Groundwater stories

villagers share their voices

a MARVI project

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Preface

India's groundwater story is uniquely scripted by millions of farmers who independently operate and manage dug wells and tubewells throughout the country leading to increasing level of groundwater anarchy. Access to cheap pumps, subsidised electricity, changing crop patterns and increasing population have increased the tensions between groundwater supply and use that typify uncoordinated pumping of groundwater. Maintaining groundwater dependent rural livelihoods without further reductions in already depleted hard rock aquifers is a critical dilemma faced by the government and farming communities in rural India. Using the Dharta and Meghraj watersheds as examples to understand groundwater challenges, the focus of this Photovoice narrative, we share here the groundwater stories of ordinary people in this book.

Literally viewed through the lens of individuals, the everyday stories told by villagers in this book introduce emotional and profound glimpses into the nexus of groundwater and livelihoods in rural India and the values held by villagers and their families. The photo essays also introduce humanness into the groundwater story in India and how it connects and contradicts with contemporary economics, politics, hydrology and agronomy in groundwater deliberations.

The narratives presented are not simply opportunistic and arbitrary caricatures of Indian farming communities; these are carefully and systematically crafted photo-essays corroborated and endorsed by the individual story tellers. The systematic interaction with the individual story tellers increases the confidence that these are accurate reflections of the groundwater dilemma facing farming communities, and their ideas about the situation improvement. We hope this book will help you visualise how groundwater connects with villagers and influences their daily lives and understanding the complexity of managing and sustaining this invisible resource.

Groundwater

Groundwater is the water that is stored below the land surface. Water from rain and rivers moves deeper and is stored in porous soils and rocks. Groundwater is everywhere – in some places it is at a few metres depth and in other places it can be several hundred metres deep; at some places it is available in plenty while in other places the amount is very small; also in some places it is of good quality and in other places it contains too much salt or other substances.

In India and many parts of the world, groundwater is the main source of water for drinking. It is also widely used for agriculture in North Africa, the Middle East, South and Central Asia, North China, North America and Australia, but its excessive pumping has raised concerns about its sustainable use.

Groundwater is an important source of irrigation in India and more than half of the irrigated area depends on groundwater. In most semi-arid regions of India, farmers face significant water shortages and the risk of crop failure with even the slightest abnormal decline or delay in monsoonal rains. Advances in pumping technology and its easy affordability have seen groundwater exploitation for irrigation by small-holder farmers across India undergo massive expansion, and it has to some extent enabled farmers to manage deficiencies in monsoonal rainfall, and even allow dry-season irrigation, thus contributing to poverty alleviation.

The presence of over 20 million wells all over India has meant that groundwater is over extracted and groundwater levels are declining. Rapid population growth and increases in groundwater use in the past three decades meant that groundwater is pumped out at a rate far greater than the natural recharge. In particular, the problem of excessive groundwater pumping in many districts of Rajasthan, Gujarat, Maharashtra, Telangana and Andhra Pradesh is quite severe and those districts have been declared 'dark zones' by government agencies.

The management of groundwater recharge by directing surface waters to aquifers is one means of reducing the impact of over-exploitation of groundwater. Other ways to reduce the use of groundwater is by selecting crops that consume less water and apply irrigation by methods that are more efficient (e.g., drip).

The MARVI Project

MARVI, Managing Aquifer Recharge and Sustaining Groundwater Use through Village-level Intervention, project was developed to improve the security of irrigation water supplies and enhance livelihood opportunities for rural communities. The project focuses on assessing the effectiveness of current rainwater harvesting and recharge structures and demand management strategies at village scale. Another important aspect of this project is the involvement of local farmers, schools and other stakeholders in the monitoring and management of groundwater at the local level. The study areas for this project are the Dharta watershed in the Udaipur district in Rajasthan and the Meghraj watershed in the Aravali district in Gujarat.

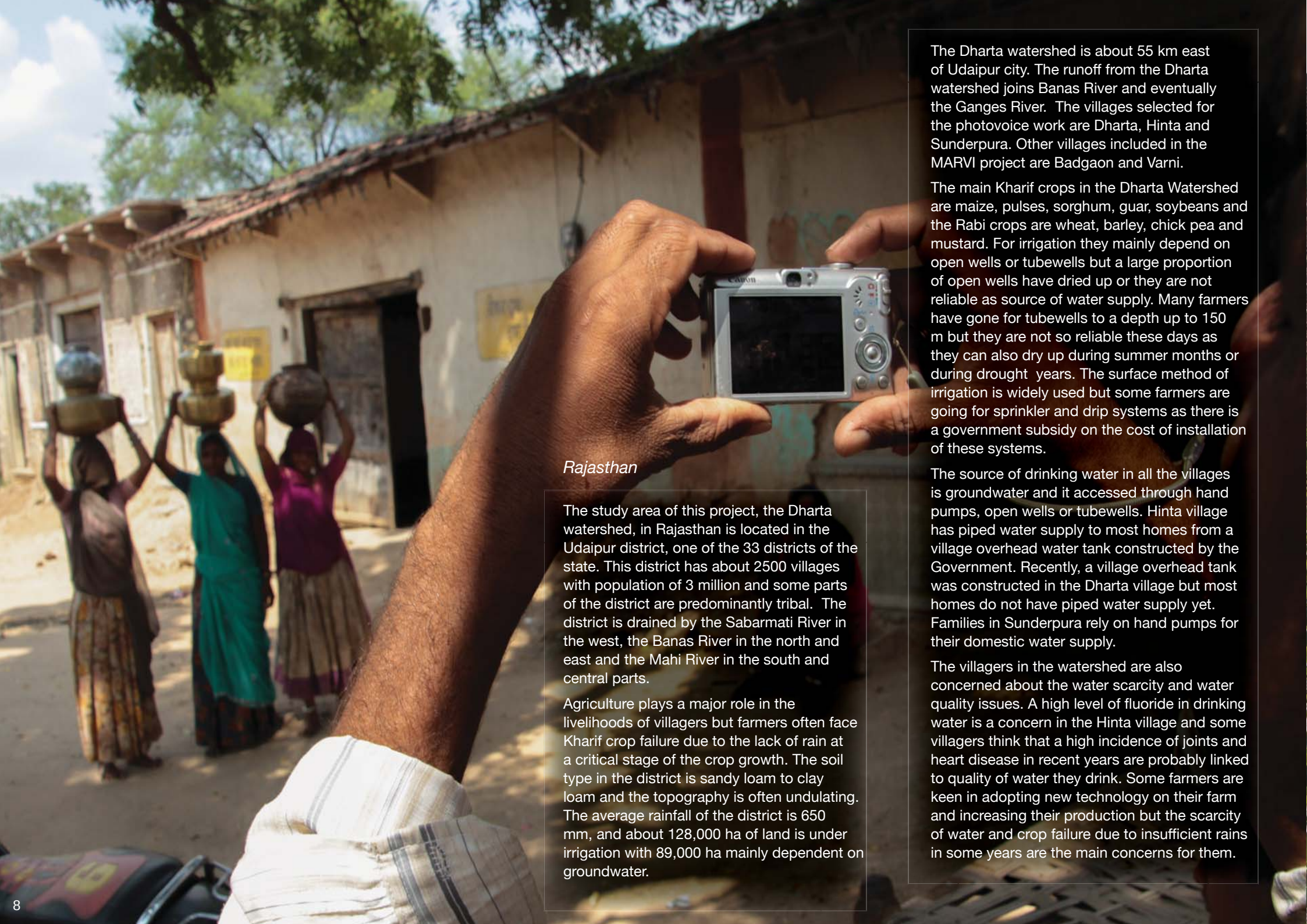
The MARVI Approach

Groundwater is an invisible resource flowing below the surface and there is hardly any control on how much one can use. For this reason, its management is quite complex and challenging and so the problem of groundwater is both technical and people related. For this reason, we need to involve local farmers and other community members for successful and sustainable use and management of groundwater.

We used a transdisciplinary research approach in this project, meaning that the focus of the project was on an issue such as 'lowering of watertable' and not on the disciplinary background of researchers. Such a research approach requires researchers from different disciplines to work together from the beginning. Equally important in this approach is the genuine engagement of beneficiaries at the onset of the research and regular dialogue with them during the research. This ensures that holistic solutions are developed by all those involved and there is a wider ownership and adoption of the research outcomes.

The project involved monitoring of watertable fluctuations in 250 wells in the Dharta watershed and 110 wells in the Meghraj watershed. The other important activities were demonstrating water saving practices to farmers and engaging and working with local villagers and the school community to educate them about their groundwater issues and help them to have dialogue for future village water security and livelihood improvement. The end purpose of all this is to engage farmers, government agencies, policy makers and other stakeholders to come together to work out and implement sustainable solutions.

The project partners in Australia include Western Sydney University and CSIRO Land & Water. The partners in India include the International Water Management Institute (IWMI), M.P. University of Agriculture and Technology, Vidhya Bhawan Krishi Vigyan Kendra, Development Support Centre (DSC) and Arid Communities and Technologies (ACT). The project was generously funded by the Australian Centre for International Agricultural Research (ACIAR).



Rajasthan

The study area of this project, the Dharta watershed, in Rajasthan is located in the Udaipur district, one of the 33 districts of the state. This district has about 2500 villages with population of 3 million and some parts of the district are predominantly tribal. The district is drained by the Sabarmati River in the west, the Banas River in the north and east and the Mahi River in the south and central parts.

Agriculture plays a major role in the livelihoods of villagers but farmers often face Kharif crop failure due to the lack of rain at a critical stage of the crop growth. The soil type in the district is sandy loam to clay loam and the topography is often undulating. The average rainfall of the district is 650 mm, and about 128,000 ha of land is under irrigation with 89,000 ha mainly dependent on groundwater.

The Dharta watershed is about 55 km east of Udaipur city. The runoff from the Dharta watershed joins Banas River and eventually the Ganges River. The villages selected for the photovoice work are Dharta, Hinta and Sunderpura. Other villages included in the MARVI project are Badgaon and Varni.

