the rate of 10 cm per year. Over 70 per cent of surface water and ground water resources are contaminated. The estimated 'Water Gap' for India by the '2030 is an alarming 50 per cent. (TERI discussion paper, 2014)(see also Box).

Improving water use efficiency in farming

Irrigated agriculture is the predominant consumer of water resources. Unconstrained use of water under water scarce regions is resulting in the deepening of water tables, environmental degradation, and also affecting soil quality. Agricultural land-use practices in general exert a major influence on ground water quality. Cropping choices determine the extent of water used in farming.

Adoption of climate resilient agronomic practices, appropriate crop choices and crop management practices go a long way in influencing the water use efficiency. It is a well known fact that crops like paddy and sugarcane are water guzzlers, whereas millets require much less water and hardy crops.

Incorporating watershed-based planning and appropriate crop choices increase the scope for *in situ* moisture conservation and improve biodiversity. Watershed projects introduce sustainable land management practices to encourage land use as per people's needs and to ensure full participation of watershed users in the development and management of common properties. (Abhijit Mohanty, p.6; Mohan Dangi, p.15).

Water use efficiency can be increased by using technological approaches too. Simple techniques that are usable by communities go a long way in saving and conserving water used for crop cultivation. Innovation is the key necessity. For example, successful trials of an irrigation technology have been conducted that provides assured moisture directly to the plant root zone. It combines tradition with modernity. Buried traditional clay pots harvested rainwater which is supplied to each plant from a overhead tank through pipes. The effectiveness seems to be based on supporting gradual wetting of the soil rather than abrupt provision of water in 'concentrated' loads, thus enabling water saving, better absorption, microclimate and microbial activity in the soil. (K S Gopal, p.9)

Equipped with innovative approaches that cut down water consumption, farmers in Nidhan village of Madhya Pradesh have started looking for ways to grow two crops in a year. The village has been guided by the local Krishi Vigyan Kendra in their efforts to undertake water use efficiency in agriculture. (Amita Bhaduri, p.30). The communities of Krishna Dehariya village in Madhya Pradesh are not only able to meet the current water requirement of the village but are also prepared to meet future water demands without affecting ecology. Besides crop productivity and income increases, there has been some significant changes on the social front too, for instance, increased enrolment of girl children in schools who were busy fetching water earlier. The villagers informally changed the name of village as "Krishna Dehariya" after achieving water self-sufficiency, even making a request to the District Collector to change in revenue records. (Ranchitha Kumaran, p.35).

Banking on indigenous knowledge

Traditional tribal farming communities have an invaluable wealth of indigenous knowledge about managing scarce water to grow crops. (Abhijit Mohanty, p.6). *Kenis* or sacred wells and *Surangas* reveal the ancient knowledge and wisdom of tribes of Wayanad in water conservation and sustainable utilization of perennial water sources. (Unnikrishnana Nair, p.23). By renovating traditional water harvesting structures like *khadins* and *nadis*, farmers in Barmer have proved beyond doubt that rain-fed farming, even with minimum annual rainfall in the 200-250 mm range, can contribute to the food security and enhance the quality of life of the people. (Ravdeep Kaur, p.20).

Community management is the key

Water usage practices have specific connotations based on local culture and practices, whether it is for domestic use or agriculture. Better and more efficient management requires the involvement and participation of local communities. Local level community institutions ensure proper regulation, minimize wastage, and enhance efficiency and these need to be nurtured.

However, the most basic belief system required seems to be to recognise that water is for common good. To revive this, a consultative process involving the local community, professional inputs and expertise, and persistent efforts in the field, is required. (Ravdeep Kaur, p.20). The deeper the process the more effective it is. This is illustrated by the farming community in Rajha village in Nepal through good governance mechanisms.(Ganesh Dhakal, p.12). Again, a community drive to revive wells resulted in water security for longer periods and sustained increase in rural incomes in Sawna macrowatershed area near Udaipur. (Mohan Dangi, p.15). Strong local institutions are critical for social transformation (Ranchitha Kumaran, p.35).

Supportive policies with shift in approach

There is a need for shift in approach in water resource management - from purely engineering works to systems that incorporate traditional practices, local materials and are manageable and maintainable by local communities. The local community need to be involved at all stages of discussion, planning, implementation and maintenance.

Clear policy guidance and focused local action are required to make better use of scarce water resources. The National Water Policy (NWP 2002) gave emphasis for the first time to ecological and environmental aspects of water allocation. Also, food and energy policies do influence the way the water is managed. For instance, eliminating guarantee prices or subsidies for the cultivation of highly water-intensive crops (like paddy rice or sugarcane) in water-scarce areas will greatly aid resource management.

Inspiring examples

There are inspiring examples of indomitable human endeavours guiding communities and bringing lasting changes. For instance, beginning in 1985, traditional water harvesting was revitalised and local rivers were transformed from ephemeral to perennial. (Rajendra Singh, p.26). Similarly, all her working life, Elizabeth Peredo has been engaged in defending human and environmental rights, aiming to "contribute to people living in harmony with each other in a world of solidarity, with respect for life and nature, using art, analysis and activism." (p.18).

These examples should motivate us and enable us to move beyond individual short term interests towards long term community concerns. Its time for collective thinking and action.

Reference

S Vijay Kumar and Girija K Bharat, **Perspectives on a Water Resource Policy for India**, *October 2014*, TERI Discussion paper.

Water Facts

Did you know that by 2025, water withdrawals are predicted to increase by:

- *50 percent in developing countries*
- *18 percent in developed countries*

Did you know that by 2025:

- *1800 million people will be living in countries or regions with absolute water scarcity*
- *two-thirds of the world population could be under stress conditions caused by water scarcity*

Water footprints

Did you know that we need:

- *13 litres of water for a tomato*
- *25 litres of water for a potato*
- *35 litres of water for a cup of tea*
- *70 litres of water for an apple*
- *75 litres of water for a glass of beer*
- *120 litres of water for a glass of wine*
- *140 litres of water for a cup of coffee*
- *170 litres of water for a glass of orange juice*
- *184 litres of water for a bag of potato crisps*
- *200 litres of water for a glass of milk*
- *2400 litres of water for a hamburger*

(source: IFAD)

A farmer checks his mixed-cropping of black gram, horse gram and chickpea

The journey from grey to green

Abhijit Mohanty

Development of watershed is an approach to make best use of the rainwater for agricultural production while improving soil conservation and bio-diversity. By harvesting rainwater on the upper and middle slopes, the farmers in Mankadmundi tribal village could bring in an additional area of 63 hectares to grow crops with protective irrigation.

Mankadmundi is a tribal inhabited village of Dasmantpur block in Koraput district of Odisha. The region receives an average 1,300 mm rainfall annually. Most of it is received in intense storms during three months of the year. Four-fifths of the rain gather into rivulets and streams, rush down the narrow valleys, get lost – carrying tons of precious fertile soil with it. People in the village could grow only one crop of upland paddy, millet/ maize a year.

Generally, water applied to the crops is not measured. Farmers have a tendency to flood their field with excessive water when it is available as it does not incur any additional cost. This has resulted in leaching of salts, increased soil salinity, affecting yields and increasing costs. If only they could tap some of the extra water and use it to irrigate crops, then they could grow another crop after the main one.

The remaining nine months of the year are dry and parched. Unable to grow anything in the dry soil, farmers migrate in search of work. Sometimes, distress migration is the only option to sustain.

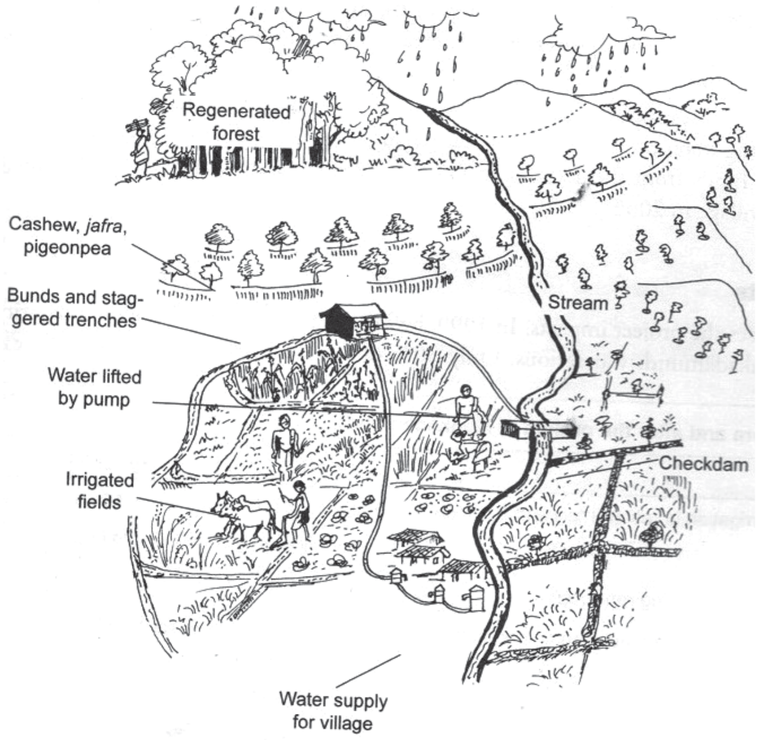
The journey

The village leaders approached Agragamee, an NGO that has been working in remote tribal areas of Odisha since 1987, and asked for help. Agragamee staff held many discussions with groups of villagers. Together, the villagers and Agragamee conducted a Participatory Rural Appraisal (PRA) to identify the problems, map its natural resources, and identify opportunities for improving the grim situation. One of the things that emerged from the PRA was the invaluable wealth of indigenous knowledge about managing scarce

Tribal farming community had an invaluable wealth of indigenous knowledge about managing scarce water to grow crops.

water to grow crops. For example, farmers designed their wetland rice fields in the village bottomland so that they could capture runoff from the hillsides. To prevent the wetland fields from washing out during heavy storms, they diverted the water in channels along the edges of the fields – where it could be tapped for use during the dry spell. However, less than 10 percent of the cultivated land was irrigated in this way. Agragamee suggested applying this principle to a much bigger area.

Agragamee perceived that recovery of water cost, promotion of micro-irrigation systems and involvement of water user's group for water distribution would significantly help in improving the water use efficiency and reducing the cost of agricultural production. As a result, they designed a 5 year Watershed Development Project (WDP). Under the WDP, the catchment area of a basin is considered as a unit and efforts are made to harness rainwater by treating the land from the ridge to the valley.



After the project: check dams on the river, with a pump to lift water to the fields

Communities built a series of stone bunds and dug staggered trenches along the contours to harvest water on the steep slopes. This has significantly facilitated water percolation while reducing soil erosion. Between the bunds they planted trees such as cashew, mango, litchi and jafra to conserve the soil and produce extra output. While trees demand less water and can withstand water stress, they also serve as wind breaks to reducing evaporation losses.

The villagers also built a check dam across the stream to harvest some of it, to grow crops. As the stream is nearly 10 meters lower than the land to be irrigated, a diesel pump was used to lift water to the highest point on the fields. A gently sloping channel then carries it from field to field. Because of this long flow path, much of the water percolates into the ground, increasing the soil moisture while recharging wells and ponds at the lower level. Farmers regulate the distribution of water using planks. If there is too much water, they let it flow down to the stream again.

