5 The rain catchers of Saurashtra, Gujarat

Ambrish Mehta

India's western state of Gujarat recently has faced a great deal of turbulence in its water sector. Name a water-related problem, and one or another part of the state is afflicted with it. These problems range from chronic water scarcity and droughts to floods and water logging, mining of deep underground aquifers to water logging and secondary salinity in canal-irrigated areas, intrusion of sea water in coastal areas, unviable public water service systems for urban and rural water supply and canal irrigation projects, discharge of untreated sewage and industrial effluents in the rivers, and pollution of drinking water with fluoride, nitrates and other pollutants.

However, Tushaar Shah of the International Water Management Institute (IWMI) makes the astute observation that "There are few regions in the world where water has become everybody's business quite like it has in Gujarat, especially in water-scarce regions of Saurashtra and Kutch" (Shah 2002).

For over a decade, a broad-based mass movement for capturing rain water to recharge ground water has occurred in these two regions of the state.[1] Today, it is still going strong and showing no signs of fatigue. Individual farmers, village communities, local voluntary organizations, activists, non-governmental and community-based organizations, religious and spiritual organizations, Gram Panchayats (local government councils) and municipalities all are catching rain water. They store it in wells, ponds, tanks, check dams, drains, or wherever they can, and find ways to put it under the ground so that it can be retrieved and used later. Across the entire state, there is broad-based support for these "rain catchers" of Saurashtra.

What is striking is that this movement is entirely local and home-grown. Local philanthropies and voluntary organizations, religious groups, NGOs, individual activists and farmers initiated the movement, and they are the ones who are keeping it going. In many ways they have all become "barefoot" engineers and hydrologists who are always in search of some new method or location for capturing more water.

Notable by their absence in this movement are international donor agencies, government engineers, and water experts. Most of them have been skeptical or even hostile bystanders. The same was true for the state government until the recent past; however, from 2000 it has lent its support to the movement. Some critics have described the movement as a mad rush for capturing water runoff, which produces no net improvement in the overall water situation but creates new demands for water in the upstream areas at the cost of downstream users (Shah 2002). The movement's proponents, however, have no time or patience for such criticisms and still proceed with their "mad rush."

Not much is known about the rain catcher movement outside Gujarat. This chapter examines its genesis and primary ideas, its actors, and its achievements. The central question posed is whether its efforts have improved the water situation in Saurashtra – or whether, as claimed by critics, it is all just a "mad rush." Finally, the chapter will examine some of the wider implications that this experience may have for overcoming India's emerging water crisis.

Saurashtra – an overview

The peninsula of Saurashtra, jutting out from the mainland into the Arabian Sea, is the most conspicuous part of Gujarat. It comprises an area of about 60,000 square kilometers and its topography resembles an inverted saucer. This characteristic in particular contributes to the region's water scarcity (discussed below). The region's mean annual rainfall is quite low – about 500 mm, most of which falls over 25 days during the monsoon.[2] Inter-year variability is also very high, about 40 percent. Consequently, rainfall in many years is far less than an "average" year, and in some years it is far greater.

The total quantity of rain water which falls in the region in a normal year is about 30,000 million cubic meters. Much of this precipitation is, however, taken up by vegetation (including agricultural crops) and lost to the atmosphere through evapo-transpiration (referred to as "green water"). Some water does sink into the ground and contributes to the natural recharge of groundwater. The remaining flows through numerous streams and rivers (about 80 river basins) to the sea.

The annual utilizable natural recharge to the ground water in a normal year is estimated to be about 4,500 million cubic meters (GOG 1999) and the surface water potential in streams and rivers – at 60% dependability – is estimated to be about 3,600 million cubic meters (GOG 1996).[3] The drainage pattern is radial, with streams and rivers flowing in all directions away from the centre. Given its topographical characteristics, most of the region's surface water flows quickly through the rivers to the sea; there is not a single perennial river in the region.

Most of the region is underlain by hard rock basalt of the Deccan trap formation, thus it has no deep confined aquifers which could be tapped by digging deep bore-wells. Only shallow, unconfined aquifers (up to the depth of 100 ft.) are found, which are tapped with open dug wells – and these are only replenished with local rainfall. In fact, water levels in the wells rise significantly after rain falls, and then fall rapidly as water from the wells is used for agriculture and domestic requirements. By the onset of summer, most of the wells have little or no water. This seasonal variation in water levels in the wells is characteristic of all areas with shallow, unconfined aquifers.