The main Kharif crops in the Dharta Watershed are maize, pulses, sorghum, guar, soybeans and the Rabi crops are wheat, barley, chick pea and mustard. For irrigation they mainly depend on open wells or tubewells but a large proportion of open wells have dried up or they are not reliable as source of water supply. Many farmers have gone for tubewells to a depth up to 150 m but they are not so reliable these days as they can also dry up during summer months or during drought years. The surface method of irrigation is widely used but some farmers are going for sprinkler and drip systems as there is a government subsidy on the cost of installation of these systems.

The source of drinking water in all the villages is groundwater and it accessed through hand pumps, open wells or tubewells. Hinta village has piped water supply to most homes from a village overhead water tank constructed by the Government. Recently, a village overhead tank was constructed in the Dharta village but most homes do not have piped water supply yet. Families in Sunderpura rely on hand pumps for their domestic water supply.

The villagers in the watershed are also concerned about the water scarcity and water quality issues. A high level of fluoride in drinking water is a concern in the Hinta village and some villagers think that a high incidence of joints and heart disease in recent years are probably linked to quality of water they drink. Some farmers are keen in adopting new technology on their farm and increasing their production but the scarcity of water and crop failure due to insufficient rains in some years are the main concerns for them.

Gujarat

The study area of this project in Gujarat is located in the Aravali district, the 29th district created in 2013 and lies north of Ahmedabad. It has about 650 villages with a total population of over 1 million. The district is drained by the Sabarmati River in the west, the Banas river in the north and east and the Mahi River in the south and central parts.

The Aravalli district has a large tribal population with approximately 30% of the population coming from socially and economically disadvantaged groups. The soil in the district is loamy type with topography undulating. Unlike other districts in the state, about 80% of rural livelihoods are dependent mainly on agriculture and dairying and the district does not have many industries or urban centres. Average rainfall of the district is 750 mm, and there are 444,000 ha under irrigation with 170,000 ha dependent on groundwater through dug and tube wells.

The Meghraj watershed is located about 25 km west of Modasa town and 100 km from the state capital Gandhinagar. In this watershed also, agriculture is quite important in the livelihoods of villagers and the threat of Kharif crop failure is always there if there is insufficient rainfall at some stage during the monsoon season. The main crops grown in the district are maize, cotton, wheat, pigeon pea and castor. The soil type in the district is sandy loam to clay loam and the topography is often undulating. The average rainfall of the district is 750 mm, and about 444,000 ha of land is under irrigation with 170,000 ha mainly dependent on groundwater. The villages selected for the PhotoVoice work are Bhatkota and Navaghara. Other villages included in the study are Valuna, Tarakvadia, Dhandhiya, and Ranjedi.

In general, in both watersheds, groundwater is the main source of irrigation water supply and plays an important role in agriculture and the livelihood of people. Both districts are in hard rock aquifer areas and groundwater levels have dropped significantly due to excessive pumping. As such, the two study watersheds are living laboratories for a diversity of transdisciplinary research issues in groundwater recharge and management.

Participatory Approach to Groundwater Monitoring

This is one of the community workshops held in the Meghraj watershed to start a dialogue among farmers to understand their current groundwater situation.

The problems and challenges of groundwater scarcity now are much more complex. It is increasingly being recognised that the participation of local people is important due to the growing problem of water scarcity worldwide, depleting groundwater storages and rising conflicts between different water users. Building dams and other physical infrastructures are not sufficient any more to improve the situation of water scarcity. There is a significant gap between a technical solution and the solution that will make difference and be long lasting.

The management of water, particularly the groundwater, needs to be a shared responsibility between farmers and government agencies. For this, there needs to be a genuine dialogue among farmers and between farmers and government agencies to understand the issue from a range of perspectives, explore different ways by which some practical solution can be found and identify actions to move forward.

A greater farmer involvement in groundwater management can have many benefits. Both farmers and agencies will perform their management tasks better when they feel a mutual responsibility for a common objective.

This also creates a sense of self-respect and self-reliance in managing and sustaining the use of local groundwater resources. Farmer participation requires a significant effort and patience but the benefits can be substantial. Strong community participation is crucial for ensuring the capacity building of the locals and so that they can help themselves in the longer term and design solutions and actions that are more effective. The project explored a range of participatory methods that assisted in improving supply and demand management of groundwater, while educating and engaging with village communities, local NGOs and government agencies to help them work together to achieve sustainable groundwater management.

Community participation helps to encourage collective action at the village level that could be mutually beneficial to all the villagers and from which communities in other regions could learn. A citizen science approach that involved village volunteers, who were called 'Bhujal Jankaars' (BJs), a Hindi word meaning ' Groundwater Informed' were engaged.

The BJs were involved in groundwater monitoring and were trained and nurtured to act as local champions for village groundwater management in the MARVI project. A total of 9 BJs were recruited in the Meghraj watershed, and 25 in the Dharta watershed. The role of BJs was to give local villagers ownership in the project, build their capacity to understand their local groundwater issues and eventually help them to assist their community for improving the groundwater situation. The BJs were trained in mapping, water-table depth and quality measurements, geologic observations and basic geo-hydrologic concepts regarding groundwater availability for agricultural use. They were involved in weekly monitoring of the watertable depth and water quality across 250 open wells in the Dharta watershed and 110 in the Meghraj watershed.

The data collected by BJ are valuable in informing village communities about the situation of their groundwater system and providing local data to start conversation, make informed decisions and plan for cooperative actions.

PhotoVoice by Village Community

Participatory photography, or 'photovoice' is a technique where participants use photography to show aspects of their lives and the broader social, economic or environmental issues affecting them. Photovoice can play an important role in communities with a limited voice due to poverty, language barriers, race, class, ethnicity, gender, culture, or other circumstances. This can be used to capture images of their environment and experiences and share them with others to improve a problematic situation. The photos can bring out the realities of the photographers' lives and hopes to the public and policy makers and to effect change, which sometimes will not emerge from a normal conversation. This technique was introduced to the MARVI project to complement the existing focus on quantitative data collection, by providing a way of directly and powerfully exploring the villagers' relationship to their groundwater. The approach was also designed to empower participants to value their own water knowledge and enable them to share this with others.

The PhotoVoice workshops were run at a number of villages and schools in the project areas, a selection of which are featured here. They were focused on three themes: i) the participants' current perception of groundwater situation, ii) the future of groundwater supplies in their villages, iii) their thoughts about their ability to influence the management of groundwater.

The process involved three steps:

1. Photography Workshop – this introduced the project and provided basic training on camera operation, followed by time for the villagers to take photographs in their local area in response to the themes.
2. Selection and Printing – participants chose a sample of their images that best showed their views and these were collected and printed.
3. Photograph Discussion Workshop – the printed photographs were returned to the villagers who discussed and recorded the ideas behind them.

The images in the next pages are a selection of the villagers' voices. The images have not been edited.

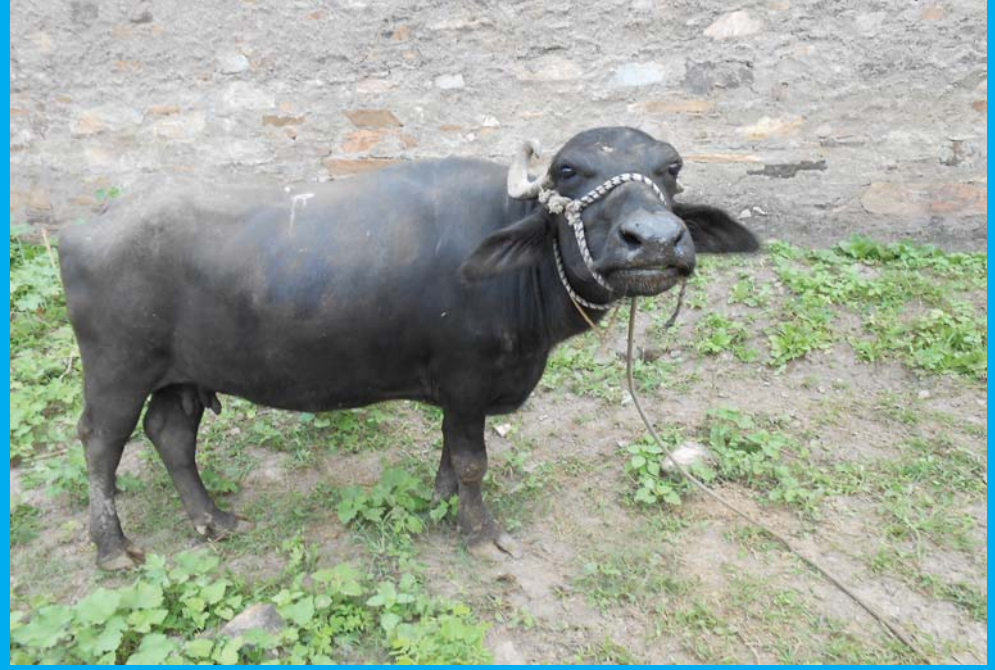
Hinta Village

The villages included in the PhotoVoice work are Hinta, Dharta and Sunderpura.

Hinta is the largest of the three villages and has about 750 families with a population of 3680. Dharta has about 350 families with population of 1475. Sunderpura is the smallest of the three villages selected and has about 80 families with a population of 415.

In the Hinta village, the population is composed of most community groups including Brahmins, Rajputs and Vaishya and most of them are connected to farming in some way. Some residents also rely on labour work in their village or travel inter-state for work to supplement their family's income. There is a primary and a secondary school in the village and there are many resident of the village who have schooling up to 10th standard and some are even graduates or have done post graduate study.

