

Indigenous knowledge of water management

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A TYPICAL CHARACTERISTIC of the precipitation pattern in semi-arid and arid areas is that a large amount of the total annual rainfall is often received in one or a few high-intensity storms. Therefore, people who often rely completely on rainwater for their survival have over the centuries developed local methods to secure and store rainwater until the next rainy season. Even though these traditional water harvesting systems can look precarious and casual in the eyes of modern technologists, they have been perfectly sustainable for centuries. The reason for this is that they are compatible with local lifestyles, local institutional patterns and local social systems. They represent a fund of solid experience gained through generations of observations, trials and errors, concerning soils, plants, animals, groundwater movements, runoff flow patterns and climate.

India is a country where all types of economically poor regions are represented. However regions of high poverty are also very often regions of high biodiversity and this, often forgotten, relationship has allowed the development of numerous sustainable indigenous survival strategies (Gupta, 1993). In the desert and salt affected areas, mainly located in the north-western parts of the country, local communities have over the centuries developed many traditional techniques of rainwater harvesting. Unfortunately, many of these techniques have disappeared along with their innovators, since modern civilization has forced them to abandon their land and ways of living. According to Gupta (1993) there is now a recognized need, not only in developed countries but also in developing countries, for reorienting research and educa-

tion processes to incorporate greater sensitivity towards the importance of natural resources and the associated existing knowledge systems.

Kachchh district and the grasslands of Banni

Kachchh district is India's largest district. It lies between Pakistan in the north and the Arabian sea in the west. More than half of the district is covered by extensive salty deserts known as the Great Rann of Kachchh in the north and the Little Rann of Kachchh in the west. The Ranns are partly flooded during the monsoon period by sea water.

On the edge of the Great Rann of Kachchh lies the pasture land of Banni. At one time it was considered as the largest and finest grassland of its kind in Asia (Yadhav et al, 1992). The floodwaters brought by the north flowing rivers during monsoon times and emptied in Banni have allowed for the growth of a high variety of different kinds of palatable and salt tolerant grasses. For centuries its good reputation, reaching far beyond the boundaries of India, used to attract nomads and pastoralists from all parts of Gujarat, from parts of Rajasthan and from parts of Maharashtra such as Bombay. Even migrating herders from Pakistan and other parts of Asia used to come to Banni during the rainy and post-rainy season to let their animals graze freely in the area.

The climate is arid; average annual rainfall is approximately 250mm, which is distributed unevenly and varies widely from year to year. Severe droughts are common. The rainfall occurs only through the south-west monsoon, between June and September. The rain falls within short time, often during a period of 10 days or less. Up to half the average rainfall may occur within a few hours. Although the area is sparsely populated (20,000 per 3840km²), the Maldharis make a very important contribution to the regional economy by producing large quantities of milk, meat, wool, ghee etc. The women produce intricate embroidery work that is considered some of the best in the country. The people keep large herds of buffaloes, sheep and goats and have also horses and camels.

Groundwater exists at shallow depths but is highly saline. The soil is also saline. The Maldharis classify it as "khari" a term that means "salty soil". Due to the low rainfall and saline groundwater no arable farming is practised. There are almost no rivers nor small natural streams in Banni. However, about 100 rivers and rivulets flowing northwards from Kachchh mainland drain into Banni along its southern boundary. These rivers are non-

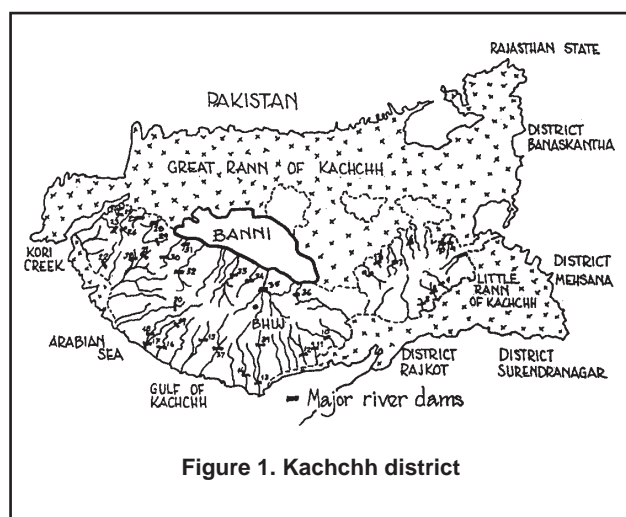


Figure 1. Kachchh district

perennial and consequently dry most of the year. During normal years, the water spreads over Banni and towards the Great Rann of Kachchh. The flooding process of the area creates the ideal conditions for the growth of varieties of grasses and annual shrubs. Over 40 indigenous species have been counted in the area.