Efficient cropping patterns

The success of any intercropping system depends on the proper selection of crop species so that they do not compete for light, space, moisture and nutrients. More diversity in the farming means more stability, resulting in reduced pest infestations and disease incidence. The combined yields of two crops grown as intercrops are higher than the yield of same crops as pure stand.

Agragamee promoted some of the most successful intercropping system amongst the farmers- inclusion of legumes as intercrops in paddy and mustard; Intercropping of legumes with cereals (like upland rice) helps in conserving moisture by reducing runoff, improving physical properties of soil and building-up soil fertility. Intercropping with different canopy architectures (like legume and mustard) have an edge over growing solo crops of mustard. On the other hand, pulses that acts as a rich source of nitrogen, providing food and fodder, also is a hardy crop like the millets. They grow well in dryland conditions and require less water to grow.

Dealing with nature's adversaries

Despite practising the indigenous system of cropping, farmers continue to face many challenges like delay in monsoon, moisture stress, erosion of top fertile soil etc. Farmers have also learnt how to deal with such challenges. For example Mandia Disari of Tentuliguda village says that *"when the monsoon fails, and there is more than 50% of mortality rate of paddy owing to 15-20 days dry spell after sowing, we usually re-sow the crops. This is done up to July after receipt of sufficient rain water along with intercropping with green gram, horse gram or cow pea in a ratio of 2:1 or 2:2. In this case, the fields should be free of weeds for utilization of water and nutrients by the late sown crops. During the rainy season,*

Cropping of indigenous Maize with Tomatoes

when there is heavy rainfall coupled with wind blow, the crop fields face severe soil erosion. To mitigate this, we cultivate crops like pearl millet and pigeon pea which provide cover to the soil, thus resulting in considerable reduction in runoff and soil loss."

Water Governance System

One of the striking features that Agragamee did was to encourage the villagers to form a Watershed User's Society to govern the watershed development activities. The Society is self-governing and is registered with the government. The Society collects dues from people who benefit from using the pump and the water. This money goes into a maintenance fund. The amount collected depends upon the crop: Rs.400-500/- for a hectare of rice, and Rs. 100/- for a hectare of millet.

Local youth have been trained as barefoot engineers to maintain the pump and canals. If a complex repair is needed, the Society pays an outside mechanic using money from the fund.

Perceptible impacts

Before the project started, food security situation in Mankadmundi was serious. Only 30% of residents got enough to eat round the year. Another 40% managed to get enough for six months a year, while the remaining 30% had enough for only four months. But now, after project interventions, around 70% of the families have food all year round and the remaining 30% have enough to eat for at least 7 months. The villagers have formed grain-banks as a buffer stock against food shortages.

The water table has risen, increasing water availability. Farmers now grow vegetables such as tomato, brinjal, chilli, cauliflower etc in both rainy and winter seasons. They eat part of their produce and sell the rest in the local market. The multi-crop production has improved the people's nutrition - especially for the children.

Before the project interventions, 30 percent of the families in the village were engaged in shifting cultivation which was no longer sustainable in the area because of the very short fallow periods. With increased cropping intensity, people no longer have to clear forest land to grow crops, resulting in forest conservation.

With improved access to irrigation, farmers feel it is worthwhile taking care of their land. They rent out fields they cannot cultivate themselves to landless farmers, arranged through the Watershed User's Society. In this way, many landless people now have the chance to earn a living in the village. For instance, labourers find wage work up to 200 days a year, stopping distress migration.

The higher incomes are reflected in people's belongings. They have started building houses from stone rather than the traditional mud. They have bought bicycles, radios, clothing and cooking utensils. They have money to deal with health problems. They visit the market more often because they have more to sell, and more money to buy things with.

Conclusion

The Watershed project has introduced sustainable land management practices in selected watershed areas through cost effective and replicable conservation technologies; vegetative, soil, water and moisture conservation measures to encourage land use as per people's needs and to ensure full participation of watershed users in the development and management of common properties.

Many indigenous technologies like the one used in Mankadmundi have potential for scaling up. But they have to be documented, validated and fine-tuned so that they fulfil local people's needs. Small-scale programmes that are less expensive and more effective have major potential for expansion in the hilly areas.

◆

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Trials are underway to further reduce water requirements and to explore the use of SWAR for vegetables.

SWAR

A technology to drastically save irrigation water

K S Gopal

At the Centre for Environment Concerns, an NGO based in Hyderabad, India, the challenge was clear: develop an inclusive irrigation technology suitable for low rainfall areas. Alongside farmers and female farm labourers, they developed an irrigation technology that provides assured moisture directly to the plant root zone. Initial trials show two unique benefits: it requires about one fifth of the water needed for drip irrigation and it supports a healthy soil ecosystem. Key to the effectiveness of this technology appears to be the gradual wetting of the soil rather than abrupt provision of water in 'concentrated' loads. This not only saves water, it makes it easier for the plants to absorb the water, and it provides a microclimate that encourages microbial activity in the soil.

In semi-arid areas of India, low rainfall with frequent and long dry spells during the monsoon makes farming even more difficult, taking its toll on large numbers of smallholders, many of whom rely on seasonal rainfall for irrigation. In the light of water scarcity, the Indian government has looked to canal irrigation from tanks and dams, tapping groundwater from ever deepening aquifers, drip irrigation and now greenhouses. Although the provision of copious irrigation water to selected areas for cereal crop cultivation has helped India move from 'begging bowl to bread basket', much of these 'green revolution' areas are affected by severe salinity and falling productivity. Moreover, unsustainable use has led to alarming rates of groundwater depletion. It is amidst these circumstances that the Indian Prime Minister has called for "More crop per drop." Unless water efficiency and soils are improved by 'out of the box innovations' and farmer centric practices, the Prime Minister's ambitions will not be met.

Why irrigation technology?

The Centre for Environment Concerns has been working for the past three decades to improve farmers' livelihoods in drought prone areas of Andhra Pradesh. Based on this experience, the centre became convinced that irrigation is crucial for successful farming. Further, through work on the National Rural Employment Guarantee Scheme (MGNREGS), a programme providing 100 days of employment per rural household per year, the toil of women added another dimension to the centre's challenge.

Under the employment scheme many women were employed on massive fruit tree plantations. The saplings require irrigation for the initial three years. Women need to head load and fetch water from long distances in the hot summer months. Although the work is hard, the wage is crucial. Yet, in the hot summer months, women have had difficulty to even find enough water. We needed alternatives that would use less water. We need an irrigation system that drastically saves water and labour so that all farmers in water scarce regions can access and use irrigation when needed.

Traditional roots

During interactions with farmers on how to reduce irrigation water requirements and increase its efficiency, we learnt that many sacred groves of fruit, ornamental and medicinal plants were successfully grown with little water by using buried clay pots. This traditional way to grow trees with less water uses the suction capacity of the soil and root system in tandem with the sweating properties and slow release of moisture by clay pots. But it had problems - each tree had to be served with water; pots were not standardized and had problems of clogging, for example. We decided to probe further using modern sciences and materials and farmers' experiences.

Key criteria guiding design of a new irrigation system were: drastically reduce plant water requirements by serving water only at the root zone in the form of adequate, well spread and assured moisture. In addition, the system should function without electricity and it must be automated to eliminate drudgery.

During two years of action research, the first model was developed and tested. The basic principle was served – water was reaching the root zone. But there were problems such as clogging of pipes. After two years of technology iteration, at the beginning of 2014, the final product, named System of Water for Agriculture Rejuvenation (SWAR), was implemented on a fruit tree plantation under the national employment scheme.

> Water requirements are one quarter to one fifth of those prescribed for drip irrigation

How does it work?

Rainwater is harvested or water is fetched from nearby water bodies. This water is then pumped to an overhead tank using a pedal pump. From the tank outlet large diameter pipes deliver water to the field. From this pipe, smaller, UV and rat resistant lateral pipes deliver water to rows of plants. Near each plant a measured dripper lets water slowly through a pipe into the specially baked buried clay pot. The pot is buried about 30 cm below the soil surface next to the plant root zone. From each pot two micro tubes half way up the pot, fitted with a sandbag, let water slowly ooze into the soil. After some time the pot begins to sweat and this is based on the suction capacity of the soil and the plant roots. Water supply to the pots is regulated through control levers so that all plants can be reached with gravity flow. To facilitate microbial growth and spread of the moisture, we apply microbial inoculants that are prepared on site.

First results

The results are highly promising. Above all, water requirements are one quarter to one fifth of those prescribed for drip irrigation. And, despite much less water use, all plants grew well in terms of stem, leaf count and size and early plant maturing. Soil moisture remained for over a week after irrigating. There was no weed growth as there was no water on the soil surface. And, soil organisms grew well, likely as a result of the enabling environment of oxygen and moisture in the soil.

In 2015, we established trials comparing drip irrigation with SWAR and so far plants under SWAR have performed much better. As we faced a severe heat wave and water shortages across the state, we could observe its impact on the trial sites. We noticed an interesting result. With SWAR, water could be further rationed to keep the plant alive until the next rains, an impossible situation under drip irrigation. Women made an interesting observation: "SWAR works like a mother who feeds everyone in the household with the available food, while drip irrigation is akin to a man eating most of the food and leaving little for the rest of the family."

With ongoing trials we are exploring the scope to further reduce water requirements of SWAR. In 2015, we also started using SWAR to grow vegetables and flowers. This helped show immediate results in terms of both soil and plant health and farmers' incomes. In vegetables and fruits, where close planting is done, we found that one eighth of the water suffices, compared to drip irrigation.

Road ahead

It was due to these promising early results that SWAR received the Global Champion Innovation Prize for Water

Photo: Centre for Environment Concerns

The first model of the irrigation system was developed during two years of action research.

and Forestry at the 2015 Paris International Agricultural Show. Accepting new technologies takes time. Though farmers have been involved in experimentation, further on-farm testing and development of the technology will reveal more about the practical value of this technology for farmers struggling with drought. India is a large market with a desperate need for water efficient irrigation technologies. Serving the market is difficult as it is dominated by heavy subsidies exclusively targeting technologies owned by large corporations, scientists guard their knowledge and government procurement procedures have high transaction costs. But together, farmers' satisfaction with SWAR, the desire to bring more low rainfall areas under irrigation and the Prime Ministers' call for increased water use efficiency opens enough opportunities to scale up SWAR.

The time has come to shift from rain dependent farming to harvesting and storing rain water and using it efficiently to cultivate crops. Optimum use of water – providing moisture rather than 'concentrated' loads of water – combined with healthy farming practices such as soil improvements, will make agriculture in India more sustainable and offer improved incomes to smallholder farmers.

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Call for Articles

Women and agro-ecology: the strongest link

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Women are strong drivers of agroecological change on farms and in farming and consumer communities. One example is the women's movement for agrobiodiverse, pesticide-free crop production in India. In other places, women experiment with intercropping, vegetable box schemes and seed exchanges. What motivates them? And what role does agroecology play in improving the lives of women? Little has been published about this connection. *LEISA India* is looking for experiences that can improve our understanding of the role of women in promoting agroecology, and how agroecology has helped them to achieve their aspirations.