Villagers have to walk their livestock long distances from their home to provide drink for them. Providing water to livestock is a big problem these days and it is critical in drought years or in summer months. *Jagdish Bhatt*



I need grass to eat and water to drink. I feel concerned that I don't know from where I will get my water and feed in the future. *Rameshwar Soni*

The big hurdle in the village is that the peoples are installing more and more tubewells every year. This causes groundwater levels to fall rapidly. I think new tubewells should not be allowed to be installed. If we can do this, we can hopefully stop the fall in groundwater levels. This earthern pot is 150 years old and it still exists in a reasonable condition becuase we 'conserved' it. We need to conserve and use water wisely. Old is gold! *Bhavar Lal Rao*

1) At present it is rainy season, so the water level in wells have risen up, but after a month or so when we start pumping it will fall and many of the wells around our village will be dry. 2) If we have more water, then we will increase our crop production and improve our livelihood. 3) For the last few years some wells in the village had no water, but this year with good rains the water has come back in the wells. The wells have no 'life' without water. *Kishan Lal*

People of the village believe that to welcome prosperity, doors of new ideas should be kept always opened. The ideas of water conservation and wise use of water should be stored in big 'tanks'. *Shanker Lal Chaubisa*

We need to create a situation such that all the water resources, like check dams, ponds, wells, and bavadis (open well with steps) to be full of water. *Bhawarnath Nath Yogi*

I have enough water to drink and it is of good quality, this means I can produce more milk and I can help in improving the livelihood of my owner's family. I will be happy if in the future, there is no problem of water. *Rameshwar ji Soni*

This water tank was made by the local government for drinking water supply, but it is not in good working condition. The maintenance of infrastructure and care for resources is quite important. The same applies to the maintenance of check dams for recharging groundwater resources. *Bhawarnath Nath Yogi*

I am one of the Kharif crops in this area, and I am very important for the locals. One less rain at a critical time in my life could mean I am dead or one life saving irrigation using groundwater can make the farmer happy. So, the groundwater can make huge difference. *Manju Soni*

My picture shows people working in different directions - if everyone wastes a little bit of water, all this wastage will add up. Apart from growing crops, water is also required for other purposes. We need to avoid wastage of water in all its different uses and this saving will ultimately benefit the entire village, and then the whole country. *Kelash Choubisa*

This tube well was constructed by the Gram Panchayat in Hinta. The depth of tubewell is 240m, but it is still dry. So constructing more and more tubewells around villages will result in the groundwater level further decreasing, and low water security for villages and for common people and farmers. Overall, life will be more difficult. *Bhavarlal Rav*

Stop wastage of water. Saving of every drop will all add up to help making our future. Water is life. *Shanker Lal Fouji*

Dharta Village

Dharta village has a significant proportion of population classified as Other Backward Class (OBC) and Schedule Caste (SC) with ethnicity mainly Gaadri and Gamethi. The people in the village depend mainly on agriculture and animal husbandry for their livelihood. There is a primary school and a secondary school in the village and the level of education in the village is rising. Many people from older generation did not have an opportunity to go to school, but now they are trying to provide good education for their children.

Lack of water has meant a poor crop and less income this year. *Hariram Gadri*

Now a days farmers use pipelines to transport irrigation water to field, and this way they can save water rather than use unlined channels and lose water through seepage. During the earlier times, although they knew benefits of pipes to transport irrigation water but they simply could not afford the cost of pipes. *Kishan Lal Gadri*

On our farm, we do not have proper storage of drinking water for animals, which are important for our livelihood. The water for drinking is not available easily either. Some farmers waste water, instead it should be used properly for plants and trees so that our village can be greener and more prosperous in the future. *Premkumri Gadri*

Water plays a very important role in animal husbandry, and a communal water supply facility such as this one, which relies on groundwater supplies, provides water for farm animals of the entire village. *Prithvi Raj*

Even this current generation is facing water problems, what will be the situation for the next generation? What should we do to improve this situation? How can we bring happiness back to our village through water? *Kalu ji*

If water is available, we can produce grain crop and can feed our family better. We consider water as a 'family member' and you need look after it. *Santosh Gadri*

Plants are very important for humans, just like food, clothing and houses. When there was enough forests, there were good rains and steady climate, but at present our requirements are increasing day by day, and we are not taking care of the forests. We should should think about our future first before cutting trees. *Kishan Lal Gadrii*

We must teach our children and grandchildren to protect water and not overuse groundwater - otherwise our life will fail like this tubewell. Water is not for one generation xzzxbut it is for many generations to come. We need to educate the next generation to protect and not overuse groundwater, if its not available everything will be finished. *Onkar Lal Gaadri*

There is already a scarcity of water. Every household needs water for washing utensils every day and so we cannot afford to waste water while using at homes. We should also use the domestic wastewater for growing some plants and vegetables around our home. This way the water is not wasted. *Santosh Gaadri*

Whether water is for small animals or small plants, we need to reduce any wastage. Every drop of water counts!. *Onkar Lal Gaadri*

We grow chillies for household needs and farm income. With enough rain, they grow well. But there have been no rains for some weeks, they will probably now die and impact family's needs and income. Water is very important, we should use it efficiently and recycle it when possible to fulfill the plants' water needs. *Pushpa Kumari Gaadri*

I lift water from a well to meet my family's needs for drinking and washing. But the well's water level is dropping gradually, making life harder. We need water every day for so many of our needs, including drinking. Without enough water in the well in future, how will we produce food? Simply, it is a big question of our survival. *Santosh Gaadri*

Sunderpura Village

In Sunderpura, the population is dominated by Rajput caste, and they are involved in farming and military service. There is a school in the village up to 8th standard. The level of education of villagers is low and it is mostly limited to primary level.

The school in the village is an important partner in the MARVI project, and it is rapidly developing to provide much needed education for children in the village. The village also has an important checkdam constructed about 10 years ago, and according to local villagers it has improved the groundwater recharge for the wells around the villages.

Because of water scarcity, all the utensils are empty. If we cannot improve the water situation, we will have to walk long distances to fetch water. Our day-to-day living without a good supply of water will be very difficult. *Leher Kunwar*

I am an important handpump in this part of the village. I can provide water to people but the way groundwater level is falling, very soon, I will not be able to meet the water demand. If there is no water left to pump out, I will be a toy for children and will feel ashamed. *Swaroop Singh*

We have 10 handpumps in our village but most of them are not in working condition at the moment. Even when some of them work, the pumped water is of poor quality, so nobody drinks it. *Lila Kunwar*

I'm an important checkdam of the village, but unfortunately I do not get all the water I need to do a good job for groundwater recharging. This is because many of my brother checkdam are not letting rainwater to flow my way. This is not fair, but it is not their fault either. The people who built them did not plan and design them properly. *Mithu Singh*

People in this village collect their water from a well by lowering bucket with the help of rope. Due to groundwater levels falling, wells will become dry and we will need to run around with empty bucket to collect water for family's need. *Prem Kunwar*

Water is not only used for agriculture and drinking purposes but it is also important for building houses such as here. If we do not have adequate supplies of water, we will not be able to complete the houses. *Swaroop Singh*

When water supply for home is not adequate to meet the needs, how will we then prepare food, clean dishes and other tasks around homes? *Jas Kunwar*

We need for water our animals such as goats and cows. But in future, it will be difficult to meet this demand because the groundwater levels are going down and groundwater is becoming scarce. *Ratan Singh*

I am serious about our water and the future. We can improve our farm production by using pipes to reduce water losses and sprinklers to irrigate crops more efficiently. Use water efficiently and wisely! *Tama Kunwar*

If we have sufficient water of good quality, we can produce food and other things from land. This way our home, our village, our state and eventually our country will be surrounded by peace, happiness and prosperity. So save every drop of water! *Mithu Singh*

We collect water daily from a nearby well. During summer months or drought years, we have to walk extra distance for drinking water. With lowering of groundwater levels, water from deeper wells have the possibility of higher fluoride levels. Some people have bone joint pain, possibly related to fluoride levels in drinking water. *Tama Kunwar*

With more water, we can increase our crop production. After maize crop during Kharif, we can grow wheat crop too in Rabi. Everyone should harvest rainwater and store in tanks for cows and buffaloes. This way we can have more groundwater for growing crops. More groundwater recharge through ponds and checkdams will be good.*Tama Kunwar*

Bhatkota Village

Bhatkota is one of the villages included in this study in the Meghraj watershed and has about 150 families with population of 782. The main Kharif crops in the village are cotton and caster and the Rabi crops are wheat and gram. The total number of wells are 28 and tubewell number 87. There is a primary school in the village with about 177 students including 96 girls and 81 boys. The literacy rate of Bhatkota village is 68%.

This tank was provided by the local organisation DSC. We use can store rainwater and groundwater in it and use water efficiently for domestic and animal use and thus save water for crops. *Kailashben*

I am a farm pond. I hold water like this around the village to help retain water locally and increase groundwater recharge. There needs to be more such facilities in surrounding areas. *Damorsingh*

The cotton crop on this farm is irrigated with traditional irrigation method and it results in lot of water losses. Drip method of irrigation will reduce the water use by half in this crop. Cotton is widely grown in the area and if we can use drip irrigation, we can increase production, reduce the growth of weeds and save a lot of water. *Chimanbhai*

When I wash clothes, I reuse soapy water for irrigation of trees etc and this way I can save fresh water and so less pressure on groundwater supplies. *Farmaben*

We regularly fill this tank from the borewell and use this water for bathing, animal drinking and cleansing of utensils. Without groundwater, this storage facility will be empty and we will be in trouble. *Farmaben*

I am an important well of this village. I get recharged every year during monsoon and as my water level rises, the farmer pumps water from me for the Rabi crop. For my water to be useful, its quality is important. But people throw trash in me and so my water quality reduces.This is not helpful at all - someone needs to put a barrier around me to stop all this. *Priyanka*

This farm with wheat crop belongs to Suverabhai Dhanbhai. I feel the irrigation method used is not very efficient and so there is a quite bit wastage of water. If more efficient irrigation method such as a sprinkler system is adopted, we can save water and produce more out of every liter of water. *Kaljibhai*

This handpump is out of order. If we can get it repaired, our problem of water for drinking in homes and for animals will be resolved. Besides, we will not need to go to distant places to fetch water and spend too much time to meet our daily water needs. Problems like this affect our animal husbandry also and the time we have available for farming activities. *Dineshbhai*

Previously there was no arrangement for drinking water in our school. DSC helped us to install handpump in our school to satisfy our water requirement. If such handpumps are given in each Falia, then water could be available for use. *Rashikbhai*

Good quality drinking water is so important for a healthy life. *Rashikbhai*

Collecting rainwater like this can help in groundwater recharge. Besides we should save water for the next generation. *Dineshbhai*

We should not waste even a small quantity of water at home, like what is happening here. Because at the village level, it all add up and put pressure on groundwater supplies. Community eduction to value water is very important. Water is life. *Kinjal*

PhotoVoice by School Community

Youth are an important catalyst for change in the way we use, manage and view the importance of water. Together with farmers, government agencies, and other stakeholders, we can reshape our water future. The way we manage water today does directly influence our future, and every investment we make to involve youth to tackle water-related challenges will make the task of solving the water problem easier in the future. This is one important reason we involved schools to participate in the MARVI project - to recognise the power of youth for a water secured world.