Indigenous knowledge of water harvesting and artificial recharge

The most important strategy by which the Maldharis traditionally have managed to safeguard their livelihood has been through rainwater harvesting. Therefore, it has become a necessity for the inhabitants to collect a maximum of rainwater falling over the area, in a manner that would secure fresh water availability for the entire year. The Maldharis have even learned to harvest the sporadic floodwater through a technique that actually ensures that their drinking needs are fulfilled even during scarcity years when no rain at all falls. Their extensive knowledge of water harvesting as well as of the local ecosystem and the complex water harvesting system they subsequently have developed, is based on hundreds of years of experience and deeply embedded in their culture.

Because of its flat gradient, Banni normally gets partly flooded every year during the monsoon season by the rain falling directly over the area and from the large quantities of water brought by the north flowing rivers of Kachchh. Though the area is very flat, some depression areas of varying sizes exist which normally accumulate some of this flood water. These depressions are also called "tanks" or "jheels". There, the water can be stored in the depressions up to a few months after the occurrence of the monsoon showers, before it disappears through infiltration and evaporation. The period under which the water

can be stored in the depressions is highly dependent on the size of the depressions and the amount of rain falling during the rainy season.

By studying surface water movements, the nomads traditionally coming to Banni during the monsoon season, learned to locate these zones and used to come back periodically to these when they needed water for the cattle. They eventually discovered that after infiltration the fresh water with its lower density got "trapped" in the ground and stored at shallow depths in a layer "floating" above the denser salty groundwater. In these zones, they have for centuries dug many small shallow wells locally called "virda", reaching only into the layer of the sweet water. The purpose of this practice is precisely to collect as much as possible, the fresh water having infiltrated through the bottom of the depressions. After 20 to 40 days when there is no water left in the depression, the Maldharis remove the silt carried by the runoff and accumulated inside the virdas, thus obstructing them. They can then collect and use the sweet water that slowly enters into the well.

The water in the virda remains relatively sweet for 20 days to 1,5 month but then gets progressively salty. When the water is too salty and thus not suitable for drinking anymore, the people start to remove the silt from the next virda located just a few meters away and collect the sweet water entering inside it. This operation is repeated every time a virda starts taking in too much salty water, and until the depression gets replenished the next rainy season.

The bottom half of a virda is consolidated by straight tree poles forming a square frame. The Maldharis have put layers of grasses from the grasslands, between the wooden frames. The grasses are put there mainly to reduce the velocity of the water entering the well, reducing its erosive effect, whereas the wood consolidates the well and prevents it from collapsing. The grasses also filter out soil particles that would otherwise enter the well. The virda's upper part is circular and has been designed to facilitate the heaving of the water for the animals which is done with ropes and skin or rubber buckets. This shape also permits to enter easily into the virdas for maintenance and for accessing to the water. Generally it is the women and children who do so, to fill their buckets. They are responsible for bringing water for the families' home consumption, while the men are responsible to water the animals (Figure 2).

The Maldharis discovered that the salinization of a well occurs only after a certain period of time depending on the intensity of its pumping. They also discovered that through upcoming, the salinization of a well being pumped, occurs very locally without affecting the wells dug closely around. This phenomenon eventually necessitates to stop the collection of water from the well because of the degrading influence of the saline water. By having the possibility to dig many virdas closely spaced inside a depression zone, the Maldharis were able to