There are 500 million small scale farm families around the world, and 70% of the agricultural work on these farms is done by women. According to FAO, women could increase their productivity by up to 30% if they had the same access as men to land, water, seeds and credit. Often, we see that women use these productive resources to take up or strengthen agroecological practices. Closing the gender gap, as was called for by so many during the 2014 International Year of Family Farming, could reduce the number of the world's undernourished people by 12-17% (*http://www.fao.org/sofa/gender/home/en/*). Besides higher yields, working with an agroecological approach has additional benefits for women and for society as a whole, in terms of increased biodiversity, improved family nutrition, less pesticides use, and more community coherence.

We have long known that women hold important agriculture and food knowledge, and that they are a force pushing for agroecological changes that lead to resilient farming. Where men tend to focus more on economic gains, women's ultimate concerns tend to food sovereignty and nutrition, social stability and peace, and the conservation of biodiversity and natural resources. These concerns are echoed by thousands of women who walk the streets of Brazil in March each year calling for agroecology.

We want to have a closer look at what motivates women to inspire positive progress in farming, and how agroecology is or is not helping them to achieve their goals. What direction do women envisage for family farming systems? What role does agroecology play? What happens within the household, in the community or in the broader (socio-political) environment that supports or hinders them? Does agroecology mean more or less work for women, and what are the qualitative and quantitative changes they experience? And what role do women's organisations play in building a better future for the women and their families?

Articles for the December 2015 issue of LEISA India should be sent to the editors before 31st October 2015.
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Community water resource management

A suitable option for sustainable rural livelihoods

Ganesh Dhakal and **Chiranjibi Rijal**

Farming community in Rajha village in Nepal, through effective management of the scarce water resource and good governance mechanisms, have moved towards building sustainable communities.

Photo: Authors

A woman waters her crop

In Gulmi district in the Western Development Region of Nepal, dry season is as long as eight months. About 90% of total annual rainfall is received during four months in the summer season. Rajha village lies in the hilly region of the district and has a sub-tropical climate. There are no additional sources of water except monsoon rainfall.

The village suffers from alternating cycles of excess water and water scarcity. Twelve years back, people used to rely on a single source of spring-water for drinking and household use. Being located away from the village, communities required to walk for an hour to fetch water from this spring. In 2002, the Resunga Drinking Water Supply Scheme, started supplying drinking water through its 16-kilometer length pipeline with scattered distribution outlets. Though the communities got access to safe drinking water, it was not sufficient to meet the domestic and irrigation needs. Therefore, rain-fed subsistence agriculture has been predominant in the area.

In order to cope with the prevailing situation, in 2007, a few community members started harvesting rainwater from rooftops. The water thus collected was used for household needs during the dry season. As the rainwater storage tanks constructed at household level were small, water was not sufficient for irrigation. The community then got together and established an agriculture cooperative, named Nava Durga Agriculture Cooperative, with 35 members. Initially, the cooperative delivered saving and credit services to local groups. Later on, in 2009, the cooperative formed a "Water Management Committee (WMC)", with nine members. The WMC with partial external support constructed a plastic-lined water storage tank with the storage capacity of 600,000 liters of rainwater. The harvested water was available to 34 households; the water user group (WUG). The storage water was strictly used for income generating activities such as growing off-seasonal vegetables and rearing improved breed of cattle.

Meeting increased water demand

The demand for water increased, as the neighboring community also showed interest. The WMC came up with an ambitious water project called "Pakhu Khola Dharapani Lifting Irrigation Project" to meet the increased water demand. The total cost of the project was NRs. 2.9 million (USD 29,000) of which community shared 91% of the total cost, and the rest was supported by the District Agriculture Development Office (DADO)-Gulmi and Gaudakot Village

Development Committee (VDC). The WUG was expanded to 63 members covering 70% households of the village and started lifting irrigation in 2010.

The lift irrigation scheme lifts spring water from 190 meters downstream (1,324 meter altitude) and stores water in at collection tank constructed on top of the village (1,514 meter altitude). At the source, a tank of 35,000 liters collects water from two small springs as Pakhu Khola and Dhara Pani with a total discharge of 0.05 liter per second during the dry season. Water from the source is pumped by 17.5 HP submersible motor which lifts water at 1,000 meters horizontal and 190 meters vertical distances. Two distribution tanks are located at the center of the village which receive water from the main collection tank located at the top of the village. The distribution tank has distribution pipe lines with valves at the bottom from which water is supplied to the individual household tank of 2,000 liters. Water is distributed to members through a separate pipe. Households use collected water to irrigate vegetable fields, for livestock and other domestic uses.

Membership is open to all households in the village. The membership fee is NRs. 10,000 (USD 100) per household, who had already contributed to the project. The fee is NRs. 50,000 (USD 500) for the new household. In addition to membership fee, all the members pay a nominal monthly operational cost that is used for repairs and maintenance and towards costs of electricity bill. As members, each household receives water in a fixed schedule (3 hours a day) through a separate distribution pipeline. The household can store water in the tank of 2,000 liters. It is mandatory that water should be used for income generation activities only. In case of violation, the member has to pay a fine and the water supply is cut off.

Managing water use

The Water Management Committee (WMC) is one of the sub-committees of the cooperative, which is responsible for the operation and maintenance of water supply schemes. The WMC comprises of nine members (5 women and 4 men) including a president, a vice president, a secretary and a treasurer, and five board members. It represents sixty three Water User Groups (WUGs) and guarantees the proper functioning of water supply schemes and ensures that the water source is well managed. The WMC is also registered in District Water Resources Management Committee (DWRMC), and has by-laws and operational guidelines. The WMC sets rules and regulations in the regular meetings. Generally monthly meetings are held, however, special meetings are also arranged if necessary. The WMC endorses operational decisions, such as operation and distribution schedules, maintenance of the system, recruitment and

Water harvesting during monsoon season

Photo: Authors

Women empowerment is one of the major impacts of the water project.

mobilization of operators and other manpower requirements. However, the general assembly of WUG, which is held twice in a year, decides on water tariff, distribution volume, expansion of the project, and membership fee.

Out of total credit mobilized from cooperative, 85% is issued for women. Women are not only the beneficiaries of the project, they are part of all the management committees, e.g. 55% of WMC members, must be women. Out of 22 farmer groups, more than 50% groups have women in the decision-making position.

Besides the Water Management Committee, there are three more sub-committees in the cooperative - Credit Mobilization Committee, Insurance Committee, and Market Management Committee. The Credit Mobilization Committee facilitates savings and provides small credit to farmers. The Market Management Committee is responsible for input and output operations of the agricultural products. The committee coordinates with agro-input suppliers, and collects and disseminates market information to its members. The cooperative has adopted a collective marketing system of agricultural products. Thus, it has established its own vegetable and milk collection center. The Insurance Committee insures cattle with a premium of NRs. 1,000 (USD 10) per cattle and pays back up to 80% of the total cost of cattle in case of casualty. Also, the cooperative enhances the capacity of farmers by providing skill and vocational development trainings, exposure visits, etc. The cooperative board is responsible for overall management of the cooperative and coordinates with public and private sectors.

Life has changed with water, for this farmer

Photo: Authors

Access to water improves livelihood

Access to irrigation water is an attractive option for poor farmers in Rajha village to initiate income-generating activities. The most direct outcomes of the irrigation scheme are changes in crop diversity, cropping intensity, and crop yield. The farming system was typically subsistence and used to be two crop cycles in a year - maize/millet-mustard/beans/lentils. With the increased access to irrigation water, necessary agro-inputs, credit, and market information, the subsistence farming has been changed to commercial farming. Farmers now follow three crop cycles, such as cucurbits/tomato - Cole crops/tomato - green pea/okra. Currently, there are 63 vegetable farms, 45 improved cattle, two poultry farms, and two pig farms. Due to increased income generating opportunity in the village, migration is reduced. During field visits, it was observed that some households (about 30%) who had once migrated to India and Middle East have returned to the village and initiated commercial agriculture. Institutional development, such as cooperative and WMC are the positive impacts of water project which has developed linkages with government agencies and private sectors. The community has managed water in an efficient way through better water governance.

The equitable distribution of water supply has benefited all members of the village, including disadvantaged and marginalized people. Women empowerment is one of the major impacts of the water project. With access to water and credit, women are involved in income generation activities and are key decision-makers. Thus, effective management of the scarce water resource has contributed towards sustainable community development by increasing household income, community assets and value, cooperation and good water governance.

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Photo: Authors

Well lining improved the water yields from the wells

Community drive to revive wells in Sawna macrowatershed

Mohan Dangi and **Amita Bhaduri**

Introduction of water harvesting and moisture conservation measures was necessary to rehabilitate the degraded lands in the Sawna macrowatershed area near Udaipur. A community drive to revive wells resulted in water security for longer periods and sustained increase in rural incomes.

Sawna macrowatershed, about 62 km southeast of Udaipur, reels under the impact of drought very often. "*Teesre sukho, aathwe akaal*" (a drought in three years and famine every eight years) is a popular saying in the area. For generations, shallow wells have been an important source of water for irrigation and human needs in this drought-prone region. Two decades ago, even amidst drought, people depended on naturally occurring groundwater in the shallow wells. The communities had developed informal institutions called '*kua pariwar*' to build, maintain and share water from these wells. However, both the wells as well as the institutions suffered with declining sense of community.

The Sawna macrowatershed area is in the hot semi-arid region in the Northern Plain and Central Highlands that includes the Aravalli Mountains. It has an annual average rainfall of around 653 mm and the normal rainy days are about 25 to 31 in a year, most of which takes place in the southwest monsoon season. The rainfall is low and erratic and droughts occur almost every three years. The annual potential evapotranspiration (PET) is 1380 mm. The length of growing period ranges from 90 to 135 days in a year. This area is also expected to witness climate fluctuations and the people here have seen the troubles, that recurring droughts interspersed by extreme rainfall, can bring.

Agriculture in the catchment area is mostly rainfed and land in the hill slopes as well as valleys is unable to produce enough, owing to poor soil depth. Maize, urad, chavla, wheat, gram and mustard are the major crops in the area. Single cropping practice as well as mixed one i.e. maize and redgram, is also common in the area.

As per a study (unpublished) by SPWD, maize is grown in the monsoon season, and can therefore be grown without irrigation. Wheat is grown in the winter and requires 6 to 7 irrigations, but is still preferred to other less water demanding crops such as mustard, which requires only 4 irrigations. Both wheat and maize are used predominantly for home consumption, with 60 per cent of maize producers and 61 per cent of wheat producers using their produce exclusively for home consumption. Other common crops include mustard for the winter season and guar for the monsoon season. An average of 0.35 *bighas* (one *bigha* equals to 2500 sq.m) of mustard is grown per farmer, and the oil obtained is used for home consumption and sold. Guar is grown both for human and animal consumption, and is cultivated on 0.65 *bighas* on an average. Land not used for agriculture directly is often used to grow dry grasses as animal fodder.

Green gram is generally cultivated during zaid season and only few farmers having sufficient water in their wells to go for the third crop. Nowadays, the farmers have started growing vegetables on small patches of lands in rabi season for which, water is fetched either from the wells or canals. The dangi community, in particular, is into vegetable cultivation.