We involved a number of schools in the Dharta and Meghraj watersheds in the photovoice work in this project. Students of Dharta and Bhatkota watersheds were quite receptive and concerned about the groundwater security of their respective villages. Manual and semi-automatic rain gauges were installed in all three schools. Students participated in daily measurement of rainfall and maximum and minimum temperature. In all the schools, a display board has been painted on a wall where they record their daily rainfall and temperature. It has created students' interest in daily, weekly, monthly and annual rainfall amounts.

There is increasing importance to providing education for female children in the villages. However, the attendance of female students in schools can be impacted by their help being required at home or on the farm. For example, female student attendance in schools can be less during the critical farming time, viz. sowing and harvesting. During the dry season their attendance can also drop when compared to male students as they may need to spend time to fetch drinking water from distant water sources.

Hinta School

The Hinta village school has over 300 students from standard 1st to 12th class, and has one science laboratory and one computer lab. For drinking water, there is an overhead water tank and one hand pump. The students of the school are highly devoted towards their studies and want to be successful in life. They are well aware of the current situation regarding water in their village and know about water scarcity. The attendance of the students is irregular. Sometimes students miss class due to water scarcity as they travel long distances to fetch drinking water. This is a big issue for the students. They want to do something to save water so that it can be readily available for the future and ensure they will not miss school. To increase their knowledge about the groundwater and weather conditions (rainfall, temperature), one rain-gauge station and one tipping bucket instrument was installed through the MARVI project. Some selected students are taking daily reading of rainfall and temperature and sharing the data collected with all students and villagers. They prepared some drawings which showed how to save water and also gave the message "JAL JIVAN KA ANMOL RATAN, ISE BACHANE KA KARO JATAN" – meaning water is a costly diamond, so try to save it.

In recent years, the groundwater pumping has increased so much that the water level has gone quite deep. It is no wonder the water levels in the tubewells around are failing. There is virtually not much water left underground. 'Save water, save water!'. Nilesh Choubisha, Mahesh Kumar Rao

Water adds life to landscape and make farm full of greenery peace and harmony. Water is so important for us that, it helps us grow crops in field, cook food at home and for many important activities around us. That is why water is important for us. *Gajendra Choudhary, Yuvraj Singh Shaktawat*

The first thing in managing water is to measure how much we have. The raingauge installed in our school has helped us learn more about the rainfall amounts. *Akshika, Ravina Choubisha*

Green plants are very pleasing to eyes but they depend on the magic of water that keeps them alive and makes them grow. In the same way, water is also important for animals and humans to keep them going. *Bhawana Garg, Kiran Choudhary*

Hygiene is very important and washing with water can help in maintaining good hygienic conditions. Water is required for bathing and washing clothes. In our village, water is coming to our homes through pipeline for 30 minutes every alternate day or sometime every third day. This means we need to use water quite carefully. Water is basically our life and we cannot even imagine to live without it as fish cannot survive long without water.
Pooja Choudhary, Khushboo Shaktawat

It seems this field is having enough water, so there is a good greenery all around it. If in the future, scarcity of water occurs than the greenery will be finished. *Akshika, Ravina Choubisha*

As shown in this writing on the wall, I have duty towards water. We can overcome the scarcity of water by: 1. Rainwater Harvesting; 2. Preventing the wastage of water; and 3. By bringing awareness about water in the community. By doing this, I am quite hopeful of the future.
Gajendra Choudhary, Yuvraj Singh Shaktawat

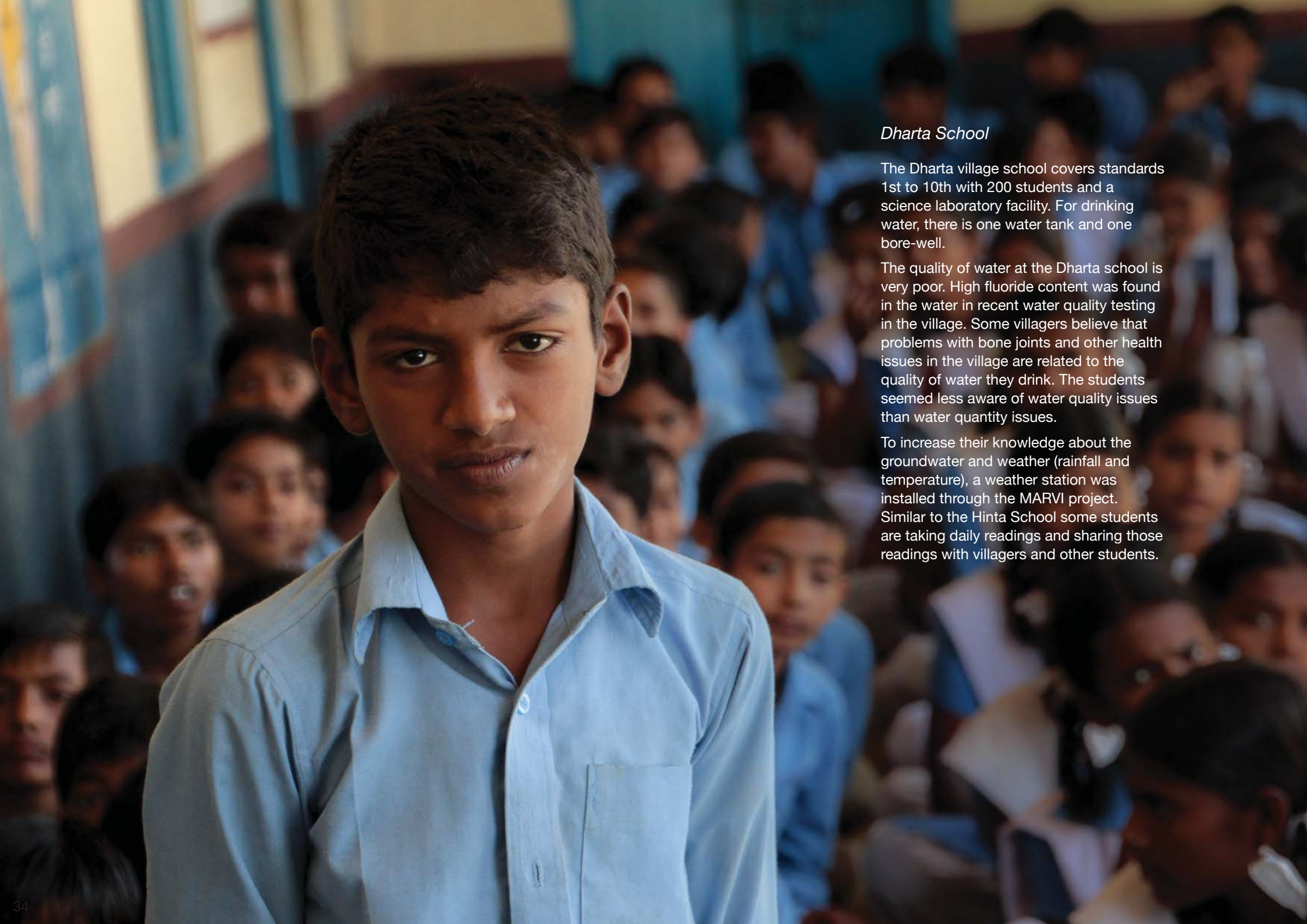
The water stored here for animals is dirty but they are still drinking it. This can cause disease in animals and can affect farmers' livelihood. We should keep in our mind that for a better water future we do not do anything that pollutes water. *Prahlad Singh Devda, Seema Nai*

We all know that sun is the biggest star in the solar system. It is very far from our earth, but it scatters its rays everywhere so its presence can be felt wherever you are. Likewise, water on the earth is connected to all other parts through rivers, dams and clouds in the sky and it has virtually no boundaries. As we cannot control the rays of the sun, we cannot control consequences of our local mismanagement of water on the locations far away. Let us be careful and thoughtful about water in our homes and farms. *Prahlad Singh Devda, Seema Nai*

If you cut trees or remove vegetation, we will create imbalance in the nature and reduce oxygen plants release during the day. I think trees helps to reduce the impacts of climate change and reduce changes in rainfall amount and pattern. Rainfall means there will be more greenery. *Nilesh Chaubisha, Mahesh Kumar Rao*

We can harvest rainwater at homes and store for domestic use. This way we can reduce groundwater and make more water available for for crop production. This way we can save water for our next generation. *Pooja Choudhary, Khushboo Shaktawat*

If water is in short supply, water for drinking should be the priority for its use. Any water use other than drinking should be carefully thought out. We need to campaign for water use with care. *Naveen Chaubisa, Kanhiya Lal Telit*



Dharta School

The Dharta village school covers standards 1st to 10th with 200 students and a science laboratory facility. For drinking water, there is one water tank and one bore-well.

The quality of water at the Dharta school is very poor. High fluoride content was found in the water in recent water quality testing in the village. Some villagers believe that problems with bone joints and other health issues in the village are related to the quality of water they drink. The students seemed less aware of water quality issues than water quantity issues.

To increase their knowledge about the groundwater and weather (rainfall and temperature), a weather station was installed through the MARVI project. Similar to the Hinta School some students are taking daily readings and sharing those readings with villagers and other students.