Scarcity and droughts

Water scarcity and droughts are not new phenomena for the people of Saurashtra. They have always lived with them and thus have treated water as a highly scarce and precious resource. An elderly mother-in-law would always tell her newly-wed daughter-in-law that "It is alright if a jar full of *Ghee* is upturned, but a glass of water should not fall."

Since rainfall is both low and erratic in the region, rain-fed agriculture has always been a very risky proposition, with no security even for *Khareef* (monsoon period) crops. This is the primary agricultural season, when crops are grown using accumulated moisture in the soils from rains. In arid and drought-prone areas with low and erratic rainfall, the security of these crops is often jeopardized if there is no irrigation, and if rain does not fall at the right time. This is why it is said that agricultural production in India depends on the vagaries of rain.

In recent decades, water scarcity and drought meant that less employment was available in agricultural production. A great deal of young people had few options other than to seek work elsewhere, such as Surat and other places in south and central Gujarat where they were employed in the diamond-cutting industry.

Government projects

As in other parts of the state, the Gujarat state government responded to the situation of water scarcity by constructing numerous major, medium and minor dams on almost all the rivers of the region. Nearly 120 major and medium projects have been constructed, with total water storage capacity of about 2,300 million cubic meters in their reservoirs. The main purpose was to provide water through canals to specified command areas for irrigation.

However, since the cities and towns of Gujarat have experienced an increasing need for water, most of the reservoir water in water-scarce areas like Saurashtra and North Gujarat was increasingly allocated to "high priority" urban uses, leaving the farmers high and dry. Farmers might receive water for their winter crops (during the months between December and March) only once or twice in five years.

Somewhat paradoxically, large amounts of water reserved for

summer use in urban areas (and thus denied to the farmers) would often simply evaporate from the reservoirs. Moreover, large parts of the region and the state were not covered by the "command areas" of the irrigation schemes and were left to their own devices for water. All in all, canal irrigation from government constructed reservoirs has not made a significant contribution to the spread of irrigated agriculture in Saurashtra.

Well construction by farmers

Other developments took place parallel to the government's construction of dams on rivers. Left to fend for themselves, the farmers went on a well-digging spree which started in the late 1960s and lasted until the mid-1980s. During this period, the farmers constructed thousands of new open dug wells, and they also deepened old wells.

In the initial years, the wells had ample water – since they tapped into groundwater which had accumulated over the years. However, this water was soon exhausted, especially since water was being used to irrigate both *Khareef* and winter crops. Digging deeper wells was not an option, since the hard rock below does not have any confined aquifers. Still, many people dug deeper bore-wells to capture water trapped in cracks and fissures. But this was a chancy affair; many such wells simply failed. Once the stock of accumulated groundwater was fully utilized, rain water was the only remaining source to replenish groundwater on yearly basis.

In a normal situation, the natural recharge rate of groundwater increases if a majority of groundwater stock has been utilized in the previous year. But given the region's topographical characteristics, with the additional factor that its soils are not highly permeable, this does not happen to any significant degree. Thus, water levels in wells would increase after the rains, but not to the extent required unless there was an unusually high rainfall that year.

This water at most provided the *Khareef* crops with one or two protective waterings when there is no rainfall in the final months of monsoon; the situation would be even worse in low rainfall years, when water is needed most. Finally, a severe drought in 1987 caused acute hardships in rural and urban areas of Saurashtra, Kutch and northern Gujarat. *Khareef* crops failed, thousands of cattle died and there was severe drinking water scarcity, both in villages and urban areas. Water had to be carried to Rajkot (the main city of Saurashtra) in special trains.

The movement begins

After suffering through the drought, there was no way that people would just sit by idly, hoping that the government would take action to change the situation. Everybody started applying their minds towards solving a central question: how could they capture more rain water and put it under the ground for later use? No central organization was created to unify their efforts. Nearly everyone, whether individually or in small groups, addressed the same question and tried out their own solutions. The successful solutions then spread through informal exchanges and site visits. Water then truly became "everybody's business."