According to the SPWD study "even though 81 per cent of the people have access to irrigation facilities, only 6 per cent of the land is irrigated … mostly due to the low water level in wells. The heavy use of groundwater in the area and semi-arid condition means that many of the wells are dry for large periods of the year." People have access to irrigation water for five and a half months a year. The limited groundwater is exacerbated by the slope of land in the catchment area.

An alternative to agriculture is goat rearing, which the *Meena Rawat* tribals do for a living. However, the rapid shrinking of grazing lands has made it difficult for them to sustain large herds. The income from agriculture and goat rearing added up to less than Rs 15000 per year and was no longer sufficient to feed their families. Most households were compelled to depend on wage employment for survival. There was no regular work in agriculture and households struggled to make both ends meet. Most of the people here migrated to Udaipur or various places in Gujarat for wage employment.

> By constructing lining to the well, half hectare of land was capable of generating additional 6 quintals of harvest.

Revival of wells

The wells of most people were in a pathetic condition. Because of the inflow of mud during rains, the well did not have enough water for irrigation. In 2008, the locals began a community drive to revive the wells, with help from Udaipur based NGOs, Prayatna Samiti and Wells for India. While designing the project, it was observed that lack of lifting devices around wells was leading to huge time and energy losses. The loss of water due to absorption and evaporation was also a prime concern. The absence of a boundary wall around the well rendered it unsafe for children and animals. So, women and children were tasked with fetching water from 3 kilometres away when the well dried up in the summer. The situation only worsened during drought.

In 2008, the locals began a community drive to revive the wells, as a part of the project. The work necessitated small-scale investments of Rs 15000-20000 in well lining, which the locals fell short of. The project planned to undertake resource development around wells as many families in the project area relate to each other around this. Developing effective sharing systems among the members could help sustain the livelihoods. Construction of well lining and provision of pipeline in this direction was expected to protect the water for longer use and enable farmers to irrigate the land without extra labour and provide them the time to irrigate wasteland.

The project took up some positive steps to improve the productivity of land and water around the wells by a three pronged approach (i) enhancing water availability (ii) optimising water productivity and (iii) reducing water wastage. Different techniques were planned to reduce slope and enhance moisture retention period and water harvesting.

Field investigation and surveys by a technical agency called Atlas Hydro Geo Tech Consultants, Udaipur, revealed that the village had highly weathered and fractured formations suitable for groundwater recharge. In general, the depth to water levels in the village ranged from between 2 to 20 m, which was considered good. The community came up with the idea of arresting the rainwater so that it percolated into the ground.

To begin with, they constructed bunds, terraces or loose stone check dams on the upper slopes mostly on common pasturelands. These inexpensive, temporary structures have been able to arrest the flow of water and allow it to go underground. This has helped in increasing the reliability and productivity of crops grown in private lands.

Construction of well lining and provision of pipeline improved the water yields from the wells and water was available for longer periods of time. Nowadays, the farmers have started growing vegetables on small patches of lands in rabi season for which water is fetched either from the wells or nallahs. Farmers were able to time their agricultural operations better and a greater access was available for irrigation. The need for engaging outside labour lessened and time was available for irrigating fallow lands.

Well lining has enabled 31 families in Sawna macrowatershed to irrigate the fallow lands and collect extra harvest by practicing improved varieties of crops. On an average, 0.5 hectare of land per family, is capable of generating 6 quintals of surplus harvest, which is sold in the market at Rs 12 per kg. Thus, the livelihoods of these families have been secured to an extent. Water management through the provision of pipelines to 106 families has motivated farmers to irrigate the fallow lands. A farmer can on an average save 7,000 litres of water a day by applying efficient management practices like providing pipelines.

In many cases, the support for well lining was given under the project and some work was done by the individual beneficiary to rehabilitate the well on their own. This helped reclaim existing wells which were otherwise about to be abandoned.

It was hard to recreate the old institution of *kua pariwar*. However, the locals had a plan. They knew that formulating clear understanding on resource management could not be rushed along. So, the work was not just limited to developing assets like wells. It also included creating a savings group that was linked to the banking mechanism. According to the Wells for India Country Director, Mr. Om Sharma, "It is easier to develop these institutions as they are rooted in the improvement of financial access".

Some concerns

While the work on well revival is good in terms of both ecological restoration and improving livelihoods, it has led to certain externalities. Groundwater exploitation in the Sawna macrowatershed has increased leaps and bounds owing to technological development in groundwater abstraction methods and provision of subsidized or free electricity. The increase in groundwater withdrawal has led to the development of water stress in the near surface shallow aquifer that supports a significant component of groundwater draft for irrigation as well as domestic requirements. The resource is getting increasingly privatized by a few.

An area of concern for a programme like this is that it enables the communities to perceive the groundwater resources that were not perceived clearly, while creating new assets. Very often this leads to further borewell development in the areas which had shallow wells earlier. In the project villages such as Alukheda in Sawna macrowatershed it was observed that the spate of borewell development is creating a groundwater crisis and the shallow wells deepened under the programme are faced with lowering of groundwater tables.

With well revival there is need to have controls on water demand in areas to prevent intensive use of groundwater for agriculture. This can be done through introduction of water saving technologies such as drip irrigation. Else, the impact of the work will be quickly annulled by increased exploitation of groundwater.

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"Water is the engine of change"

Interview: Henkjan Laats

All her working life, Elizabeth Peredo has been engaged in defending human and environmental rights. For ten years until August 2015 she was the director of the Bolivian organisation Fundación Solón that aims to "contribute to people living in harmony with each other in a world of solidarity, with respect for life and nature, using art, analysis and activism." From 2000 onwards she shifted her focus from the rights of domestic workers to water rights. "Our fight has become a worldwide model for struggles for water justice."

What happened in 2000?

In early 2000 the 'Water War' took place in Cochabamba, Bolivia's third largest city. It was a series of public protests in response to the privatisation of the city's municipal water supply and the water price increases. Tensions erupted when the new firm, Aguas del Tunari, a joint venture involving the US multinational Bechtel, dramatically raised water rates. Protests, largely organised through the community initiative, Coalition in Defense of Water and Life, took place in January, February, and April, culminating in tens of thousands of people marching downtown and battling police. One citizen was killed. Finally, on 10 April, 2000, the national government reached an agreement with the Coalition to reverse the privatisation. As a consequence of the 'Water War', in 2004, the Irrigation Law was approved, giving family farmers and indigenous peoples control of their irrigation water sources. Worldwide this 'Water War' is recognised as one of the most important conflicts undermining globalisation. After this, I decided to dedicate myself to the struggle for the right to water, as the conflict made me realise water is the engine of change.

What role did water play in Bolivia's political change?

The 'Water War' was followed by a chain of other water related events that led to radical political change in Bolivia.

Elizabeth Peredo

Photo: CIDSE

A second revolt took place in 2005 – this time by community organisations in the city of El Alto. They ousted the French multinational Suez Company from the recently privatised La Paz-El Alto water district. In the same period, activists prevented the use of groundwater for mining purposes in Chili and Bolivia. These events, in which the *Fundación Solón* was very active, crystalised a growing movement demanding popular control of Bolivia's water and other natural resources. What followed were the 'Gas Wars' of 2003 and 2005, the overthrow of two neoliberal presidents, and the subsequent election of Evo Morales and the MAS (Movement Towards Socialism) party as a 'government of the social movements.' The Morales government has sought to develop a new institutional framework that positions the state as a direct provider and regulator of water and sanitation services. The Water Ministry, created in 2006, to integrate the functions of water supply and sanitation, water resource management, and environmental protection, is the first of its kind in Latin America. Bolivia's new constitution, enacted in 2009, proclaims that access to water is a human right, and outlaws its privatisation.

How did this experience influence other countries?

The 'Water War' and its aftermath helped to inspire a worldwide anti-globalisation movement and provided a model for struggles for water justice. And in close coordination with the governments of Uruguay and other like-minded countries such as Ecuador, the Bolivian government led the successful push for the recognition of water and sanitation as a human right by the UN in 2010. The same countries are at the forefront of a new international campaign for a UN declaration against water privatisation.

What are the current threats to water in Bolivia?

More recently, the government of Bolivia has adopted an unsustainable growth-oriented and extractivist policy. In its National Development Plan, Bolivia aims to become an energetic and agro-industrial power. This policy objective is reflected in plans for the construction of mega-hydropower projects, such as the EL Bala, Rio Madera and Rositas dams. If these dams go ahead they will have devastating environmental and social impacts. Moreover, Bolivia plans to extend its agricultural frontier by converting millions of hectares of forests and other natural areas into arable land. Needless to say this would imply massive deforestation and an increased pressure on water resources, causing scarcity and contamination. It is important to understand that in many ways Bolivia is even more vulnerable to water problems than other countries. High temperatures, droughts and floods caused by climate change have harsh impacts on its glaciers and fragile ecosystems. And being a landlocked country, Bolivia's main waterways and resources, such as the Titicaca Lake, are particularly susceptible to contamination. The extractivist approach will not contribute to the well-being of the Bolivian people. It will violate human and environmental rights and cause increasing inequity and injustice.

> Our strength is that we consider water as a common good

What is the role of family farmers and indigenous peoples in the struggle?

Although these recent policy changes are very worrying, I believe that the Bolivian farmers and indigenous peoples are prepared to continue to fight for control of the water that they use for their livelihoods. Our strength is that we consider water as a common good. Irrigation water users' organisations and water cooperatives are still well organised and have developed efficient water management mechanisms, including for dealing with conflicts, and sharing scarce water. Notwithstanding the tendency of becoming more extractivist, the Bolivian government also continues to support water projects for small and medium scale farmers, for example by means of the *Programa Mi Agua* (My Water Programme). In 2006, *Fundación Solón* started to organise *Octubre Azul* (Blue October) with about 100 participating organisations, of which many are grassroots farmers' organisations. *Octubre Azul* raises awareness of Bolivia's vulnerability to water problems, and promotes the right to water from four angles: water as a human right, contamination, agriculture and climate change.

What does the future hold?

Thanks to *Octobre Azul* and other water programmes, the Bolivian people and government are increasingly aware of the vulnerability of our water sources. Local governments, communities, and individual farmers are tackling these problems through many initiatives, such as the policy of the municipality of La Paz to improve the city's water management, the joint activities against the contamination of the Titicaca Lake, and there are examples of successful management of small watersheds. It is my conviction that the Bolivian government should not continue its current extractivist development approach, but rather support these promising grassroots initiatives and go back to its original vanguard policy that promotes water as a common good and a human right.

Traditional rainwater harvesting systems get a fresh lease of life

Ravdeep Kaur, Prafulla Behera and **Aparna Datta**

Effective management of water resources is crucial to sustain agriculture, farm incomes and livelihoods. By renovating traditional water harvesting structures like khadins and nadis, farmers in Barmer have proved beyond doubt that rain-fed farming, even with minimum annual rainfall in the 200-250 mm range, can contribute to the food security and enhance the quality of life of the people.