Water is essential for us. It is used in bathing, cleaning utensils and irrigating crops. It is also used in factories. *Pravin Singh, Anjali Kunwar, Renu Kumari*

Because little water is left underground, even if we work hard to handpump, not much water flows out of the pump. This is because the groundwater levels in this village have gone too deep. *Nana Lal, Shambhu Lal, Ravina Salvi*

Drinking water for livestock is as important as the water for irrigating crops.This woman farmer is giving bath to her buffaloes when she brought them for a drink at this communal water drinking facility. Giving an occasional bath to buffaloes keep them clean and healthy and so you get more milk from buffaloes. *Indira Kumari,Ramlal Jat, Kishanlal Meena*

When there is shortage of water, women have to travel far distances from their homes to wash their clothes and have bathe. *Pravin Singh, Anjali Kunwar, Renu Kumari*

People get quite worried when the water level in wells go deep and the water scarcity strikes them. Especially, woman folk get quite concerned because they can not easily meet the water needs of the family and they have to spend a lot more time in fetching water. *Nana Lal, Shambhu Lal, Ravina Salvi*

With enough rainfall, we can see greenery around the village, and this way we get more oxygen and the effect of air pollution will be less. And also, all the animals and birds around here will be happier. *Pushpa Kumari, Dipak Kumar, Ramnarayan Jat*

When rainfall is insufficient or late, crop failure is inevitable. The wells have insufficient water to meet farm demands. This desperate farmer is bringing water from another well and putting it in his well for later use - not a good practice as it just wastes so much energy in pumping the same water twice. *Indira Kumari, Ram Lal Jat and Kishan Lal Meena*

Rajasthan being a dry state, we have limited rainfall and so whatever water we have we need to look after it. We want to see the condition of water to be good so that it can be used without any future problems such as salinity. Also, good quality water will help us to grow crops better. *Pravin Singh, Anjali Kunwar.*

If we have enough water, we can grow crops successfully, provide feed to animals and overall makes the whole area come alive. Earlier when we had water problems, we were not able to irrigate our crops on time and so the crop failed and the life became a bit hard. *Pushpa Kumari, Dipak Kumar, Ramnarayan Jat*

I have experienced many droughts and water shortages in my life. My message for future:you can have other life luxuries, but if you don't have enough water, daily life will be very hard. So recharge groundwater, limit over-pumping and use water wisely so we can avoid the previous problems. *Bhupendra singh, Suryaveer Singh, Rookman Salvi*

If the land everywhere becomes like this, imagine what will be life like. It will affect plants, animals, birds and many other things that depend on water. The best solution that we plan and act cooperatively to avoid this situation in the future. *Bhupendra Singh, Suryaveer Singh, Rookman Salvi*

Save every drop of water. If we do not act now, we will pay a high price of this wastage of water. *Bhupendra Singh, Suryaveer Singh, Rookman Salvi*

Understanding groundwater management

In arid and semi-arid regions, groundwater is the most important water source for livelihoods, drinking and irrigation. During the monsoon, some water runs off, some evaporates and some recharges the groundwater and raises the watertable. Pumping out groundwater lowers the groundwater level. So there are seasonal rises and falls in groundwater levels. If more is pumped out than is recharged, groundwater levels will go deeper and deeper and eventually will be depleted. In Rajasthan and Gujarat and in many parts of India, there is only enough groundwater to irrigate a small proportion of land area.

Checkdams can help to increase recharge if they are maintained, e.g., the silt accumulated in the storage area is regularly removed, and thus they can increase the amount of groundwater available for agriculture. Groundwater in an aquifer is like a battery in a mobile phone. If we want to keep the phone usable, we need to recharge the battery on time and use the phone wisely. The same applies to groundwater.

What can we do? How to work together for change?

Groundwater is a shared resource that does not respect farm boundaries and so it moves freely depending upon the geology, topography and other features of the area. Therefore, it needs to be used and shared in a way that is fair and sustainable. However, achieving the sustainable use of groundwater is not an easy task, particularly when it depends on the co-operation of all well owners in the area. It is an important challenge for water security in India but it is quite complex. We need to acknowledge that groundwater is not generated underground and, its availability is limited by how much comes from the sky and then how much of rainfall moves below the land surface as recharge naturally or by constructing checkdams and other watershed development activities.

When we drill deeper the quality of water is often poor due to high levels of fluoride, arsenic and other impurities in the deeper groundwater. The best quality water for both drinking and irrigation is more likely to be found in the shallow aquifer. We also need to remember that deepening of wells does not produce any additional water as a whole as it is just ‘stealing’ water from one-another and at the end everyone is a loser. Community investment would be better in improving water use efficiency, increasing recharge, forming sharing arrangements for existing wells and in education of children - our future leaders and groundwater managers.

Groundwater Facts

• In arid and semi-arid regions, groundwater is the most important water source for livelihoods, drinking and irrigation.

• During the monsoon, some water runs off, some evaporates and some recharges the groundwater, raising groundwater levels. Pumping out groundwater lowers the groundwater level. So there are seasonal rises and falls in groundwater levels.

• If more water is pumped out than is recharged annually, groundwater levels will go deeper and deeper and eventually will be not much groundwater left in the area.

• Checkdams and other recharge structures increase recharge if they are maintained and silt is removed, and increase the amount of groundwater available. This helps to sustain the area being irrigated.

• An aquifer for groundwater storage is like a battery in a mobile phone - the phone will be dead If we use it too much and do not recharge it regularly. This is what is happening with our wells and tubewells.

• Groundwater is a shared resource and so we need to share the responsibility to recharge and use it properly.

• There are no streams or rivers underground. The groundwater we get is what is recharged. So, our emphasis should be doing more recharge of aquifer and using what we have wisely.

• Pumping from tubewells and putting it in open wells is not a good idea – it simply increases the consumption of electricity.

Views of the villagers

• Most villagers are saying that we want to stay in our village and continue our present farming activities if we have sufficient water.

• Groundwater availability is the most important factor to keep producing food and we need to produce more income with less water. This will ensure our children will water in the future and they will stay in our villages.

• Villagers trust traditional groundwater knowledge and often rely on groundwater information from neighbours and others in village.

• In recent years, villagers have experienced groundwater shortages and deteriorating water quality and as a result their family income has been reduced.

• Most villagers would be willing to share the costs of a recharge scheme and be part of new cooperative groundwater management that shared water and costs fairly.

• Most villagers need education and skills about cooperative groundwater solutions.

Managing crops to manage groundwater

• Groundwater availability is declining. So water needs to be used efficiently. Grow drought tolerant crops and varieties.

• Groundwater use can be reduced by growing crops that use less number of irrigations. For example, some farmers in the Dharta watershed replaced wheat crop with a medicinal crop called Isabgol. This way they reduced 5-6 irrigations to grow a crop that required only 3 irrigations without a decrease in their income

• Farmers mostly apply 5 to 6 irrigation to wheat based on crop appearance and rarely use soil moisture and crop water demand criteria for irrigation. They need to apply irrigations based on soil moisture at critical stages.

• Farmers rarely get soil testing done to decide on type and amount of fertiliser to apply to meet the nutrient demands of crops. Fertiliser is an important and expensive input in agriculture and any wrong decision on the type can affect crop yield and water productivity and eventually the livelihood of farmers.

Groundwater education for future

• Groundwater problems can only be solved through better awareness and education about aquifer recharge and water conservation at all levels - farmers, schools, households and Gram Panchayats.

• Reaching students through school engagement is one of the ways we can enhance awareness about groundwater issues. The availability of appropriate resource materials for students and teachers related groundwater, environment, agriculture, sanitation and hygiene is important.

• The research carried out in the MARVI project indicates that groundwater problem is having an adverse impact on the educational opportunities for students, especially girls. This is because students have to help out at home, such as in fetching water, and arrive late to or miss school.

• Policy makers play a critical role at the state and national levels, and the success of water policies they make and implement depends on how aware and educated they are about the real issues and challenges of groundwater and realities on the ground.

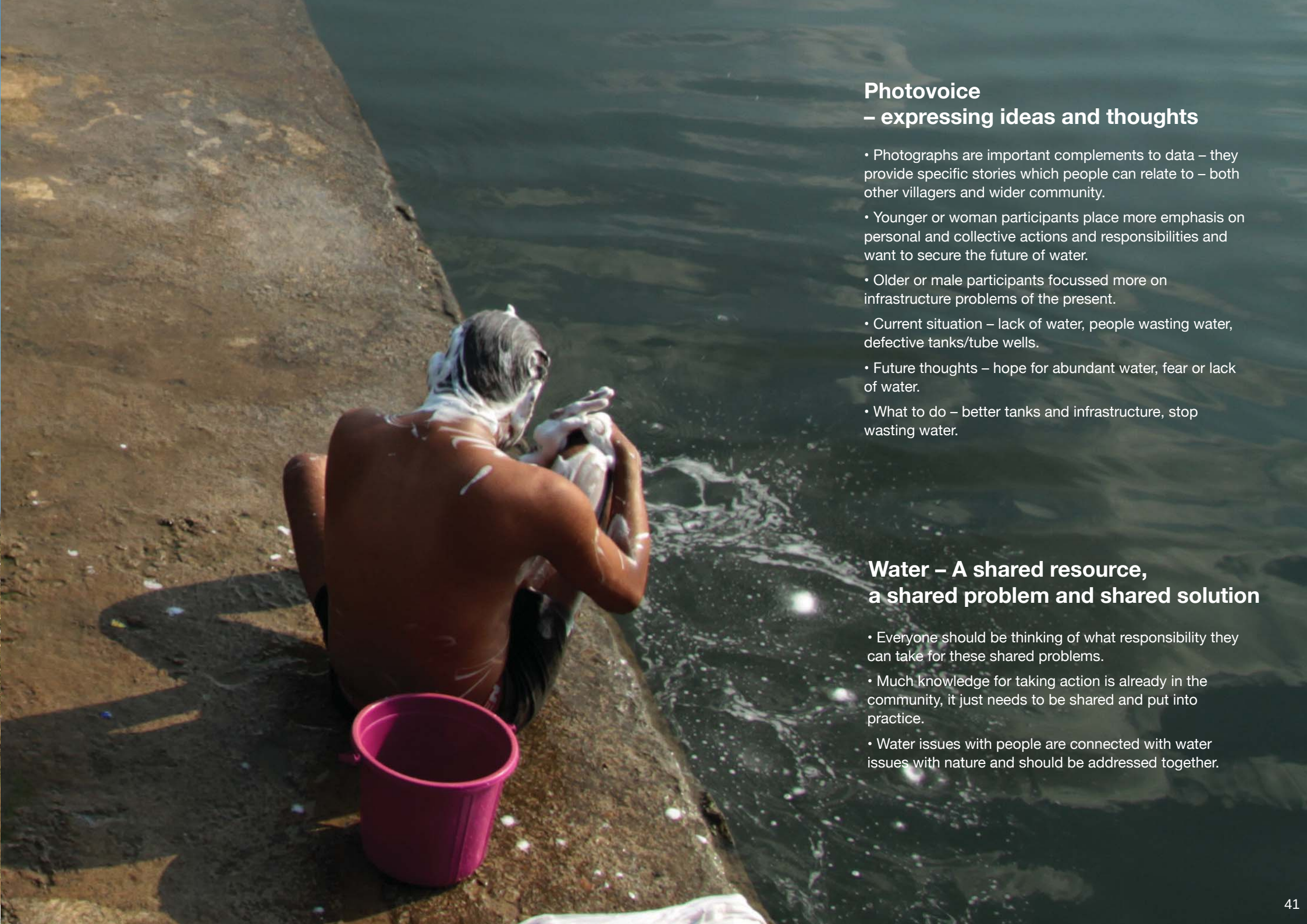
Gender and groundwater

• The main source of drinking water in India is the ground water. Women are responsible for collecting water for drinking, cooking, bathing and feeding the animals. Women have to travel several times a day, time that they could spend doing more household chores or working in the farm.