Well recharge

Immediately after the 1987 drought, the farmers, individuals and communities, and voluntary organizations started to explore ways that rain water could be captured. The first experiment, tried by some local philanthropic groups and individuals, was to recharge wells. This involved diverting farm run-off and passing it through a filtration bed into the wells through pipes.

Initially, the farmers were very skeptical of the process – but it quickly gained momentum after they saw the real benefits. Philanthropic and religious groups and individual donors provided initial support – in the form of cement and pipes – to willing farmers, and then the farmers started to do it on their own. Within a short time almost all the farm wells in Saurashtra had well-recharge systems in place, and this is still true today. This was done entirely by the private initiative of farmers and local philanthropies. No financial

support from government was ever received for this program – nor was it ever sought.

Other experiments

This direct recharge of the wells did help to improve the availability of water, but it was not enough. A great deal of farm run-off was still running into streams and rivers, while groundwater was not being recharged to the extent required.

So again, nearly everyone was engaged in the search for new and better ways to put more water under the ground. All sorts of methods were tested (and are still being tried). These included farm-ponds, percolation tanks, a series of cascading tanks, constructing dedicated recharge wells and check dams. Some methods were successful, and some were not. Some were suitable for specific locations, but not for others. The merits and drawbacks of each method were intensely debated in minute detail – with proponents of any specific method always arguing that theirs was the best!

Check-dams

Eventually, the idea of constructing check-dams caught people's imaginations and was implemented on a large scale. This method relied on the simple idea of building a series of check dams at regular intervals in streams and rivers, approximately 3 to 4 feet in height, in order to obstruct the flow of water in quickly-running streams and rivers. The stored water would then percolate into the groundwater, and eventually a dynamic equilibrium would be established between the two. Specifically, when the groundwater level is below the level of water stored in the streams (behind the check-dams), the stream water will percolate down into the groundwater. Likewise, when the groundwater level meets the stream level, it will flow from the ground into the streams.

However, this idea had to overcome a major hurdle before its implementation was possible on a large scale. Farmers simply had no confidence that they could design and construct such dams: "It requires engineers to decide the location, calculate the flows and then prepare the design," they said. "How can we possibly do these things on our own? What if the dams are washed out away in the first rains?" they asked.

There were a few individuals and groups who had great confidence in the farmers' abilities and were willing to share the risks. They launched a "Cement Support" program which provided the required amount of cement at no cost to those farmers who were willing to construct check-dams.[4] Meanwhile, farmers bore the costs of labor and other materials, and also made decisions about the site location, design and other issues.

Many farmers took up this offer and began to construct check-dams. In fact, their initial experiences greatly boosted their confidence. Some of the dams in the initial phase indeed were washed away – but this was taken in a stride as a part of the learning experience. The farmers quickly mastered the art of low-cost construction of various types of check-dams.

Many other individual donors and NGOs also chipped in and started to support the building of check-dams. Central government funds (allocated under the "Watershed Development Program") were also utilized by the villagers and NGOs for this purpose, giving the activity a tremendous boost. A number of innovative organizations – such as "Vruksh Prem" – insisted that the farmers make a substantial financial contribution (up to 50 percent; normally only a 10 percent contribution from farmers is required). By doing so, they achieved far more than would have been possible under a normal implementation of the program. Most importantly, involving the farmers in this way discouraged the "dependence syndrome" and encouraged a spirit of self-reliance.

In January 2000, the Gujarat state government (under the leadership of Keshubhai Patel) decided to throw its weight behind the initiative. It launched a massive program called the "Sardar Patel Water Conservation" scheme, a version of "Cement Support" initially launched by Vruksh Prem and others. Any group or individual farmers desiring to build check-dams were given support of 60 percent of the estimated cost, while the group or farmer contributes

the remaining 40 percent. In total about 24,000 check dams in Saurashtra have been constructed under this program. Given that a great number of check-dams were already constructed before, the total number of check-dams is larger but no one knows what the actual figure would be.

Evaluating the rain catcher movement

The central issue of this chapter is whether the building spree has been worth the effort in terms of improving the overall water situation. The answer, by the movement's protagonists – including farmers, NGOs and local activists – is of course an emphatic "yes." Not only have these efforts augmented the total water storage, but they have also helped to improve utilization of the stored water, they say. A large amount of runoff that previously was lost to the sea or evaporated from the government reservoirs is now captured and stored. Thus, it is contributing towards meeting the growing water requirements of both agriculture and households.