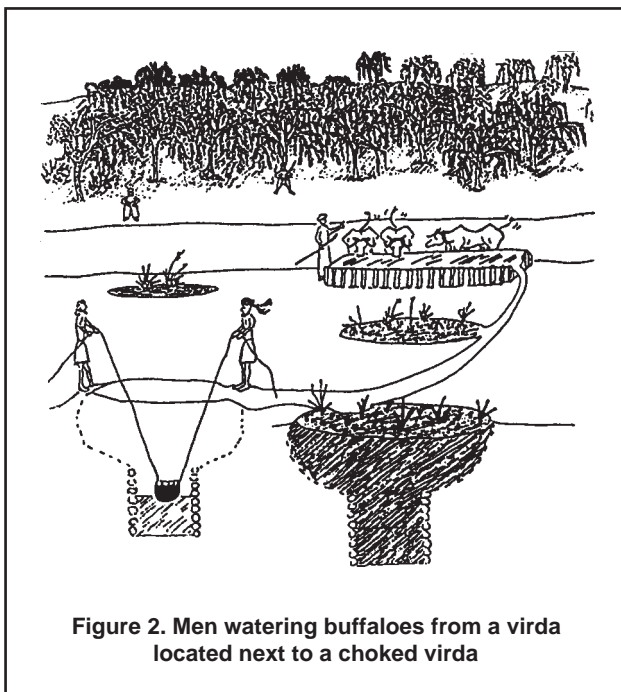


Figure 2. Men watering buffaloes from a virda located next to a choked virda

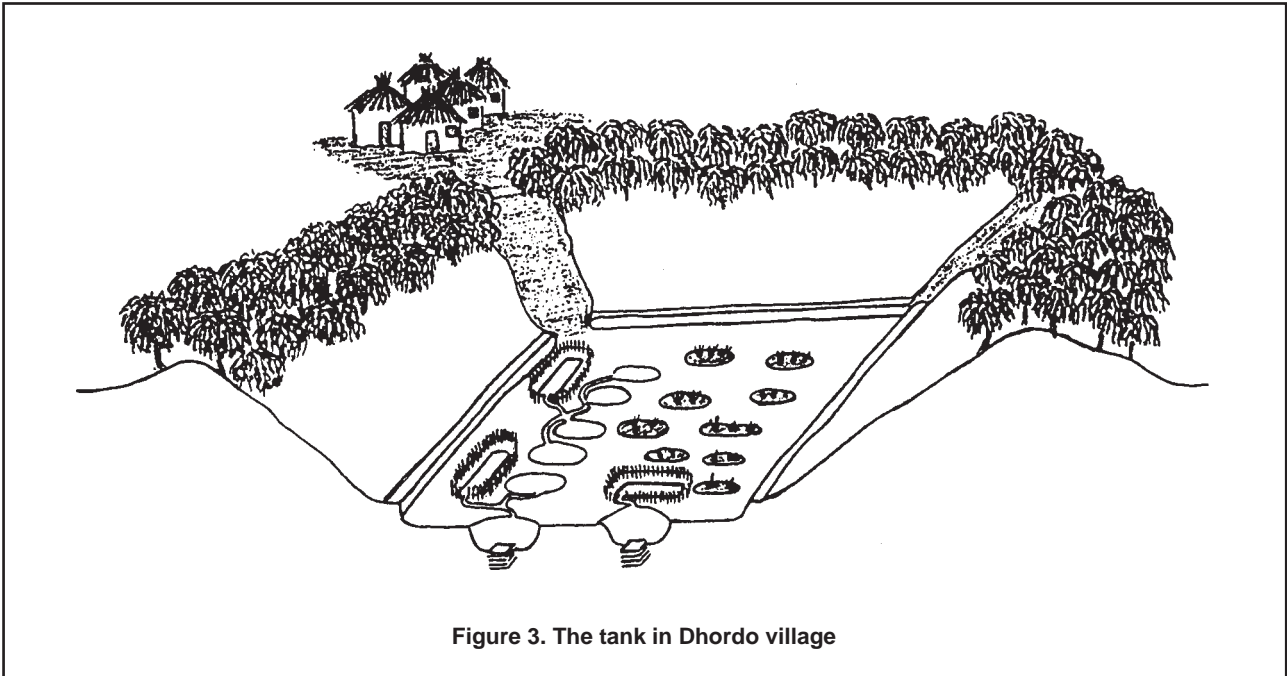


Figure 3. The tank in Dhordo village

collect a maximum of the sweet water stored in the ground. Over the centuries, they have gradually managed to determine the optimum locations, depths, spacing and pumping rates of their virdas to ensure a production of the largest quantities of fresh water, while at the same time they strive to minimize the underground mixing of the fresh water with saline water. Because the rise of salty water occurs only locally under the well being used, this explains why a virda that is just beginning to be used collects fresh water even though a virda located just a few meters away is abandoned due to high salt content

This traditional system of harvesting rainwater is still in use today and there is essentially no difference between the virdas of today and those used by the nomads coming to Banni during the centuries and passing their knowledge through generations. Today most of the people in Banni are settled in villages. Many villages were however built close to, or sometimes inside, low lying areas and have virdas either right in the village area or nearby it. In fact, depressions in many villages were widened, and even deepened in order to increase their capacity and at the same time the total amount of water that can be recharged and stored in the ground. Examples of such villages are Dhordo, Gurewali, Hodka, Chachchla, Luna, Birandiyara and Bagaria.