• Women need to be encouraged to actively participate in the management of groundwater to address gender related issues of groundwater management.

• The research in the MARVI project indicates that the majority of women feel that fetching water for family's needs affects their children's education, especially often their daughters who are late for school do not get time for homework. This does not affect their sons as much. Our daughters' success in education depends on how together you all manage groundwater.

• A major concern of women in the MARVI project area is the quality of drinking water due to higher level of fluoride and other salts in water. The water quality often deteriorates when water is obtained from deep tubewells.



Photovoice – expressing ideas and thoughts

- Photographs are important complements to data – they provide specific stories which people can relate to – both other villagers and wider community.
- Younger or woman participants place more emphasis on personal and collective actions and responsibilities and want to secure the future of water.
- Older or male participants focussed more on infrastructure problems of the present.
- Current situation – lack of water, people wasting water, defective tanks/tube wells.
- Future thoughts – hope for abundant water, fear or lack of water.
- What to do – better tanks and infrastructure, stop wasting water.

Water – A shared resource, a shared problem and shared solution

- Everyone should be thinking of what responsibility they can take for these shared problems.
- Much knowledge for taking action is already in the community, it just needs to be shared and put into practice.
- Water issues with people are connected with water issues with nature and should be addressed together.

Water in My Well Over Time - Individual Stories

Bhanwar Singh

I am Bhanwar Singh from the village of Sunderpura in the Dharta watershed in Rajasthan. I was in military service but am now retired and involved in farming.

Until the early 1970s, water in our village was plentiful. We used to lift water for irrigation using a chadas, a water lifting device that uses a pair of bullocks, a chadas container and a sloping pathway for the movement of bullocks. With this method the bullocks move back and forth in a straight line to lift water. The depth to the water level in wells was about 8 m (25 ft) in the 1960s.

Electric powerlines were installed in our village in 1972 but not everybody was able to afford access to electricity in the beginning. Over the years more people started using electric pumps and the watertable started to go down which in turn required deepening of wells to continue the supply of water. With this deepening of the wells we sometimes got more water and sometimes we did not.

With more farmers pumping water with electric pumps during the 1990s, water in our open wells was only lasting for one or two hours with a 5 HP motor. We realised that further deepening of the wells will not help so we started drilling tubewells. Some tubewells increased the water supply but many of them failed. Some tubewells supplied water for a time then dried up.

Our belief is that if you construct checkdams, the open wells and tubewells located downstream will benefit. So in 2001 the local NGO, Sahayog, with the aid program of the Netherlands government, constructed an checkdam in the village. Many farmers benefited with an increased water supply. Whenever the checkdam is filled with water, they are be able to pump water from their wells for a good number of hours. When the checkdam becomes dry, supply in the wells would also decline or they may be dry. We observed that after the monsoons, during the October – December period, there was generally a good supply of water due to this checkdam. I now feel that there has been a decline in the effectiveness of the checkdam when compared with when it was constructed. The decline is probably due to silt deposits in the storage behind the checkdam wall.

In shallow open wells there is generally no change in water quality but in deeper wells the water is not as sweet. It is now common to drill tubewells to depths of 100-120 m (300 to 350) in the area. Installing a tubewell is not cheap – Rs 40,000 to drill and up to Rs 150,000R for pump, pipes and other accessories.

In future, there will be a shortage of water for our village unless we make efforts for more recharge. We would like to harvest rainwater but we need funds to do this.

Hajari Lal

I am Hajari Lal from the Dharta watershed in Rajasthan and I am in my late 60s. I have been farming all of my life. Previously we had plenty of water in Dharta but in the last 15 years our wells have really dried up and there is a shortage of water. Tubewells are being built to a depth of 150 m and there is no guarantee of their success. In fact, we should stop constructing tubewells as those farmers who are drilling take unfair advantage of others by taking their share of water. If I had the money I doubt I would drill a tubewell since it is unlikely to yield enough water to justify the cost.

I have a well which is about 500 m from my home which I dug by hand and it is about 20 m deep. At the end of the last monsoon season water in my well was about 2.5 m measured from the bottom. I have developed a 'rule of thumb' that it is wise not to plant a Rabi crop if the water in the well is less than 6m at the end of the monsoon. So, I did not plant a Rabi crop this year. I do not use the water in my well for drinking water as it smells. This may be caused by tree leaves falling into the well. So we collect our drinking water from a hand pump which is about 200 m from the house. I travel several km to get water for my animals as I do not want them to be thirsty.

My vision of the water future in my village is very bleak, due to declining and erratic rainfall. Banning tubewell construction would be a good start to help prevent the situation becoming dire.

Hem Raj Bhatt

My name is Hem Raj Bhatt and I am from the village of Hinta. I was in the well deepening and drilling business during the 1980s and 1990s. Several years ago I realised that there is no future in the drilling business so I am now in the business of processing agricultural and medicinal products and fortunately the business is running well.

I was the first person to bring a drill rig, compressor and tubewell drilling machine to use in my village. In the 1960s it was easy to find water at a depth of 6-7 m in most areas around my village. Before the arrival of electricity (early 1970s) in the village there was hardly any need to deepen wells to meet irrigation and drinking water needs. Also, the irrigated area required to meet household needs was not huge; about 0.5 ha/well.

After electricity came to the village, the volume of water farmers could pump in one hour with an electric pump used to take one full day with a pair of bullocks. This resulted in the emptying of the shallow aquifer and farmers were forced to deepen their wells up to 30 m in search of more water from the deeper aquifer. When this further deepening did not help, horizontal drilling (45 mm bore) was also tried by some farmers in the early 1980s.

The horizontal drilling occasionally helped to put more water in wells but the extra water flow into the well did not last long. In reality, the horizontal drilling approach did not help much.

In the mid-1980s, the era of tubewells in the area began. We started drilling to 50 m, then 80 m, then 100 m and now some farmers drill tubewells to a depth of 200 m or more. A friend in Coimbatore has a tubewell down to 600 m. When the tubewells were 50 to 80 m depth there was some increase in water supply but the supply rarely increased from the tubewells that were drilled deeper than 80 m. This means there is not much extra water to be gained when one drills deeper than 80 m depth.

From my experience as a driller, I learned that soft rock has more fractures and cracks and so relatively more water is available from it than black rock. Water quality is good up to 30 m as the water is fresh and is probably replenished to this depth every year. As you go deeper, groundwater is likely to be more salty and if you drink this water you are likely to have heart, joint and liver problems.

I also observed that with an average monsoon (about 600 mm of rainfall) in wells that are 30 m deep, the watertable will rise about half way mark, i.e., 15 m depth, at the end of the monsoon.

We need to limit or ban tubewells altogether and we need to reduce pumping. With the deepening of wells and the installation of tubewells, farmers are simply stealing each other's water. Drilling tubewells sometime is a copycat phenomenon as they see someone drilling so they think they should also drill. We need to store water where it falls and recharge the aquifer and grow crops which require less water.

If we can limit water that is pumped out, we can reduce the depth of the watertable and so reduce power required for pumping. People are behaving stupidly when they keep putting all their energy and money into drilling deeper as it is all wrong. Kalu, a man in my village, installed six tubewells, one after another, to get more water and he went bankrupt and committed suicide when he realised that he could not secure water for his grape vines from any of the six wells he drilled.

Also, people should use a crop variety that yields more per ha so less land and less water is required for irrigation. I saw some greenhouses in Gujarat last week and that is what we should do in this area. It costs Rs 15 lacs to build a greenhouse and then you can grow some cash crops and earn several lacs per year with less water.

In the future, people will fight each other or maybe even kill for water. We need to educate people as to where water comes from and how to use it properly. NGOs have an important role to play in this regard.

Ram ji Bhai

My name is Ramji Bhai from the Meghraj watershed in Gujarat. I am Chairperson for the local Watershed Management Committee. I have lived in this area for a long time and have seen changes in groundwater availability as pumps and tubewells were installed. Women in our area used to travel 3-4 kilometres to fetch drinking water but the situation has slightly improved due to the developmental actions of DSC, the local NGO.

From our experiential learning and the knowledge passed on from our parents, we have developed our own local knowledge and insights. For example, some vegetation and trees are a good indicator in determining the presence of groundwater. In particular, a dead palm in some situations may indicate shallow groundwater. The direction in which some types of trees bend shows the direction of groundwater flow. We often use water diviners for deciding the location for a new well site.

We used to pump water up to 16 hours every day and the watertable in our wells quickly went down. The Government of Gujarat then intervened and restricted electricity supply to farmers to 8 hours per day. This indirectly controlled the pumping of groundwater and reduced the rate of lowering the watertable. Essentially this means that having the right kind of policy in place can make a real difference.

We can harvest rainwater through installing recharge structures and use water more efficiently by using drips for irrigation of crops. I have observed that a pit dug along the road has been helpful in recharge and wells situated near recharge structures usually have water longer. But not all check dams installed in our area are effective; either their location is not good or due to silting they not do hold much water. Some of them develop leakage from the wall and water is lost downstream of the checkdam. One village in our area is very dry as the check dam there is leaking – so this village is dry like Rajasthan while the nearby village is green like Kashmir.