However, various hydrologists and other experts have contested these claims, and have expressed grave concerns about this movement. Their criticisms suggest that "cannibalistic competition" for water run-off will result in down-stream externalities for other users, evaporation losses and a limited potential to recharge groundwater in the underlying basalt.

Down-stream externalities

The primary criticism by many experts is that there has been a chaotic and cannibalistic rush to capture run-off through local water-harvesting structures (WHS), instead of creating additional storage. This criticism suggests that the WHS have only replaced the storage created by the government dams and reservoirs, resulting in new demand for water in the upstream while the costs are inflicted on previous downstream users.

For instance, Dinesh Kumar – a renowned hydrologist with the IWMI – has suggested that "The growing profusion of the small water-harvesting structures captures a bulk of run-off, leaving nothing for the down-stream people who depend upon the government structures for irrigation and domestic water requirements. This not only makes government investments useless but also renders towns and cities of Saurashtra perennially parched" (Shah 2002).[5] The World Bank has also reiterated the point against decentralized water-harvesting programs in general in its latest report on India's water crisis (World Bank 2005).

As mentioned before, the total storage capacity created in large and medium government reservoirs is around 2,200 million cubic meters. The runoff in the streams and rivers of Saurashtra at 60 percent dependability is estimated to be 3,600 million cubic meters, but mean runoff (50 percent dependability) is greater. Hence it is clear that additional storage capacity has been created by the check-dams.

Furthermore, in areas with scarce and erratic rainfall it is always a good idea to create extra storage capacities. If it really were the case that towns and cities are left perennially parched, there would have been huge riots for water in Saurashtra by now. City and town dwellers (and likewise villagers) are not meek folks whose rights can be easily trampled upon. The urban residents continue to enjoy full rights to water from the government reservoirs, and moreover receive water from the Narmada pipeline.

Government reservoirs are indeed filled, in spite of the plethora of upstream WHS. In fact, people in towns and cities also support the check-dam movement. Its beauty is that instead of wasting time and energy in fighting for the limited water that was available, the farmers of Saurashtra silently continued to make more and more water available to themselves in a creative manner. Theirs was a most imaginative response to the crisis, precipitated by an arbitrary government decision to favor towns and cities in its distribution of reservoir water. If there was any "cannibalism" in Saurashtra, that was its real embodiment – and the farmers have responded to it creatively and successfully.

Another "externality" claimed to result from the check-dams is

that they have a negative impact on downstream farmers who are located in reach of water from government reservoirs. It is true that they hardly get any water from the government dams. Yet this was true even before the construction of check-dams in the upstream areas, since the government has allocated more and more water to urban users. These farmers, like their upstream counterparts, depend largely on groundwater for irrigating their crops. They too have joined the scramble for rainwater harvesting to augment water availability.

Evaporation losses

Another criticism made by many experts is that given the arid conditions of Saurashtra, large quantities of water stored in shallow ponds behind the check-dams actually evaporate and the people upstream also do not benefit. This argument has little merit and if anything, the reverse is true. Maximum evaporation occurs from the government reservoirs, which do have water in the summer months. According to M. S. Patel, Secretary of Gujarat's water resources department, every year government reservoirs lose 600 million cubic meters (out of a total of 2,200 million cubic meters) of their water to evaporation. This loss is greater than the total annual domestic water requirement of Saurashtra, which is estimated to be 500 million cubic meters (Shah 2002).

In the case of water stored behind check-dams, most of the water percolates down to replenish the groundwater extracted for winter crops – long before the onset of summer. It is the dynamic connection between ground and surface water that the experts seem not to see. In arid areas, surface and ground water must be viewed as a single resource, not separate resources. While the farmers intuitively grasped this idea, the government and the "experts" have generally ignored it.

Limited capacity for ground water recharge

Other researchers have expressed grave doubts about whether these decentralized recharge efforts can produce any beneficial results.

