The Thirst is Real: An Analysis of the Water Scarcity Problem in Kachchh, Gujarat

Shezeen Suleman[1]

Watershed Management Project
Indicorps

August 20, 2003

[1] Shezeen Suleman, age 22, is a recent graduate of the University of Toronto in Environmental Sciences and International Development Studies. Upon graduation Shezeen came to serve India through a one-year fellowship program, *Indicorps*. Based in rural Kachchh, she was given the opportunity to carry out a watershed management project that would directly benefit the inhabitants of the area. Having witnessed the problems surrounding drinking water supply this issue seemed like a relevant direction in which to take the project. With the help of engineers, local villagers and committed volunteers she was able to develop and implement a drinking water strategy for 4 villages in the area. The strategy focused on traditional methods of supply, tying these to more recently developed low-cost recharging methods.

Abstract

Kachchh is currently facing acute water scarcity. However water scarcity is not a recent occurrence here. Civilization has survived in this area, for many millennia, despite its characteristically low rainfall, high rates of evaporation, undulating topography and inherently saline land. There are natural limitations to Kachchh's water endowment that date back to the geological formation of the land. However, over time, the inhabitants of Kachchh learnt to live with these natural limitations and developed various indigenous methods of rainwater-based systems to capture this valuable and necessary resource. The recent past has yielded a decline in the traditional systems of water supply. The characteristics that rendered the traditional systems both suitable and sustainable have been forsaken for the convenience of a new centralized pipelined water supply. This "modernization" has exacerbated the water problem in Kachchh, raising issues of long-term sustainability. The centralization of water supply has led to changes in the pattern of use (greatly increasing it), and a dependency on the government. The pipeline system though convenient is a not without its own share of problems in ensuring a reliable and sufficient supply to the area. This paper argues that the disregard for time-tested and honed sources of water supply, and the inability of a community to provide from within will have long-term negative implications which need to be addressed immediately. The modern system, even with inputs from other basins, will not be able to satiate the growing demands for this scarce and essential resource. Finally, it discusses potential solutions to the identified issues with the present system of water supply in Kachcch.

Contents

Introduction

Sitting on the back of a bumpy *chakado*[2] or a busy ST bus here in Kachchh, you will almost certainly hear at least one conversation about water. The water that has not filled the *gam*[3] tank in the last five days. The water whose levels have sunk in the farm well. The water that seems to fall from the heavens everywhere except here. It is a subject that is rarely ignored, and having spent some time in Kachchh it has become quite evident why.

Water scarcity is a problem faced by more and more people all over India today as water tables are plummeting while demand is continuing to escalate. The same is true for Kachchh; however, this scarcity is not a recent occurrence here. For many millennia civilization has persisted in this area despite its characteristically low rainfall, high rates of evaporation, undulating topography and inherently saline land. These are all natural limitations to Kachchh's water endowment and date back to the geological formation of the land.

These natural limitations to water had forced people to develop their own rainwater-based systems over time, to capture this valuable and necessary resource. Implicit in the development of these traditional systems - *talavs, virdas*, wells and tanks – was an understanding of the land and its water distribution. Each of these systems were honed to perfection over thousands of years. The people of Kachchh developed these technologies based on their historical experience with the land while taking into consideration the water demands of the generations to come

The recent past has yielded a decline in the traditional system of water supply. Community-based systems have been replaced by centralized pipeline supply system. Water that once came from the land below their settlements is now provided to villagers from a source far away – thousands of kilometers away in many cases. The characteristics that rendered these traditional systems both appropriate and sustainable have been forsaken for the supposed convenience and reliability of the new pipeline system. This paper will serve to describe the traditional system of domestic water supply, delineating the recent switch to centralized pipelined water supply. It will show how this new system, even with inputs from other basins, will not be able to satiate our growing demands. Finally, this paper will offer potential solutions to the identified shortcomings in order to address the looming water crisis in Kachchh. A systemic perspective is taken to analyze the issue; taking this perspective helps to identify the weaknesses and offer solutions for the current approach.

1.0 Kachchh – An Introduction

[2] Chakados are the local motorized form of transport – a cross between a noisy motorbike and a pick-up truck.
[3] Gam is the Gujarati and Kachchhi word for village.