Barmer district, located in western Rajasthan bordering Pakistan, is part of the Great Indian Desert or Thar Desert, its terrain dominated by sand dunes, low infertile hills and scrub vegetation in community protected areas. This inhospitable desert ecosystem supports a population of 2.6 million people in Barmer district (Census 2011) with 93 percent living in rural areas. In this land of scorching summers and dust storms, chilly winters, droughts and erratic monsoons, agriculture is the primary occupation of over 82 percent of the population living in rural areas. Around 80 percent is under rainfed agriculture.

During the summer months, the availability of water, for drinking as well as for agricultural purpose, is a matter of serious concern. The district receives an average of about 270-300 mm rainfall which is generally spread over 15 days in a year. If rainwater is not harvested and stored during these 15 days, availability of water through the year becomes a challenge. In Barmer, every drop of water counts.

Traditional ingenuity

A striking feature of the Barmer landscape is the "khadin", a traditional rainwater harvesting system, said to be in use for more than 500 years. The design is attributed to the Paliwal Brahmins who lived around Jaisalmer. In this system, a long earthen embankment, a bund measuring about 300m, is built across a slope to collect surface runoff water during the rainy season. The khadin harvests rainwater for crop production and restores the land where it is captured, enhancing fertility. The design incorporates spillways and sluices to drain out excess water.

Photo: Authors

First rain harvested in Uttarlai Nadi

The khadin is a classic example of the integration of agriculture and natural resources management, with agricultural production greatly contingent on efficient rainwater harvesting. Maintaining khadins can be difficult, requiring men, materials and money at the appropriate time and in good measure. Over the centuries many such structures had been neglected, or were poorly managed.

The great flood

In Rajasthan's usual weather cycle, a good monsoon in one year is followed by three-four years of drought, but exceptional rainfall and flooding takes place once in 75 to 100 years. In the last week of August 2006, the heavens opened and dumped 750 mm of rain on Barmer – four times the district's average annual rainfall – all in one week. The inundation was compounded by rainwater flooding in from neighbouring Jaisalmer. Barmer district became a lake district, its topography suddenly featuring some 20 new water bodies that had literally surfaced out of the blue. Kawas and Maluva villages were the worst-hit, with 102 people losing their lives, houses going under 15 feet of water, and extensive damage inflicted on Barmer's network of khadins, tankas

Khadins helped in bringing about 300 hectares of additional land under cultivation.

and anicuts that got washed away. Barmer has a subterranean layer of gypsum that prevents rainwater from seeping down or draining away, and this aggravates water logging.

The villagers had to work all over again to restore the water harvesting structures. The bad news notwithstanding, many environmentalists then felt that the floods could be a blessing in disguise for the region, with the floodwaters possibly increasing the region's groundwater levels in the long run. Oil companies operating in the region weren't too upset either, with experts of the opinion that when floodwater seeps down, it forces oil to move up.

Barmer Unnati

Cairn India implements a wide range of CSR welfare programmes with a focus on the overall socio-economic development of the area through interventions in health, education, skills and capacity building training and through identifying employment and sustainable livelihood opportunities. Around 140 villages in the Cairn operational area in Barmer have been adopted with all households targeted to ensure inclusive growth. Since October 2013, Cairn India has partnered with TechnoServe in a strategic corporate social responsibility programme to transform the lives of farmers in Barmer.

TechnoServe, a non-profit organisation with operations in India, Africa and Latin America, develops business solutions to poverty and is currently implementing agri-based interventions and catalysing local economic development under the "Barmer Unnati" project. The project aims to improve agricultural production and productivity, and improve the overall economic status of 10,000 farming households over a period of five years, with substantive increase in revenue from agriculture. This is being achieved by implementing agri-based interventions, enabling natural resources management, assisting capacity building, and by creating a permanent human resource base by enhancing the skill of the rural youth and building rural enterprises.

Water harvesting – key to livelihoods

Natural Resources Management (NRM) is a significant component of Barmer Unnati and NRM activities have been taken up on a large scale, with substantial results observed within two years from the start of project implementation. Under this project, more than 1000 NRM structures and units will be established or renovated across the district.

In less than two years, 155 NRM structures have been established by TechnoServe in cooperation with local NGO Gravis and local communities, comprising 150 farm-level khadins, two group-level khadins, two community Nadis renovated and one SPU (Silvi Pasture Unit) developed. The scope of work includes convergence with NABARD for the construction of 15 khadin structures.

A khadin is constructed on an individual farmer's field covering about two hectare (five acres) land area, where an average 1000 cubic meter (approximately 10 Lakh litre) water is harvested. The khadin constructed on an individual farmer's field redirects excess water to nearby fields and a pond. The water is absorbed by the soil till it is ready for sowing and no further irrigation is required post sowing.

A farmer couple who benefitted by constructing khadin

Photo: Authors

Destiny, refuelled

In January 2004, oil exploration by Cairn Energy of the United Kingdom yielded the Mangala field in Barmer, the largest onshore oil discovery in India in more than two decades. With this breakthrough, the economy of Barmer took a new trajectory. Overnight, Barmer, the district headquarters, became a boom town with rapid property and infrastructure development to support the energy industry. Today the Mangala, Bhagyam and Aishwariya fields – major discoveries in the Rajasthan block – form part of the assets of Cairn India, one of the largest independent oil and gas exploration and production companies in the country, operating 27 percent of India's domestic crude oil production.

In just over a decade, much has changed in the urban areas of Barmer, yet by all social indicators, the district remains amongst the most backward regions in India. Social amelioration is obligatory for the corporate entities in the region, and Corporate Social Responsibility (CSR) is an integral part of Cairn India's operations in Barmer, considered essential for the holistic development of communities in the area.

The Barmer Unnati team worked with Chatur Singh to build a khadin on his 2.8 hectare farm in March 2014. The total cost of the khadin was Rs.45,000, of which Chatur contributed Rs.12,000 in unskilled labour. The investment paid off when Barmer received less than the usual rain during the kharif season just a few months later. Due to water shortage, many farmers in the area experienced total crop loss. However, due to the rain water retained by his khadin, Chatur successfully raised bajra, moth bean, moong and guar crops, grown for sale, home consumption and feed for his animals. The total value of Chatur Singh's crop was Rs.48,396, despite the severe drought in Barmer. With proper annual maintenance before the onset of monsoon, Chatur Singh will benefit from his khadin for many years, making this an important and worthwhile investment. Neighbouring farmers, convinced on seeing Chatur Singh's success, came forward with requests to build khadins on their own land.

During the monsoon season of year 2014, a total of 37 farmers who had constructed khadin on their farm cultivated bajra, guar, moong, mothbean crops and earned additional revenue of Rs.20,000 each. The farmers aver that "Khadin construction has brought at least two hectare land area for each farmer under assured cultivation for atleast 20 years." As of July 2015, 150 rain-fed farmers have benefitted and about 300 hectare land area has been brought under cultivation.

Long-term benefits

Under the Barmer Unnati project, renovation of other traditional water harvesting structures such as the "Nadi" is also underway. Nadis (ponds) serve as the principal drinking water source for the surrounding villages, but are prone to siltation since the runoff water comes from sandy and eroded rocky basins and large amounts of sediment gets deposited along with the torrential rain.

Renovation work at two Nadis has been completed, and these two Nadis will benefit about 7000 households residing in 31 villages. The Nadis are expected to collect at least 9 crore litres of water in four to five normal rain showers annually. During the current monsoon, with the initial two rain showers in June and July 2015, about 500 lakh litres of water has been harvested in these two structures. The renovated Nadis will be able to collect twice the amount of water as compared with the estimated capacity, which gives the flexibility of holding excess water in heavy rainfall conditions. With community and project contribution, these structures will continue to benefit the region for about 15 years.

One Silvi-Pasture Unit (SPU) has been developed at village Bhadka in Barmer district. After conducting meetings and getting consent and cooperation from the village community and Gram Panchayat, SPU has been developed on 16 hectares of common land. Here around 10,000 trees will be planted and local species of grasses like *Sewan* and *Dhaman* will be cultivated. The SPU, once fully established, will not only provide sufficient fodder for animals, but will also become a model site to demonstrate development and management of common grazing lands.

The Barmer Unnati project has created a strong impact with a strategic focus on natural resources management interventions and has considerably raised awareness of water conservation techniques and practices amongst the farmers in the rural areas of Barmer. A consultative process involving the local community, professional inputs and expertise, and persistent efforts in the field have now proved beyond doubt that rain-fed farming even with minimum annual rainfall in the 200-250 mm range is possible, contributing to food security and enhancing the quality of life of the people of Barmer.

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Photo: Authors

A panam keni well

Harvesting water-the traditional way

G S Unnikrishnan Nair

Kenis or sacred wells and *Surangas* reveal the ancient knowledge and wisdom of tribes of Wayanad in water conservation and sustainable utilization of perennial water sources. Neglect of this valuable indigenous knowledge, deserves to be protected and passed on to future generations.

Water has been harvested in India since ages, with our ancestors perfecting the art of water management. Many water harvesting structures and water conveyance systems specific to the eco-regions and culture have been developed in India like Zing of Trans-Himalayan Region, Kul, Naula and Khatri of Western Himalayas, Bamboo drip irrigation of North-eastern Hill Ranges, Korambu in Eastern Ghats, Talab in Central highlands, Virdas in Western coastal plains, Katas in Eastern highlands, Kunds of Thar desert and Cheruvu of Deccan plateu. In Kerala State, South India two such distinct systems are there; Panamkeni in Wayanad and Suranga in Kasaragod district.

The sacred wells of "Kurumas"

The native tribes of Wayanad, Kerala mainly consist of various sects like *Paniyas, Kurumas, Adiyars, Kurichyas, Ooralis and Kattunaikkans.* Kuruma tribe is a very prominent tribal group of Kerala state with unique culture and ethno botanical practices. A group of the kurumas, referred to, as *Mullu kurumas* is concentrated in the Wayanad district of Kerala. As early inhabitants of Wayanad, *Mullukurumas* are mainly found in the panchayaths of Noolpuzha, Kidanganad, Muppainad, Muttil, Parakkadi, Tirunelli and Mananthavadi of the district and also in the adjoining areas of Gudalur taluk in the Nilgiri district of Tamil Nadu. *Mullu kurumas* are presently cultivators and hunters.

"*Panam Keni*" is the special type of well used by *Mullu kuruma* hamlets. This type of wells is being used by *kurumas* for hundreds of years. *Kenis* are located on the edge or middle of paddy fields and near forests. Cylindrical in shape, they have a diameter and depth of around four feet only. The wall is of Toddy palm (*Caryota urens*). Usually the bottom stem portion of large palms are used to make wooden cylinders after retting them in water for a long time so that the inner core gets rotten and degraded and the hard outer layer remains. The wooden cylinders are immersed in the spots where there is good ground water spring and that is the secret of abundant water even in hottest summer months.

"We don't know when these *Kenis* were made. May be about 500 hundred years back. It was there till my childhood. We consider these wells sacred. During monthly periods and for 3 months after childbirth women don't collect water from kenis. Otherwise, every family in the hamlet collect water from these wells daily and it is exclusively used for cooking and drinking purpose. We never use *keni* water for bath or washing cloth, so that the *keni* water won't get polluted. Wearing footwear near *kenis* is even considered a sinful practise."- Says Devaki, a *kuruma* tribal woman in her seventies, at the Pakam tribal colony near Manathavady, Wayanad, Kerala.