They note the basaltic nature of Saurashtra's hydrogeology, which limits groundwater recharge to 8 to 12 percent of precipitation. They say that a typical hectare of an aquifer in Saurashtra cannot absorb and store more than 400 to 500 cubic meters of water – a small fraction of the amount of water utilized by a single crop in a season. In other words, if Saurashtra were to receive five inches of precipitation, using current recharge methods, aquifers in the region would fill up to the brim. Any remaining water would reappear on the ground as "rejected recharge" (Shah 2002).

If this really were the case, why should we be preoccupied about the upstream farmers capturing all the runoff and rendering government reservoirs useless? Moreover, the state government estimates that natural utilizable groundwater recharge in Saurashtra is 4,500 million cubic meters. (This is equivalent to more than 750 cubic meters per hectare, given that this is utilizable – not gross – recharge.) Here also, the dynamic inter-relationship between the surface and ground water seems to be totally ignored. The fact is that these complex interactions have not been properly studied.

Overall, it seems that the main motivation for concerns about check-dams is their perceived impacts on "planned government projects." At the same time, the experts have totally neglected to study what is actually happening in Saurashtra – to either confirm or deny these perceived impacts, and then to draw lessons from their research. Many have not managed to unshackle themselves from the "planning" mode and are deeply uncomfortable with the farmers' seemingly chaotic and unplanned interventions.

Meanwhile, the farmers of Saurashtra have not waited for such studies and research, and do not even need them. The evidence and the benefits they have observed is sufficient to convince them.

First, they have improved water levels in their wells, and have experienced a consequent increase in agricultural production. Security of the first *Khareef* crop has been assured, not only for years of normal rainfall, but also for years of scanty rainfall. Even one or two good rain showers are sufficient to capture enough

water to protect the *Khareef* crop. In normal years, winter crops are also assured.

Second, the growing agricultural sector in the area – which previously experienced outward migration – now provides employment to migrants from Panchmahal and other tribal areas. Agricultural wages have risen; the daily wage is as high as Rs.100 (approximately USD $2) during the peak season, a relatively high wage for agricultural workers.

Third, the previous crisis over drinking and domestic water has simply disappeared.[6] Moreover, in good monsoon years there is even surplus water at the end of year, which can be utilized the following year. It is possible that these benefits have not been experienced in all of the region's localities – but the overall effects of the rain catcher movement can certainly be observed while passing through the area.[7]

Wider implications

It is clear that Saurashtra is not just a quirky exception; there is no reason why similar local interventions to address water scarcity in other areas of India should not work with equal success. Experiences from similar areas in Rajasthan and Madhya Pradesh indicate that such local interventions are indeed helping to resolve water issues.

However, this intervention of local, decentralized rain water harvesting would be unlikely to work in all areas. For instance, it will not work in arid areas – such as Mehsana and Banaskantha in the northern Gujarat plains – where tube-wells are used to mine groundwater from deep confined aquifers. In fact, the farmers of northern Gujarat are so convinced that local water-harvesting schemes will not work that they have not even attempted to implement them.[8] Water scarcity in these areas is indeed difficult to tackle and would require some difficult choices – but that is beyond the scope of this chapter.

Fortunately, the conditions are contained to specific locations and largely do not prevail in the rest of the country. In all other water-scarce, arid areas, decentralized interventions to harvest rain water and recharge groundwater – appropriately adapted to local situations – can make a significant difference.

Apart from this, the Saurashtra experience also raises some critical questions for policymakers, especially regarding some of the fashionable characterizations of "market-oriented" policy solutions which are often advocated by organizations such as the World Bank. A few of these are discussed below in the light of the Saurashtra experience.

Solution 1: Most of water is used by agriculture; minor reductions in this use can release a substantial amount of water which can and should be used to meet the growing urban needs.

This is a major misconception, at least, in Saurashtra, in northern Gujarat and in most of India's water scarce areas, especially where water is not imported from other regions which have a surplus. Here, most of the surface water stored in government-constructed reservoirs is already allocated to the cities and towns, while farmers get less, and in an unreliable manner.[9] During years of scarcity, water supply for irrigation is drastically cut, without any compensation to the farmers. This has caused severe hardships. Further reductions would need to come from reducing use of groundwater, causing further hardships and making agriculture itself an unviable proposition.