One way to improve groundwater recharge is to fix the check dams that are already there. Also there are some good sites where one can put new checkdam but they have not been approved. If check dams at these sites could be installed, there will be more water available to farmers in our villages. As farmers, we are willing to put in the labour if material assistance is provided to improve water security.

One serious issue I see in the future is the issue of sharing the groundwater among farmers equitably. In order to improve security of groundwater supplies, we need to understand what is happening to recharge and how much and how effectively we are using the groundwater. For this, we need some local, targeted research. Water is the limiting factor for our farm production and livelihood and so it is important for the future wellbeing of the entire village community.

Limba Bhai

I am Limba Bhai and I am 75 years old. I went to school until grade two and can sign my name but that is all I can write. This land was owned by my grandparents and parents. The well near the wadi was constructed over 50 years ago and the water then was at a depth of about 6 m. We drew water from our dug well by bucket and the crops were cultivated by hand. For a long time, water in our dug well varied from between 10 and 15 m deep until about 15 years ago when electricity was supplied. I then started to pump water from the well and was able to plant more crops. Water is the main thing that made me prosperous and allowed me to build a house on the farm and move there from the village. Now I use a tractor and sell 3-4 times more crop than before the arrival of electricity on the farm.

After most farmers installed electric pumps, the water level in my well fell quite quickly, as it did in all other wells in the area. If your well ran dry you could go to your neighbours and they would give you water for drinking without charge but not for irrigation supplies. When wells dried everybody got busy digging wells deeper. I deepened my well several times after I obtained electric powered pumps. When the well was deepened to 45 m, someone suggested that I do horizontal drilling in the wall of the well at the bottom. So I then had two 36 m long horizontal bores of 150 mm diameter in my well. This operation cost me Rs 50,000 Rupees and initially helped to maintain supplies but eventually this also failed. Digging deeper has given me some water but there was a smaller increase in water each time. I also tried drilling tubewells and had five tubewells drilled to a depth of 90m but they all failed to yield the required water supplies. My overall conclusion is that tubewells are generally not successful in my area.

After wells started running dry in my area, the government began constructing 10 checkdams in the village area under a watershed development program. These structures certainly helped replenish nearby wells. However, after some time, silting has reduced the storage capacity of some checkdams and therefore made them less effective. I think it would be cheaper to clean out check dams to help restore groundwater levels than to dig wells deeper. We need to have a common vision for the area, a charismatic leader, a “Water Ghandi” to motivate and care for neighbours and provide a long-term water solution.

I have three sons and two daughters. My sons were educated to 10th Grade and are all college graduates while my daughters went to school to 5th Grade. They worked on the farm so that we could afford to keep the boys at school. They married locally. Interestingly, my grandsons and granddaughters have all been educated to a high level and some of my granddaughters are in college now.

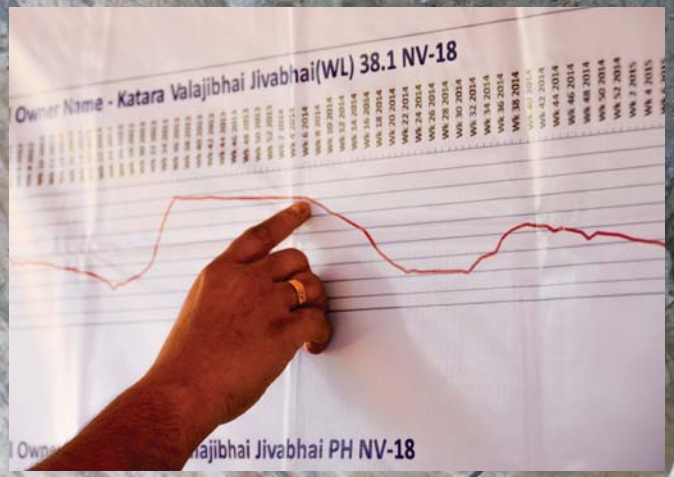
As for the water future here, only God knows what will happen. We will have to use less water than we currently do or we will have to harvest more water. Either way, we need to work together to prevent groundwater levels from dropping any further.

The groundwater challenge

The race to pumping groundwater has been continuing for several decades and groundwater is the most extracted raw material on the planet. The days of groundwater problems being solved by modelling on computer screens, producing technical guides and manuals or installing check dams alone are no longer a viable solution. In the 21st century, the challenges of water management and strategies to provide access to water and share with all users, including the environment, is far more complex. In many parts of India, groundwater reminds people on daily basis what they drink during the day, their livelihood and the wellbeing of communities and their environs.

We cannot afford to continue with the present water situation. The key problem is that our population and water demands are always increasing, but we get all our water through rain during three months of the year and this water has to last the whole year and on the top of this there is the climate uncertainty. So we need to store this water to ensure that the supply will last the whole year. Storage of water on the surface is no longer the best way, and so the storage underground in the form of groundwater is going to be the only main option in the future. Also, we must learn to live within our means.

Until now, the management of water in India has been about constructing dams and canals. So, the focus has been to create assets and not so much on the using water to improve the livelihood of famers. One reason for this is that construction costs money and this is where politicians, bureaucrats and contractors drive the water management. Often there is misuse of money and the problem of accountability affecting the water management in the country. Now we have a huge difference between irrigation potential created by building assets and actual irrigation in the country. We need a total rethink of the water management approach in the country, particularly we need to manage both surface and groundwater together and ownership of water management is handed over to the people who use the water.



Groundwater management – needs a total rethink

We need a complete rethink on groundwater management at the village level that acknowledges the complexity of physical nature of groundwater dynamics, particularly in hardrock areas, and uncertainty with monsoonal rainfall and needs of village communities. We also need an approach that takes into account the likely consequences of groundwater pumping and use practices, e.g., the use of saline water from deeper aquifers on soil health and crop growth and high fluoride levels on community health. The control of groundwater pumping through any legislation and law enforcement in India will only give rise to more theft of groundwater and corruption and bribes in the system.

Learning from the MARVI Project

Based on the research in the MARVI project, the BJ's data from all wells revealed groundwater levels rose and fell approximately in unison, showing that the wells all tapped the same aquifer, but with small local variations. In each year groundwater levels in the rabi returned to a similar level suggesting the supply available for irrigation had been spent and in some wells there was not enough left for drinking. This means that drilling more wells will not produce more water for these villages but would reduce the water available from existing wells. It also means that some drinking water wells (having low fluoride concentrations) need to be better protected so as to sustain safe supplies throughout the year as a top priority.

The BJ data on daily water levels at 4 check dams showed that these contribute substantial groundwater recharge, enough to support of the order of 20% of all crops. The fall in check dam water levels in dry weather showed that infiltration was typically 3 to 5 times higher than the evaporation rate, so they are quite efficient. Manual scraping of silt from check dams increased infiltration rates in the following wet season. Annual check dam maintenance together with good irrigation and mulching practices are ways that farmers can work together to enhance livelihoods. There is room for more check dams in some areas, but not in all, and these would increase local groundwater storage and reduce surface flow downstream. Downstream impacts, positive and negative, warrant evaluation at catchment scale.

BJs are now in a position to help communities to develop local groundwater management plans that would help them achieve the best outcomes for the community through the judicious enhancement, protection and use of groundwater. Local water management plans need to be incorporated in catchment-scale water planning to maximize benefits of the available water over the long term.

The role of Gram Panchayats and village communities

Water is backbone of village economy and the involvement of village communities to develop their own water use plan is critical for an effective local water management. In particular, its control has to be in the hands of Panchayats (elected village councils) and village water cooperative groups who prioritise and decide how to use water for different needs of the villages, viz., for human, livestock and irrigation.

For Panchayats and village water cooperative groups to take right decision about their water resource, they need the information on how much water is available in a given year and then they can decide how to use it, and how to save some in case the next year is a drought year. This way the farmers make their own decision to select what crops to grow and in how much area and avoid the situation of growing water intensive crops like sugarcane and irrigated rice in a water scarce area or during below average rainfall years.

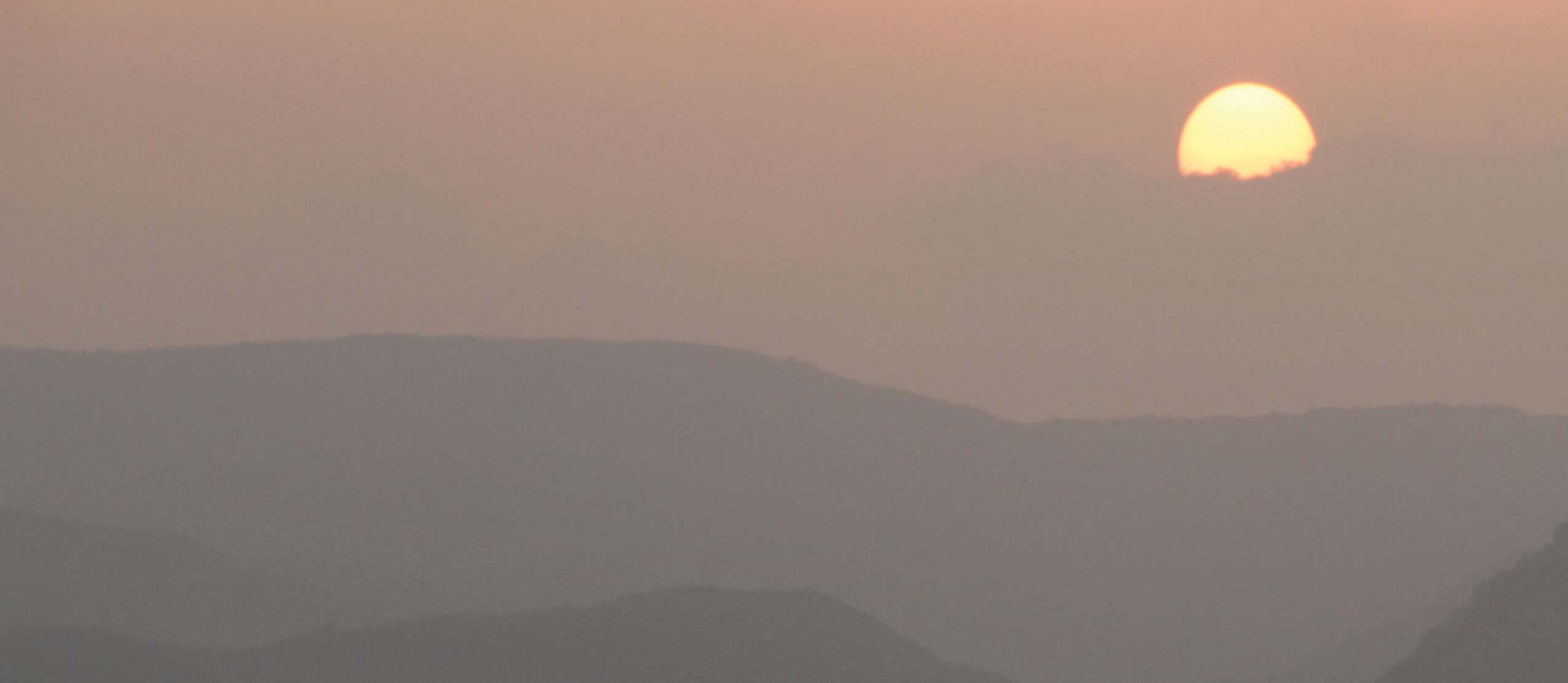
For equitable and effective sharing of village water resources, panchayats and village communities have to sit and decide. They are best to decide their own water future, and any law imposed on them, especially in relation to groundwater use, is unlikely to effective in sustaining village water supplies. The capacity building of Panchayats and farmers is vital for success but it is an enormous task in a country with over 650,000 villages.