The example of Dhordo village

The village of Dhordo is a typical example of a village in Banni where virdas represent the major source of water supply. Approximately 200 people live in the village located just 5 km away from the Great Rann of Kachchh and at 80 km south of Pakistan. The livestock numbers 300, including 200 goats and sheep and 100 buffaloes. Five tanks have been created in the village and have virdas dug in their bottom. One tank is however considered as

the most important and is also deeper than all the others. During the rainy season it collects the largest amounts of runoff water. The bottom part of the tank has the dimensions 46 x 46 m and the upper part 60 m x 60 m. The bunds were planted, after a governmental initiative, with *Prosopis juliflora* trees. The tank is located such that it gets filled with overflowing water from the four other tanks during the rainy season. These are all located at higher level compared to the deepest one. They also have much larger areas but are much shallower. After the rainy season when all the tanks are filled the Maldharis use mainly the water stored in the deepest tank. Today this tank is considered to be the best in the region. It can provide fresh water through the virdas for the longest period as they can still provide fresh water after more than 4 months of use.

The 1993 monsoon illustrates how it fills and how the village water supply system is replenished. On the 18th of July, 120 mm of rain fell within 12 hours. After only 3 hours all the tanks were filled and had even overflowed. According to the Dhordo villagers only 70 mm are required to fill up all the tanks. In good years the tanks overflow up to 3 times. Water can then last up to 6 months before the first virdas must be used. When about 15 cm of water is left in the tank only livestock are allowed to continue to drink it. The villagers then begin removing some of the silt to construct a circular structure around the location of a few virdas. The walls of these structures are made higher than the water level, which allows people to remove water inside the structure creating a dry space. They can then start to use their first virdas by digging out the silt accumulated inside. Although some virdas are dug in the four shallow tanks, it is the major tank which has the largest amounts of virdas dug in its bottom. In early July 1993 before the first rain came, there were 31

virdas in the major tank. Only 10 of them had so far been used and the others were still filled with sediments. In January 1996 the amounts of virdas present in the tank was the same.

According to the villagers, the period under which a virda can be utilized before the water gets too salty to drink, depends on the intensity of its exploitation. It depends also on the capacity of the tank to store water and on the quantities of fresh water recharged above the salty groundwater. The period of utilization varies thus between 20 days and 4 months, before a virda is abandoned and a new one is opened. Some virdas in the major tank are after 3.5 months of use, still pumped and yielding potable water. The villagers explained, that if a year of good rainfall was followed by 2 to 3 consecutive years of drought, they would still find fresh water available under the bottom of the tank.

People can use any virda in the tank for their own drinking purposes but not if they want to water their livestock. Group of families usually collaborate in the digging process and maintenance of 2 or 3 virdas and share the water for their livestock. All the virdas in use are connected via channel systems to water troughs made out of silt and consolidated by wooden poles. The troughs are protected by fences made from thorny branches of *Prosopis juliflora*. Without fences, thirsty animals may come at night and destroy the troughs as access to the tanks is not hindered and since animals are left to graze freely in the village area.

Prospects for the future existence of the virda system in Banni

For centuries virdas have been inseparable parts of the Maldhari's social fabric and have tied families together. This may not be so in the future as deterioration of the sensitive natural environment is taking place at a fast rate. Today the alarming decline of the natural grass cover is such that it has led to regular fodder scarcity forcing the Maldharis to migrate out of Banni every year. This has led to a greater marginalization and increased dependence on governmental help. The main causes for the degradation are the introduction of the "wonder tree" *Prosopis juliflora* and the updamming of the north flowing rivers that for centuries used to empty their waters in Banni.

Prosopis juliflora was initially planted in the 50's to prevent the area from ingress of the Rann and to provide the population with an additional source of income. This salt-tolerant tree has now proliferated in the area, inhibiting grass growth. Its roots brings the salts up to the surface and while the fruits are being eaten by the buffaloes, the seeds are spread throughout the grasslands as they can not digest these.

By damming up the north flowing rivers to provide southern parts of the district with irrigation water (Figure 1), the amounts of water flooding the area with fresh water during monsoon have been drastically reduced. Not only have the grasses and the Maldharis lost an important source of fresh water, but also the deposition of salts brought by the winds from the Great Rann of Kachchh is no longer counterbalanced by a regular input of fresh water. For the traditional water supply system of the Maldharis this has meant that the tanks are not collecting enough water as they used to. This has led to a faster salinization of the virdas in the area and to a greater dependency on pipeline water that was brought out to Banni after the updamming of the rivers.

Today it becomes clear that by failing to understand the complex ecosystem of Banni and adequately appreciate the value of the Maldhari's interactions with their natural environment, large scale interventions have not only failed to yield expected results, they have also increased the vulnerability of the people living in harmony with their environment and undermined their local survival mechanisms. The traditional water harvesting system developed in the area is a manifestation of the vast reservoir of traditional ecological knowledge being held by the natives of Banni. If the degradation of the natural environment in Banni is allowed to pursue, then degradation of the Maldhari's knowledge of water management will not be far behind. The latter will not be possible to restore once lost.

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