This solution also does not take into account seasonal factors. It is true that agriculture requires substantial quantities of water – but the bulk of this use in India and south Asian countries is during the monsoon and in winter, when towns and cities usually have surplus water. Agriculture in water-scarce regions uses very little (if any) water during summer months when cities face scarcity (Frederiksen 1996). In Saurashtra, we have seen that in order to reserve a large proportion of water for urban areas for summer use, governments have denied it to agricultural users in the winter. Yet a large amount of water evaporates from the reservoirs, without providing benefits to anyone.

So how can we meet the growing needs of the cities? This is a difficult question and there are no easy solutions, especially in areas where water is already scarce. More water will need to be made available. Decentralized rainwater harvesting is definitely an important option, as we have seen in Saurashtra. The option of long distance inter-basins transfers also has to be explored. In Saurashtra too, despite the water harvesting structures, water availability for cities would become critical in scarce years if the region only relied upon its own water. The availability of Narmada reservoir water through pipelines has provided long-term security for the growing requirements of the cities in Saurashtra. The main issue is that with growing population and increasing needs, we need to increase the amount of water available for cities as well as agriculture.

Solution 2: A system of water use rights for surface and ground water should be established. This would encourage markets for water rights and would facilitate voluntary transfers of water from agriculture to cities thus ensuring long-term sustainable use of water.

A full discussion of this currently "in vogue" solution is beyond the scope of this chapter. Instead, a few critical issues are raised here in light of Saurashtra experience.

Many proponents of this solution may not have any idea of the immense complexities and difficulties involved in its implementation. This solution proposes to create a system where annual use rights for each and every individual user of surface or ground water are determined, allocated, recorded, monitored and enforced. These rights are to be determined with criteria based on present uses (for instance, average use in last five years). If the aggregate present use is more than that can be sustained on a long-term basis, then necessary deductions will be made.

This idea would present several complexities that relate to inter-year variability of rainfall. Adjustments would also have to be made in the amount of water that can be used, based on rainfall in particular year. Also, there would be issues relating to rights to return flows. The total water diverted by each user is not fully used in a consumptive manner; some is used and the rest flows back into the streams or percolates down to the groundwater, and is used by others downstream. These rights to return flows would also have to be determined and recorded. Finally, such a system would require methods to monitor actual use (as to whether use rights have been respected or violated). It would also require some form of punishment for any offenders.

Although couched in terms of "property rights" and "markets", this solution actually advocates government regulation and quota-fixing for all individual users of water. No state government in India is in a position to implement such an ambitious scheme even if it wanted to do so, but that is not the main point. The main issue is whether or not the creation of such a system would help in solving the looming crisis of water scarcity.

Here, the experience from Saurashtra suggests that far from solving the water crisis and associated conflicts, this solution would actually indefinitely delay the search for real solutions. It would result in a fruitless waste of time, energy and money – and a lot of bickering. Moreover, it would not result in a net gain in available water.

The situation in Saurashtra would be very different today if the farmers – instead of engaging in decentralized experimentation and adopting methods which made more and more water available – had clamored for their own rightful share and fair distribution of the total quantity of water which was previously available. Their experience shows that what is needed is to increase the total size of the pie, making more water available for everyone, rather than creating conflict about the distribution of the present pie!

Those who advocate such solutions often forget that property rights for many resources evolve spontaneously in actual practice, if governments do not interfere. Such institutional arrangements – the set of rules by which individuals and communities allocate their resources – might then be formally recognized by the law, but not vice-versa. The fact that a form of individual, permanent and transferable property rights for water use have not spontaneously

evolved in large parts of the world indicates that there is something in the nature of water which prevents evolution of such rights. [10] The British common law jurist William Blackstone remarked that "Water is a moving wandering thing, and must of necessity continue common by the law of nature; so that I can only have a temporary, transient, usufructuary property therein."

Following from the British common law doctrine, India legally has the doctrine of riparian rights, where water which flows through a river basin is the common property of all residents of the basin, and each such resident has a right to reasonable and beneficial use of water flowing through their area without prejudicially affecting similar rights of other residents.

Similarly in the case of groundwater, it is the common property of all the overlying landowners of the groundwater basin. Each land owner has a right to extract and use water that lies below his land, without prejudicing the rights of other landowners. This is the legal position, and it is how people have traditionally used water, not only from streams, rivers and wells, but also from tanks and canals.