Key biological indicator species for phreatic water table include trees such as Vateria indica, Ficus virens, and Macaranga indica. Termite hills on a row are also another indication of water near to the surface.

During festivals and marriages, it is a custom to wash and cook rice in *keni* water. *Keni* is the property of the hamlet, not any one's property. Being a shallow water body, a mud pot is enough to dip and collect water from it. *Keni* water remains transparent and pure. More than thousand litres of water can be collected every day throughout the year.

"During older days we, *Kurumas* only used to collect water from *panam kenis*. Now other communities and settlers also collect water. They wont insist on keeping it clean and sacred as we do. The present panam kenis are very old and the wood has started to decay. Now nobody has the expertise to make such kenis. In some places cement rings are being placed around the panam kenis"-says Vellan, another tribe at pakam.

Now there may be around 200 *kenis* in Wayanad. These wells reveal the ancient knowledge and wisdom of tribes of Wayanad in locating, preserving and sustainable utilization of perennial water sources. The newer generation, getting accustomed to modern lifestyles tend to neglect this valuable

A vertical suranga well

Photo: Authors

indigenous knowledge, which deserves to be protected and passed on to future generations.

Water from the tunnel

Laterite hills acts as reservoirs of rainwater. This fact has been realised by the farmers of Kasaragod districts of Kerala long back, which resulted in the *Suranga* wells. *Surangas* are found mainly in southern Karnataka and northern Kerala in the foothills of the Western Ghats of south India. Experts estimate their number to be around 5,000. Studies have revealed the origins of the system to around 1900–1940 CE. The nomenclature of *suranga* is varied as a result of the linguistic diversity of the region. *Suranga* are referred to by many other names including surangam, thurangam, thorapu and mal. *Surangas* are horizontal adit systems (a horizontal passage leading into a mine for the purposes of access or drainage) cut into slopes in order to extract ground water.

The landscape of this part of the Western Ghats is characterized by undulating upland topography that produces relatively small but steep sloping hills. The main soils found in the region are laterite soils. The suranga are generally about 250 metres in length with an average length of 40-50 metres. The width is enough for a medium sized person to move inside. The practice of constructing multiple suranga on land holdings is common. Skilled persons are required to construct surangas. This involves the identification of suitable soil conditions at the point of excavation and indicator geo-botanical plant species that suggest a nearby phreatic water table that will provide the source of water. Key biological indicator species for phreatic (area in an aquifer) water table include trees such as *Vateria indica*, *Ficus virens*, and *Macaranga indica*. Termite hills on a row are also another indication of water near to the surface.

"I have two s*urangas*. *Surangas* are usually dug in laterite slopes during summer months in order to avoid collapse of soil. Water springs from all the three sides as well as bottom fill *surangas* with water. The flow of water is often pooled just before the entrance by building a small earthen dam. The water is then conveyed via a small diameter plastic pipe either into a farm pond or directly into an underground irrigation network. There can be multiple suranga supplying water into a single farm pond. Distribution of water from suranga and farm ponds onto crops is either by hand/bucket, flooding, hose, drip or sprinkler system No pump sets, everything by gravitational force only"-says Salva Disuse, a farmer in Enmakaje village in Kasaragod district, Kerala. Salva Disuse has 1.5 acres of land in which he cultivates betel wine, areca nut, cocoa and pepper. Since there is no water shortage and good availability of cattle manure, he can make a good income from the good yield that these crops provide.

There is abundant water in these wells even in summer and is enough for all needs including cooking, bath and irrigation of crops. Laboratory tests supports farmers perceptions that suranga's water is sweeter and purer than that found in bore wells. As water flows out perennially by gravity, tunnel wells having a flow as high as 600 litres per minute has been documented.

Abdul Sidhique has 15 acres of land in which he maintains three big ponds that are filled with water from surangas. Each *Suranga* is able to provide around 500 litres of water per hour, which is used for irrigation and domestic use.

"I grow coconut, areca nut, pepper and banana in this land. 50 HF cows are there in the Dairy farm. For all these, *Suranga* water is enough. Even though abundant water is there, I follow an economic irrigation pattern. I irrigate once in a week only and assure that water reaches the root zone without any wastage. Here we have a co-operative irrigation system. For instance, a farmer uses water from surangas for irrigating his crop. If water is there in excess after his requirement, he allows other farmers in the region to channelise the excess water for irrigating their crop. I get good crop yield and around 500 litres of milk per day."- Abdul Sidhique explained.

Suranga as well as *keni* wells are comparatively cheap, effective, eco-friendly and sustainable irrigation technologies used in these regions for a very long time. Such technologies evolved through practise and perfection are invaluable, for sustainable ecosystems.

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From water wars to world peace

Rajendra Singh

'Harvesting the monsoon: livelihoods reborn', published in the March 2000 edition of LEISA Magazine, documents an experience from Alwar district in Rajasthan, India. Beginning in 1985, traditional water harvesting was revitalised and local rivers were transformed from ephemeral to perennial. Rajendra Singh, chairman of Tarun Bharat Sangh, the NGO which started the initiative, talks about his next steps – launching World Water Walks.

This is the 21st century of exploitation, pollution and encroachment of water resources. Meeting challenges has always been a huge part of my life. When I went to Alwar, this semi-arid area was unhealthy and impoverished. The aquifers were completely dry. We started conserving the rainwater so that it wouldn't evaporate or flow away and be wasted. Using traditional wisdom, we built johads (small dams) to recharge the underground aquifers. Because of that wisdom and those efforts, the area became fertile, prosperous and dead rivers came to life again. Those who had abandoned their villages came back again. The unique part of the whole process was the active community participation, which gives the community a sense of ownership over the assets they have created.

Photo: TBS

Active participation by the community in Rajasthan gave them a sense of ownership over the water harvesting assets created.

What now?

World peace is only possible when everyone gets clean and pure drinking water. Water resource conservation and management will continue to be a climate change adaptation strategy for people living with rainfall variability, both for domestic supply and to enhance crop, livestock and other forms of agriculture. Decreasing water poverty by increasing water productivity will be key for the coming era. Demand-side control of water resources is urgent for sustainable supply-side management.

We are launching 'World Water Walks' along the rivers and lakes of five continents over the next five years. The walks aim to connect local communities to their water and secure their water rights. Walk themes and 'outdoor classrooms' will provide the opportunity to ask questions and to understand the complexity around water issues. *Can reviving the flow of water in landscapes reduce the inequalities that face the world and ensure a more peaceful era for the planet? Do world spiritual traditions and the importance of water in them have a resonance and some teachings for us in this modern age? And, what can we learn from local communities which have enjoyed a symbiotic relationship with the environment for millennia?*

Water resource conservation will continue to be a climate change adaptation strategy.

The first of a series of walks was from Holy Island of Lindisfarne to Belford in the UK. The walkers, local community members, politicians and church leaders as well as an international contingent, participated in a powerful discussion on water and climate change. Walks are already scheduled in Sweden, the USA and Germany and by 2016 water walks in all participating countries will be organised.

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Rajendra Singh (*jalpurushtbs@gmail.com*) is the chairman of Tarun Bharat Sangh, an organisation working for holistic development of all, regardless of economic situation, caste or religion in India. He also heads a national network of organisations working on water issues, Rashtriya Jal Biradari, working for restoration of all mighty and small rivers of India.

Improving water use practices for livelihood improvements

Min Bahadur Gurung, Govinda Basnet, Shahriar Wahid and **Golam Rasul**

Traditional water use practices are not adequate to meet the current water demand in Nepal's Koshi basin. To address the increasing water demand, good practices in water management that have proven to work well and produced good results were documented for replication on a larger scale.

Water demand is increasing in the Koshi basin in Nepal owing to the rising competition for water from different sectors and also as a result of population growth and climate change. The Koshi River basin, shared between China, India, and Nepal, is one of the important trans-boundary river basins in the region providing a basis for livelihoods to almost 40 million people, most of whom depend on subsistence agriculture. The demographic changes taking place in the Koshi basin impacts the way people manage water resources and respond to the effects of climate change.

To address the increasing water demand and change in labour availability, local governments, non-government organizations, development practitioners and larger society are paying greater focus on making good use of water. Their efforts focus most on promoting water use good practices: those practices that have been proven to work well and produce good results in water scare areas and are recommended for replication on a larger scale. Good practices in water use help in enhancing the adaptive capacity of women and other marginalized groups who have to bear the brunt of droughts and floods. A study was therefore conducted to document the good practices in water management.

A total of 28 key informants from government organizations (GOs), international non-governmental organizations (INGOs), UN organizations, non-governmental organizations (NGOs), and community-based organizations (CBOs) were consulted during the study. In addition to this, a few field visits were also made to understand diverse issues on different water use practices.


Photo: Keshab Panday

Each household constructed a plastic pond and harvested rain water

Water Use Practices

Water use in irrigation

In many places in Nepal, water is used in multiple ways for optimal agricultural production. Two kinds of best practices – pond irrigation and non-conventional irrigation technologies – have been promoted in the Koshi basin and are largely owned, used, and maintained by individuals and group of farmers. These practices are mostly used where there is less discharge from water sources, or the topography is unsuitable for a conventional gravity flow canal irrigation system. Commonly, pond irrigation and non-conventional irrigation technologies are used to aid in the cultivation of high-value crops like vegetables, and also help in addressing the issues of social equity by making it possible to provide irrigation facilities to people living in areas where irrigation by conventional means is not feasible.

In the areas where the water for canal irrigation is not enough, pond irrigation has proved to be a good potential alternative. In this system, water derived from canals, pipes, or rainwater harvesting is collected in a dug-out pond. These ponds are generally either concrete-lined or plastic-lined. The collected water is then carried to the field through a Polythene pipe, and irrigates crops using sprinklers and drip irrigation. In some cases, a group of households share a pond, while in other cases, a household has its own pond. The system does not require cooperation of a large number of households to build and operate. With this type of pond irrigation, water is used more efficiently than in traditional irrigation systems. An advantage of pond irrigation is that it is a decentralized system that enables individuals and communities to manage their own water for their own purposes.

Integrated water use

In the context of increasing water scarcity, integrated water use is an effective adaptation measure. A good practice documented under integrated water use is multiple water use services (MUS). MUS adopts the approach of taking into account the domestic and productive needs of the users drawing water from multiple sources. Micro irrigation technologies like drip irrigation and sprinkler irrigation systems are integrated with the drinking water supply system. The MUS system promotes efficient water uses, and thus, is a potential means of water management in areas of reduced water availability. As most of the untapped water sources for drinking water supply and irrigation facilities are far away and the discharge from existing water sources is decreasing, the MUS is a valuable adaptation measure in response to climate change. The technology associated with the MUS is also manageable at the community level.

Rainwater harvesting leads to livelihood improvement

One promising practice followed for livelihood improvement has been fresh vegetable production through rainwater harvesting. In some areas, water from the roofs and nearby areas is channeled to the pond and is used to produce high-value crops.