Can groundwater diplomacy help?

Increasingly complex groundwater problems require negotiated solutions, not technical fixes. Groundwater diplomacy can help build much needed skills among farmers, NGOs and local government agencies to transform a limited groundwater volume available at a village level into a flexible and sustainably shared resource for all. Basically we need to solve the problem through groundwater diplomacy, which is about water sharing the resource on a sustainable basis through village level negotiations and conflict management. The idea is to harmonise the groundwater availability and needs of village communities. Groundwater diplomacy can help shift the debate from 'I want to pump out as much as I can and as deep as I can' to 'how we all in the village can benefit from groundwater resource and improve livelihood and wellbeing of all' and thus open up new opportunities for resolving groundwater conflicts and future of this valuable resource.

Groundwater issues create contentious arguments over its availability, access and allocation for domestic needs, agricultural use, industrial uses and ecosystem services. Science or policymaking alone is not going to be sufficient. Sustainable groundwater futures can only emerge from diplomacy that pools innovative science, people, policy, and politics together.

Bhujal Jankaars (BJs), a network of villagers working together to come up with village-level understanding of the situation, and improvement strategies that are owned and implemented by villagers themselves. BJs can be an important link for groundwater diplomacy in connecting different stakeholders at the village level.



The way forward

The sustainable use of groundwater has become critical in India, and it is a classic example of the tragedy of the commons. Groundwater resources are used jointly by many stakeholders and when there is no regulation or individual care, excessive use and thus depletion is a logical consequence. As with any other natural resource held in common, an aquifer tends to be viewed by individuals pursuing their own self-interests as a resource to be exploited before others are able to get to it. Where water is critical to income, unregulated use of groundwater eventually brings ruin to all, since every farmer or other groundwater user aims to increase their individual benefit from an aquifer system that has finite groundwater storage that is eventually depleted. Considering the inherent logic of the tragedy of the commons, self-regulation by communities is an essential requirement to avoid this.

It is now increasingly being realised at different levels of government, funding agencies and stakeholders that any effective solution to the groundwater challenge requires technical, social, economic, policy and political inputs as well as the genuine participation of local communities and groundwater users. Access to groundwater for farming communities is also an emotional and complex issue as their livelihood and survival depends on it. Groundwater is also important for drinking water for both urban and rural communities in India.

It is also important to note that dealing with groundwater sustainability is a very complex policy issue, which is sometimes called a 'wicked' problem that is characterised by complexity and uncertainty, as well as the need to go beyond the capacity of any one organisation within government to understand and respond effectively. Further, there is often disagreement about the strategies and solutions required to tackle the problem of overuse of the groundwater resource. It is now established that part of the solution to wicked problems involves changing the behaviour of user groups and giving

them ownership of both the problem and its improvement. In general, managing complex policy problems in this situation requires successfully working across organisational boundaries and engaging community and stakeholders in policy making and implementation.

The sustainable use of groundwater through 'Village Groundwater Co-operatives' (VGC) is a possible way forward based on Ostrom's eight basic principles for managing commons. In particular, we need to focus on assisting farmers to understand the dynamics of the groundwater through helping them to learn how to measure groundwater levels, and implementing monitoring at a temporal frequency and spatial intensity that clarifies for farmers that indeed their wells tap a common pool groundwater resource that increases during the monsoon and decreases during pumping. Armed with this shared knowledge, they are further given the means to predict the size of the common pool resource available for the coming rabi season, enabling a rational community-based determination to be made of the percentage of arable land to plant that will result in the optimum harvest. while eliminating any waste of water and labour. Communities can also make determinations of whether new wells or deepening wells will actually result in more water for the community as a whole.

Participants - Hinta Village

Rameshwar Lal Soni
Wholesaler, without growing land, age 49

I don't know my future… I want to do farming, and through this can produce good quality seeds. I want to improve my house. An educated person can do anything.

Kishan Ahir

farmer, age 35

Good situation

I want to marry, and through this make my family happy.

Bhanvar Lal Rao

farmer, age 43

Doing farming, I am growing new crop varieties, and earning money, fulfilling the requirements of my family. I am growing medicinal plants, ie Isabgol and Ashwgandha, Guar.

Bhawarnath Nath Yogi
farming, age 55

We want our future to be such that all the water resources, like anicut, ponds, wells, and bavadi, to be full of water because water is a life.

Manju Kumari Soni

housewife, age 47

Living with combined family of 14 persons.

I hope to help in getting clean and sufficient water to whole village.

Jagdish Bhatt

farmer, age 55

Farmer

I want to make sure my son is educated. I want to produce hybrid seeds and to hope that each and everyone takes clean water and is healthy.

Shankar Lal Fouji

retired soldier, age 70

Good situation

My aim is that everyone should be able to get good quality water.

Kailash ji Choubisa

farming, age 42

less water is available for drinking and also for irrigation,

If rain is good, then every person, animal, birds all will be happy, this is an indication of happiness in life.

Participants - Dharta Village

Hariram ji Gadri

Farming, age 50

Current economic conditions are poor because of less water
We need your help to connect river from rivers and to make water available for growing crops.

Onkarlal Ji

Farming, age 34

We don't have water for farming. Problem of blue bull increase our difficulties by destroying crops. Due to very less crop production our economic condition is also poor.

My future dream is to get good produce so that I can construct my own house. I want to educate my children to make them capable getting job.

Kalu ji

Farming, age 5

The water is not in plenty so the number of animals in the area are less than they were before. Also, our economic conditions have deteriorated due to scarcity of water. The current generation is facing the problem of water scarcity, but I don't want this condition of the next generation. I want to bring happiness for the next generation through better groundwater management.

Pushpa Kumari Gadri

House worker, age 16

I wanted to study further, but because of poverty I could not do that, now I am earning my livelhood just barely by labour work.

I want to study further and because something so that I can bring up my family on the right path.

Premkumri Gadri

Housewife, age 20

My economic condition is not very good and due to this my education is not good either. All the members of my family do labour work and so our income is quite limited. I want to continue my studies further so that one day I can become something worthwhile in my life and manage my family well and support them. Also, I want a school specifically for girls nearby my village so that girls will show interest in their studies.

Santosh Gadri

House worker, age 20

I could not study much because of the poor economic condition of my family, but in the future I want to study further. I want to be a tutor to the village children, so that they can achieve success.

Kishan Lal Gadri

University student, age 23

I am going through harsh conditions and belong to a poor family. For this reason, I am facing hurdles in making my dreams come true. But things that are achieved easily are ordinary and not exciting. But I will not accept my defeat, till I have made my dream come true as I belong to the brave people of Mewar. I want to become a teacher and raise the standard of education. I also want to do some social service so that my society can be recognised all across the country.

Prithviraj ji

Tailoring, age 26

Now I am stiching clothes of school students for earning money.

I want to go for further studies, for bright future.

Participants - Sundapura Village

Maya Kumari

Student, age 18

I am involved in raising buffalos and fetch for drinking water. Due to this I sometime miss my school.

Swaroop Singh

Farming, age 27

We are facing the problem regarding water - because there is only limited water supply. In future, I hope we will be able to improve our water situation and will have sufficient water.

Jas Kunwar

Business, age 45

My dream is to improve water availability so that I can grow more crop and can improve my family's income. If water is available, I want to grow fruits and vegetables also.

Tama Kunwar

Farming, age 25

Facing economic problems in household Our village is facing economic problems. I want to help village children obtain university education.

Ratan Singh

Farming, age 55

Present scarcity of water is causing the farming situation to be not so good. My economic condition is only just acceptable. If we have good rains and groundwater recharge, then the crop productions will also be good.

Lila Kunwar

Farming, age 45

I want to have my children get university education and prepare them for good jobs.

Mithu Singh

Farming, BJ, age 32

I am currently facing a scarcity of water. My dream is to collect every drop of water in small ponds and anicuts so that the water groundwater level can be raised.

Prem Kunwar

Farming, age 20

Housewife

If there is sufficient supply of water, our farming situation will certainly improve and so will be our family's economic situation.

Participants - Hinta School

Seema Nai, Prahlad Singh Devda

Pooja Choudhary, Khushboo Shaktawat

Akshika Choubisha, Ravina Choubisha

Naveen Chowbisa, Kanhiya Lal Teli

Gajendra Choudhary, Yuvraj Singh Shaktawat

Nilesh Choubisha, Mahesh Kumar Rao

Bhawana Garg, Kiran Choudhary

Anjali Kunwar, Pravin Singh, Renu Kumari

Participants - Dharta School

Indira Kumari, Ramlal Jat, Kishanlal Meena

Pushpa Kumari, Dipak Kumar, Ramnarayan Jat

Rukman Salvi, Suryaveer Singh Ranawat Bhupendra Singh Ranawat

Ravina Salvi, Shambhu Lal, Nana Lal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