In actual practice, however, state governments have acquired monopoly rights over surface waters during the past fifty years. This has been achieved not by any change in law, but simply by virtue of the fact that most of the dams, reservoirs and canals used to divert river waters were constructed and are managed by the governments. Governments rarely involve local communities in planning, execution and management of such projects and their general performance has been very poor. Not only have they often seriously undermined the riparian rights of the basin users, but they often arbitrarily changed allocations of the stored water.

The "rain catchers" of Saurashtra broke the government monopoly on surface waters by reestablishing their riparian rights. They have done so in the same way in which government acquired its monopoly rights – by creating their own water storage structures. In the process, they have increased the overall storage capacity and thus have improved water availability for all users. All these farmers are very much aware that they are re-defining rights and not just building check-dams. One of their primary slogans (which is also backed by broad popular support) is that "Water belongs to those on whose lands it falls and they have the right of first use of this water."

Rather than a "top-down" system which is created and imposed from above and has no social sanction, this decentralized, evolutionary process by which riparian rights are re-established needs to be encouraged and supported.

In the case of groundwater, the riparian rights of overlying landowners have in actual practice remained in force, simply because private efforts by farmers (not governments) have driven groundwater development. Each overlying landowner has an absolute right to extract and use the water which lies below his land. This right is recognized and respected by all. Of course there were problems of "free-riding" in the initial stages of development. This was especially the case when only relatively wealthier farmers could afford to dig wells or tube wells which enabled them to extract not only their own water but also that under neighboring lands.

However, this problem was solved by the neighboring farmers in a simple and straightforward manner. Whether as individuals or collaboratively in the form of partnership companies or cooperatives (which helped to resolve finance issues), they dug their own wells. This automatically reduced the "extra" water that could be extracted by the previous well owners. Water markets have also developed, enabling those without wells to use water underneath their land by purchasing it from those who do own wells.[11]

Perhaps the most striking feature of the Indian situation is the lack of undue worry on the part of farmers about the problem of "free-riding." They have never felt the need to monitor and restrict the amount of water extracted by each well owner, either by forming their own organizations or by seeking government intervention. By the time that groundwater development reaches maturity, as has happened in most water scarce areas, the amount of water extracted by each owner is not much different from what others are extracting.

Governments have, of course, tried to exercise control over this "chaotic" development by passing various restrictive laws. But mostly these remain laws on paper and have never been seriously implemented. It should be noted as well that digging wells and extracting groundwater has never been considered an "illegal" activity as such. Privately-driven development of groundwater now is responsible for 70 percent of the net irrigated area of the country, and also provides water for domestic uses to cities and other nearby villages in times of acute scarcity.

Groundwater has performed far better than that of the government-driven canal irrigation sector. Moreover, unlike canal irrigation, the use of groundwater has become highly efficient. The use of water-saving devices, such as drips and sprinklers, has encouraged a shift towards high value but less water-intensive orchard crops; this shift is picking up momentum with farmers. So with groundwater too, there is hardly any need to establish micro-managed quotas and enforcement systems. Far from reducing groundwater use, this would only create diversions and bickering.

Strangely enough, proponents of a so-called "market solution" for water seem to be uncomfortable with decentralized water harvesting by farmers, in which the farmers have reasserted their riparian rights. Instead, those proponents (who sometimes refer to their solution as the establishment of "individual, permanent and transferable property rights" for water) seem to be deeply suspicious of unregulated, uncontrolled markets and decentralized institutional arrangements. Thus, they actually seem to advocate a tremendous increase in the role and powers of government over water allocation and use. True proponents of markets should be extremely wary of these "neo-marketeers."