In Mithinkot village of Kabhrepalanchok district in Nepal, farmers started growing fresh vegetables by constructing irrigation ponds. The area around Mithinkot is dry. So each household has constructed a plastic pond to harvest rain water. They irrigate the crops with both a drip and pipe system. Water is used efficiently, and the vegetable seed production has helped in improving livelihoods in the village through increased incomes from selling the vegetable seeds. After two years, they established a vegetable seed production cooperative to promote vegetable seed production. Initially, they started producing seeds of different kinds of vegetables. Four years later, the farmers produced seeds from 30 tunnels that produce about 30 kilograms of hybrid tomato seeds. The practice of plastic pond construction is a strategy that can be used during the rainy season.

Solar multiple use water system in Nepal

The people of Lausikhola village of Dhital village development committee (VDC) have established a new water supply system. The water user committee oversees the overall management of the system. A set of solar panels power water lifting from a spring lying below the village. The water is collected in the already existing reservoir tank. In addition, a separate, plastic-lined pond has been constructed below the tank to collect any spill-over water. Collected spill-over water is used for irrigating vegetable gardens of nearby houses. Nine tap stands have been erected to distribute water. On an average, five households share a tap stand. With the increased water availability, farmers have started producing vegetables for market. On an average, each household now cultivates vegetables in a ropani of land. They irrigate vegetables with the water from tap stands. The scheme has helped to reduce the time and physical effort that women and children spend in collecting water; has improved the process of cleaning drinking water, and has improved the financial status of households, particularly women.

A solar water system in Lausikhola village

Water user association manages the community irrigation systems

Water conservation

In Nepal, farmers traditionally constructed and maintained ponds on community lands. Besides providing supplemental irrigation during critical times of the year, these ponds also contributed in recharging water. However, over the years, these ponds were not maintained, and started disappearing due to negligence. Although irrigation ponds have become popular in water-scarce areas in recent years, they are either plastic-lined or concrete-lined and thus do not contribute in recharging the local hydrological system.

People in several places have started reviving the old practice of water-conserving ponds with the objective of recharging water into the local hydrological system. Farmers of Jaisithok, Kabhrepalanchok District have started reconstructing such community ponds. The water recharging ponds help in improving the water discharge from the water sources below the ponds. Similarly, it also ensured timely plantation of paddy. These recharging ponds have been constructed or revived in other areas as well. Besides recharging local hydrology, they also contribute in minimizing the soil losses caused by run off.

Governance for good water use practices

The sustainability of community irrigation systems depends largely on the effectiveness of Water Users Associations (WUAs). Most irrigation systems in Nepal have been constructed and managed by farmers themselves. The traditional practice of forming a committee and assigning operation and maintenance responsibilities has recently evolved into more a more formalized system of WUA (Bhattarai et al. 2012). WUAs are registered with the Irrigation Offices at the district level. The nature and function of WUAs varies from place to place. In some areas, they function more as a construction committee and are dissolved or become non-functional after the completion of a given task. In other cases, they become long-enduring institutions and provide leadership in the management of irrigation systems. In such cases, they become important community institutions, around which community norms revolve. Over the years, these WUAs have become more inclusive, with formal provision requiring the participation of women and disadvantaged groups in executive committees. An effective WUA has become pre-requisite for a well-functioning irrigation system.

Conclusion

This analysis of good water use practices has revealed that while the practices contributed to improving different aspects of water use, all the practices have contributed to the overall well being of the community and to environmental conservation. They have also contributed directly to improving livelihoods and community empowerment. Since most of these practices have relied on or emphasized the strengthening of local institutions, the sustainability of these practices is more feasible. Many of these practices have evolved in water scarce areas, and as such, focus on using water more efficiently. Given the reducing availibility of water, efficient water use is particularly important.

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Photo: Authors

Farmers raised drought tolerant varieties of wheat

Water saving in agriculture in Morena

Amita Bhaduri

Equipped with innovative approaches that cut down on water consumption, farmers in Nidhan village of Madhya Pradesh have started looking for ways to grow two crops in a year. The village has been guided by the local Krishi Vigyan Kendra in their efforts to undertake water use efficiency in agriculture.

Nidhan, a village in Madhya Pradesh, is about 30 km away from its district headquarter Morena. Located in Joura block of the district, the village receives an annual average rainfall of 450 mm concentrated in the months of July and August. While much of the village depends on rainfed agriculture, the main source of irrigation in the rabi (winter) season is borewells. There are recurrent droughts in the village and most borewells dry up during low rainfall years. The topography of the village is such that there is water logging in the lowlands due to which they are left fallow during the kharif season. At the same time, the uplands in the village face frost problem during the winters. Pest and diseases of crops are common. Also, there is poor access to improved seeds and farm machinery in addition to shortage of labour.

Pearl millet, pigeon pea, wheat and mustard are the major crops grown in the village. Pigeon pea followed by wheat in

> Immediate sowing of wheat with minimal land preparation saved energy while bypassing the paleva irrigation and saved water.

rabi season is considered to be a sustainable cropping system in the region. However, the area under pigeon pea has been shrinking over years for several reasons. Firstly the erratic rainfall patterns makes it difficult for farmers to take up timely sowing and planting. This pushes the growing period of the crop which already has a longer duration of maturity of 220-250 days. Also, owing to severe frost in winter, diseases like wilt and sterility mosaic affect the crop, reducing the yields. The longer duration of the crop does not allow farmers to take up a second crop, which they are willing to do for earning better income. It has also been observed that wheat grown after pigeon pea has reduced yield owing to temperature rise during the month of March. This problem seems to be widespread in the entire Central Indian belt where pigeon pea crop was a dominant crop all these years.

Finding solutions

One solution to this problem was thought to be developing short duration varieties. But these varieties required irrigation facilities. Also it was observed that if the sowing of short duration pigeon pea is done before first week of July and harvested before first week of December, the field has to undergo 5 to 8 tillage operations and pre-irrigation. This delayed the sowing of the wheat crop. Generally each day of delayed sowing will result in yield reductions of 1 – 1.5 per cent per day. Also the next crop required high inputs in the form of energy, seed, nutrient and irrigation resulting in high costs.

Alternatively, the local Krishi Vigyan Kendra of the area, as a part of National Initiative on Climate Resilient Agriculture (NICRA), planned to promote new approaches in management of irrigation. This national project launched in year 2011 aims at enhancing resilience of Indian agriculture to climate change. Given the presence of Krishi Vigyan Kendras in every district of the country they were entrusted with the responsibility of directing and organizing the demonstrations in 100 vulnerable districts of the country.

Drought tolerant varieties of wheat were introduced. Planting dates of wheat crop that faces terminal heat stress was advanced. Shifting from the age-old method, the farmers of the village along with the Krishi Vigyan Kendra started experimenting with various options.

The farmers from Nidhan began participating in meetings held at the Krishi Vigyan Kendra. They introduced minimum tillage in their farms. This entailed one harrowing, two ploughing followed by planking and sowing of wheat variety GW-366 or MP-4010. The sowing was done in line through seed cum fertilizer drill. Green manuring was also tried using dhaincha (Sesbania).

Dry sowing methods for planting wheat after pigeon pea crop were tried. This was to save time taken in seed bed sowing and first irrigation, locally known as *paleva* irrigation which can easily take up 10-15 days. Immediate sowing of wheat with minimal land preparation saved energy while bypassing the *paleva* irrigation and saved water. This also ensured a uniform crop stand. Alarmed by the falling water level the farmers introduced water use efficient practices. The farmers started providing two irrigations. First, was provided immediately post sowing to ensure that the wheat crop germinates properly and the second was provided after 40 to 45 days of first irrigation. The fields were irrigated by making beds and channels so as to use water efficiently. The productivity of wheat thus achieved was 53.8 qtl/ha.

A total of 125 farm families of the village have adopted this approach. A comparison of yields was done for pre-irrigation before harvesting of pigeon pea and after harvesting of pigeon pea. It was found that the yields were around 11 per cent for the latter case. Zero tillage has been adopted by thirty two farmers of the village. They were involved in sowing of 50 ha wheat by zero tillage sowing method during 2012-13 resulting in production of an additional 112 quintals of grain. This brought about savings of Rs 1.88 lakh in the village. The innovative message of zero tillage cultivation of wheat has spread in neighbouring villages in the districts and around 200 ha in the district was covered during current rabi in 2013.

It can be safely said that these practices have produced higher yield and profit. The farmers see this as a new way of doing agriculture. And most of all, as a way of enhancing resilience of farming systems to changes in climate.

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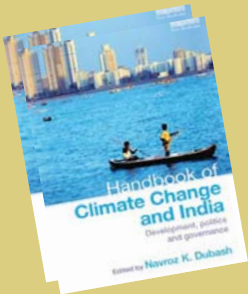


Handbook of climate change and India
Development, Politics and Governance

Navroz K. Dubash (Ed.), *2015, Routledge*, 400 p., ISBN:981138924017

How do policymakers, businesses and civil society in India approach the challenge of climate change? What do they believe global climate negotiations will achieve and how? And how are Indian political and policy debates internalizing climate change? Relatively little is known globally about internal climate debate in emerging industrializing countries, but what happens in rapidly growing economies like India's will increasingly shape global climate change outcomes.

This *Handbook* brings together prominent voices from India, including policymakers, politicians, business leaders, civil society activists and academics, to build a composite picture of contemporary Indian climate politics and policy. One section lays out the range of positions and substantive issues that shape Indian views on global climate negotiations. Another delves into national politics around climate change. A third looks at how climate change is beginning to be internalized in sectoral policy discussions over energy, urbanization, water, and forests. The volume is introduced by an essay that lays out the critical issues shaping climate politics in India, and its implications for global politics.

The papers show that, within India, climate change is approached primarily as a developmental challenge and is marked by efforts to explore how multiple objectives of development, equity and climate mitigation can simultaneously be met. There are growing voices of concern on the impacts of climate change on India. How domestic debates over climate governance are resolved in the coming years, and the evolution of India's global negotiation stance are likely to be important inputs towards creating shared understanding across countries in the years ahead, and identify ways forward. This volume on the Indian experience with climate change and development is a valuable contribution to both purposes.

The Age of Sustainable Development

Jeffrey D. Sachs, *March 2015, Columbia University Press*, ISBN: 9780231173155, 544 p., $34.95/ £23.95

Jeffrey D. Sachs is one of the world's most perceptive and original analyst of global development. In this major new work he presents a compelling and practical framework for how global citizens can use a holistic way forward to address the seemingly intractable worldwide problems of persistent extreme poverty, environmental degradation, and political-economic injustice: sustainable development.

Sachs offers readers, students, activists, environmentalists, and policy makers the tools, metrics, and practical pathways they need to achieve Sustainable Development Goals. Far more than a rhetorical exercise, this book is designed to inform, inspire, and spur action. Based on Sachs's twelve years as director of the Earth Institute at Columbia University, his thirteen years advising the United Nations secretary-general on the Millennium Development Goals, and his recent presentation of these ideas in a popular online course, *The Age of Sustainable Development* is a landmark publication and clarion call for all who care about our planet and global justice.