Notes

1. This movement for decentralized rain water harvesting and ground water recharge is occurring in both Saurashtra and Kutch, two water scarce regions of Gujarat. The situation, interventions and impacts are, however, different in these two regions. This chapter only discusses the Saurashtra experience.
2. Monsoon is a characteristic phenomenon of India and other south Asian countries. It is a period starting from the beginning of June to end of September during which most of the rain from south-western winds falls. This is also the main growing season for most plants and crops.
3. The estimates of groundwater recharge and surface water potential given here are of utilizable quantities. The figures for gross groundwater recharge and surface water flows would be higher than that indicated by these figures. It may also be mentioned that no systematic studies on groundwater recharge have been done. The state government's estimates are more often than not the result of "back-of-the-envelope" calculations based on total area, rainfall, soil types, etc. The recharge which occurs in areas with saline groundwater is then deducted.
4. Two individuals played a pioneering role in the movement by conceiving and launching the "Cement Support" program with their own money. One was Premjibhai Patel, founder of "Vruksh Prem", a local voluntary group in Upleta, and the other was O. R. Patel, an industrialist of Morbi who manufactured famous wall clocks (Ajanta Clocks). At the time, few others had confidence that farmers could successfully build check-dams. Premjibhai supported construction of about 500 such check-dams from the money he raised from individual donors (mainly from his own entrepreneurial/industrialist son). Both he and O. R. Patel have given away cement worth Rs. 50 lakhs each [in present 2006 terms this is worth over USD $113,000] for water conservation works in general. In addition, Premjibhai has also helped to construct nearly 1500 check-dams in about 40 villages under the government's watershed development program. My understanding of the genesis and evolution of the 'rain catcher' movement is largely based on my long discussions with Premjibhai and others who have played active role in this movement.
5. Also based on personal discussion with Dinesh Kumar.
6. I am referring to the hinterland areas of Saurashtra, and not coastal areas which still suffer from the problem of sea-water intrusion in the groundwater. The hinterland villages are not only meeting their own requirements, but are also providing water through tankers to meet the domestic requirements of these coastal villages. The area has a large number of water traders who buy water from farmers in the hinterland areas, and then sell it to coastal villages through tankers. This has become the main source of domestic water supply in many coastal villages which have saline groundwater.
7. I am mainly relying on my observations during various field visits in 40 villages where Vruksh Prem has been working. These are in the upstream area. However, similar evidence from across the Saurashtra suggests similar changes. Tushaar Shah has presented and discussed some of this evidence in his paper (Shah 2002).
8. Although the state government, as usual, is promoting check-dams in all water scarce regions of the state, irrespective of the local conditions.
9. In humid water-rich areas, for example in south and central Gujarat, irrigation receives a major portion of the stored reservoir water. However, towns and cities in these areas also get their share of water, which is adequate to meet their requirements and thus they do not face any water scarcity.
10. Perhaps in actual practice, the water scarce western region of the United States is the only region in the world where such rights evolved under the doctrine of "prior appropriation" and were then accepted in law during late 18th and early 19th centuries. Discussion of how this happened and whether they have led to voluntary transfer of water rights from agriculture to cities as expected or not is interesting but beyond the scope of this chapter. See Morriss (2002) for more discussion of this issue.
11. Large numbers of well-owners have ensured competition and thus have not allowed "monopoly pricing" to take hold. Shah (2005) discusses this and many related issues in terms of India's water management.

References

Frederiksen, Harald D (1996). "Water Crisis in Developing World: Misconceptions About Solutions." *Journal of Water Resources Planning and Management*, Vol. 122, No. 2 (March/April), pp.79–87.

Government of Gujarat (GOG)(1996). "Water Resource Planning for the State of Gujarat – Phase III." Vol. II, Main Report.

— (1999). "Report of the Committee on Estimation of Ground Water Resource and Irrigation Potential in Gujarat State: GWRE – 1997." Narmada and Water Resources Department, Gandhinagar.

Morriss, Andrew P. (2002). "Lessons from the Development of Western Water Law for Emerging Water Markets." *Oregon Law Review* vol.80, pp.861–46.

Shah, Tushaar (2002). "Decentralized Water Harvesting and Groundwater Recharge: Can These Save Saurashtra and Kutch from Desiccation?" Paper presented at the annual partners' meeting of the IWMI-Tata Water Policy Research Programme, Anand, February 19–20.

Shah, Tushaar (2005). "The New Institutional Economics of India's Water Policy." Paper presented at workshop, "Africa's Water Laws: Plural Legislative Frameworks for Rural Management in Africa", 26–28 January, Johannesburg, South Africa. Online: http://www.nri.org/waterlaw/AWLworkshop/SHAH-T.pdf (visited 14 February 2006).

World Bank (2005). *India's Water Economy: Facing a Turbulent Future*. (Also referred to by World Bank as *India's Water Economy: Bracing for a Turbulent Future*). Washington, DC.