Valuing variability: new perspectives on climate resilient drylands development

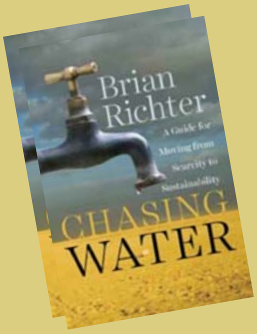
Saverio Krätli, Apr 2015 – IIED, Edited by de Jode H, 90 p., http://pubs.iied.org/10128IIED.html

This book is a challenge to those who see the drylands as naturally vulnerable to food insecurity and poverty. It argues that improving agricultural productivity in dryland environments is possible by working with climatic uncertainty rather than seeking to control it – a view that runs contrary to decade of development practice in arid and semi-arid lands.

Across China, Kenya and India – and most other dryland countries – family farmers and herders relate to the inherent variability of the drylands as a resource to be valued, rather than a problem to be avoided. By exploring these vibrant agricultural economies that take advantage of variability, this book inverts longstanding negative views about food security in the drylands.

Chasing Water

A Guide for moving from scarcity to sustainability



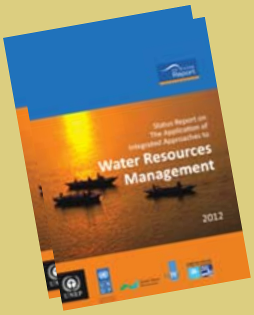
Brian Richter, *2014, Island Press,* 192 p, ISBN: 978-1610915380

Water scarcity is spreading and intensifying in many regions of the world, with dire consequences for local communities, economies, and freshwater ecosystems. Current approaches tend to rely on policies crafted at the state or national level, which on their own have proved insufficient to arrest water scarcity. To be durable and effective, water plans must be informed by the culture, economics, and varied needs of affected community members.

International water expert Brian Richter argues that sustainable water sharing in the twenty-first century can only happen through open, democratic dialogue and local collective action. In *Chasing Water*, Richter tells a cohesive and complete story of water scarcity: where it is happening, what is causing it, and how it can be addressed.

Chasing Water will provide local stakeholders with the tools and knowledge they need to take an active role in the watershed-based planning and implementation that are essential for water supplies to remain sustainable in perpetuity.

Status Report on the application of integrated approaches to water resources management 2012



UNEP, 2012. ISBN: 978-92-807-3264-1

This Status Report, prepared by UNEP in collaboration with UNDP and GWP, is based on a 2011 UN-Water survey sent to the governments of all UN member states. More than 130 countries have responded to the survey and this data has been complemented by interviews in 30 representative countries. The report is intended to inform decision-making at the Rio+20 conference and follow-up global policy discourses. It will facilitate information exchange to enhance the coherence and impact of national efforts to improve water resources management and related work of the UN and other external support agencies at the country level.

The high country response to the survey demonstrates the value of reporting and emphasizes the need for a more rigorous, evidence based, reporting system on progress with water resources development and management. Implementing integrated approaches to water resources management should remain a key component of future development paradigms**.**

Water for wealth and food security: supporting farmer-driven investments in agricultural water management

Giordano, M.; de Fraiture, C.; Weight, E.; van der Bliek, J. (Eds.). *2012, International Water Management Institute (IWMI,* 48p. ISBN 978-92-9090-752-7

Despite agriculture's significant contributions to India's economic growth, smallholder farmers, including many female farmers, continue to face a number of critical challenges to produce food in a sustainable and profitable manner, particularly in the context of climate change. Nowhere in India is this situation more pronounced than in West Bengal and Madhya Pradesh, which are predominantly agrarian states dominated by smallholder farmers and complex agrarian systems. Addressing the challenges of agricultural production in these two states requires an approach focused on smallholder agriculture. In this context, it is highly commendable that IWMI - in collaboration with FAO, IFPRI, iDE and SEI as well as numerous local partners including the Indian Council of Agricultural Research - conducted an intensive study and produced recommendations for investments to improve small-scale agricultural water management in the Indian states of West Bengal and Madhya Pradesh. These investments include rainwater harvesting, drip irrigation, rural electrification and refinements to the Mahatma Gandhi National Rural Employment Guarantee Scheme.

The results of this collaborative research effort – synthesized in this report – deliver an original and substantive contribution to our knowledge of beneficial avenues to increase incomes and agricultural production through improved agricultural water management not only for West Bengal and Madhya Pradesh but also for India, generally. The recommendations of the study produced are practical, actionable and supported by key stakeholders on the ground.

Go organic

N.R. Chandrashekhar is a farmer bringing a green revolution in Nenamanahalli village in Kolar district, known for its drought conditions. Lying on the borders of Karnataka-Andhra Pradesh states, the district has been known for its thousands of lakes, among others. But presently, the lakes and the borewells have dried up and the ground water is at about 1200 feet below the ground. The district does not have any life line river, and thus it is impossible to grow crops without water. In such harsh conditions, Chandrashekhar is showing a way for sustainable farming by utilising the naturally available water and practising organic farming methods.


Photo: Authors

Chandrashekhar, a role model organic farmer

In his 30 guntas farm, (almost 0.75 acre) Chandrashekhar has grown 500 papaya plants, 300 mango plants, 1500 mulberry plants, 1500 tur dal plants and other inter-crops like beans, soyabean etc. As water in Kolar district is costlier than gold, he has created 45-50 soak pits measuring 3x3x3 feet. In the same way, he has planted ragi samplings in 2x2 feet model, using pit system. The water gets collected in these pits. To keep the moisture and fertility, he has planted Hebbal beans after every 4 pits. After finger millet is harvested, Hebbal beans will yield. In his 30 guntas land, he has constructed a 70x50x12 feet farm pond and collects water for emergency usage for plants.

He considers that each square inch of soil is important. He has also planted horse gram, jute, dhaincha and many such dicotyledonous plants to enhance the soil fertility thereby ensuring that water remains on the top of the soil. The horse gram leaves are spread on the farm land for enhancing the organic quality of the soil. This is the best model for those farmers who use chemical manures. He has also grown subabul, linseed, glyricidia around the contours of the land. He spreads the leaves of these plants on the farm resulting in improved soil fertility and better yield.

Most importantly, he uses the scarce water resources very efficiently. He feeds the plants through bottles. He buries a holed bottle 6 inches away from the plant, but near to the roots. In summer, he fills up these bottles and ensures that the water, instead of getting evaporated, reach the roots of the plants. For instance, if the mango tree were to be fed with water by way of containers, it would have required 300 pots of water to irrigate 300 plants. But using this novel way, he can now supply a pot of water to 26 plants. Overall, the mango plants consume a total of 12 pots of water, thus saving 288 pots. Time and effort is also saved here. This way, he has got maximum yield using minimal water. In 2010, he harvested a yield of around 20 tonnes during the season. He gets mango fruits after the papaya harvest. He is also practising honey bee culture on his farm.

Chandrashekhar has become a role model for organic farming in the region. He has put a stop to unwanted agricultural expenses but at the same time, has earned his livelihood through organic farming, without using chemical inputs. He has shown that if farmers followed a model like this, could reap benefits even under difficult situations. He says with pride that the future generation can live happily without further loss to the ecosystem.

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Stronger local institutions, key for sustainability

From scarcity to abundance

Transformation of Krishna Dehariya village

Ranchitha Kumaran and
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By efficient harvesting of water, the communities of Krishna Dehariya village in Madhya Pradesh are not only able to meet the current water requirement of the village but are also prepared to meet future water demands. Strong local institutions helped transform this village into a water secured one, improving their lives and livelihoods.

Once called Krishna Dehariya, Kasai Dehariya, a village in Agar district in Madhya Pradesh, got its name for not being able to provide drinking water to a poor man who was thirsty. Krishna Dehariya which had plenty of water resources, faced a severe drought in 1942 and water availability became a challenge. By 2010, there were more rain fed patches, less soil cover, degraded lands, undulating terrain resulting in water scarcity for both drinking as well as irrigation purposes. Women had to travel 1-2 kms to fetch drinking water.

Kasai Dehariya is a village with 127 households and a geographical area of 532 ha. Only 27 ha of land is irrigated by four small ponds. The remaining area is under rain-fed cultivation. This restricted farmers to shift to crops like wheat and soyabean which required irrigation. Villagers often migrated to other states and districts for employment as labourers.

The initiative

In 2011-12, Rural Transformation Programme of the Reliance Foundation (RF) joined hands with the local communities to bring about a holistic, self-reliant and sustainable model of rural development. With the initiation of RF intervention in Kasai Dehariya, the major focus was on institution building since it provides base and empowers community to take up and sustain larger initiatives.

Water is crucial for the sustenance of farming. To ensure water security, the farming community came together to form Village Farmers Association (VFA). Mapping the needs and aspirations of the community, the VFA with a help of RF support initiated water harvesting and moisture conservation activities in Kasai Dehariya. Action plans were made based on the situational analysis of the village and the interventions were planned to conserve water at household level, farm level and village level.

Common Water Harvesting

The community realized that to bring more area under irrigation and make the village water secure, Kasai Dehariya tank (an old Talab) has to be de-silted. The silt excavated from the tank –which is rich in nutrients was applied on wasted land. Around 57 hectares of waste land was brought under cultivation benefitting 77 farmers in the village.

After establishing water conservation structures, the VFA created water user groups- an informal system which has its own bylaws and committee to manage the water in common water harvesting structures- governed by VFA members. This helped in effective water management.

Nearly one lakh MT of silt was excavated from Kasai Dehariya tank to increase its capacity to provide critical irrigation for crops. Increased access to water enabled farmers to cultivate crops in both Kharif and Rabi seasons. The area under irrigation increased from 27 to 242 hectares.

Water conservation at farm level

Dharti farm interventions were undertaken on 242 hectares of land. Activities such as farm-bunds were taken up for conserving soil and moisture. Around 37 farm ponds were constructed to provide critical irrigation. Bund plantation was done to improve bio-diversity that aids in pollination. Improved biomass and soil structure have resulted in enhanced farm productivity. The net income increased from Rs.5,400/ ha to Rs.39,000/ ha.

Conserving water for domestic needs

During summer, women and children had to walk long distances to fetch water. Analyzing the scope of getting water from the Kumarpipliya dam of Dudhpura village which is 1.7 km from Kasai Dehariya, the villagers planned to link the dam with common wells of Kasai Dehariya through pipelines. VFA provided financial support to purchase pipelines, whereas the labour contribution was done by villagers.

Thus the drinking water was made available within village boundary, reducing the drudgery of women and children. The water in common wells also enabled the women to establish RNGs (Reliance Nutrition Gardens) at their backyard which provided fresh and nutritious vegetables for the family.

> The villagers refused to provide drinking water to a visitor due to water scarcity, which made Krishna Dehariya as Kasai Dehariya

Photo: Authors

Farm ponds, a source for providing critical irrigation

At a later point, the VFA was successful in linking government department for the implementation of Nal Jal Yojana which connects every household in the village with tap for drinking water, thus ensuring water security.

Model of change

The strong institution building of the VFA played a significant role in replenishing the water resources. By efficient harvesting of water, the communities are not only able to meet the current water requirement of the village but are also prepared to meet future water demands without affecting ecology.

Besides crop productivity and income increases, there has been some significant changes on the social front too. There is now increased enrollment of girl children in schools who were earlier involved in fetching water. Above all, the villagers informally changed the name of village as "Krishna Dehariya" after achieving water self-sufficiency. They have also requested the District Collector to change the village name in revenue records for which necessary action is being taken up.

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