Kachchh is the largest district of Gujarat, spanning 45000 square km and accounting for 23 percent of the state's total area[4]. It is a vast expanse of semi-arid land that is both rich and complex. Each region of Kachchh has an elaborate history and it's own ecological and social characteristics. An array of landscapes span the district: dry lands and green fields, tall mountains and black hills, beautiful grasslands, white salt lands called the Rann and the Arabian Sea envelop it on three sides.

A Map of Kachchh outlining its location and its regions.
Source: Vinay Mahajen and Charul Bharwada, Virdas to Waterpipes: Past and Present of Drinking Water Scarcity in Rural Kachch. June 1997, Ahmedabad. P.2

1.1 The Lay of the Land

The topography of Kachchh is quite undulating and varies from region to region. It can be divided into four main physiographical regions – high hills, plains, grasslands and the Rann. The Great and Little Rann of Kachchh encompass just over half of the district to the North and the East. The hills and their surrounding pediments essentially form the central portion of the mainland[5].

The discontinuous hilly terrain has given rise to varying watercourses in radial patterns. There are about ninety-seven drainage courses that originate from the central uplands and drain into the Rann in the North and into the Arabian Sea in the South. High gradients and relatively short flow distances mean that run-off rates are high and flow duration is low[6]. Water slips across the sloping land quite quickly with little opportunity to percolate into

---

[4] Vinay Mahajen and Charul Bharwada, Virdas to Waterpipes: Past and Present of Drinking Water Scarcity in Rural Kachch. June 1997, Ahmedabad. Page1.
[5] Dr. M.V. Kanzaria, "Soils of Kutch," p 2
[6] Dr. K.C.B Raju, Effect of Over Development of Ground Water Resources and Remedial Measures Required in Kachchh District, Boroda, December 1999. p55.

the earth below. These gradients combined with the geology and low rainfall means that Kachchh holds no perennial rivers – a very important source of surface drinking water.

Another important aspect of the land is ground water[7]. Ground water here is found in both confined and unconfined aquifers. Considering the limited amount of perennial surface water flows in the Kachchh, groundwater serves as a very important source of water supply in the district. This water source is developed through the use of dug wells, bore wells and tube wells, to meet the irrigation, domestic and industrial demands of the area. What makes Kachchh unique with respect to this water stored beneath the surface is that it is a self-contained geo-hydrological unit. This means that, as a result of the physiographic features and the geo-hydrological setup of the land, the main source of ground water replenishment is limited to direct precipitation over the land during the monsoon. Little ground water is replenished through seepage from ephemeral streams traversing the area. This self-contained groundwater system means that the only renewable source of water in the area is rainwater.

1.2 Rain Drops

Low and erratic are the two exemplifying characteristics of the rain in Kachchh. The annual average varies from 338mm in Lakhpat to 452mm in Nalia, with a district average of 350mm[8]. These means vary greatly from year to year[9] making it difficult for farmers to depend on rain for irrigation. The rainfall is highly localized, and it is therefore not uncommon for it to rain heavily in village Gandhi nu Gam and not at all in village Ludiya, just one kilometer away. Rainfall often comes in sudden spates with most of the annual average falling over 15 rain days. Such sudden, high velocity precipitation unfortunately causes soil erosion and greatly reduces the capacity for natural ground water recharge[10]. Most of the rain flows away as runoff to the Rann or to the sea rather than slowly creeping into the earth below where it can be stored for later use.

Why does Kachchh have such low rainfall? It is primarily related to its hydrometric location. Kachchh is located on the western fringe of the southwest monsoon that brings rain to this part of the country[11]. Because of its positioning, it is not uncommon for rains to fail entirely once in three years. Temperatures vary significantly from 40°C - 48°C in the summer, down to as low as 1°C in extreme winters[12].

It is commonly believed that the water crisis in Kachchh is directly related to its decreasing annual rainfalls. However, an analysis of the rainfall record[13] shows that the pattern has

---

[7] Groundwater is --(1) water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table. (2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.
[8] For comparison sake, the average annual rainfall in Mumbai is 2160mm and in Ahmedabad is 750mm.
[9] See Appendix 1 for the analysis and variation of rainfall in Kachchh.
[10] Ground water recharge occurs when surface water percolates through the soil and is added to the aquifers below
[11] Mahajen et al. "Virdas to Waterpipes," p3
[12] Dr. M.V. Kanzaria, Soils of Kutch – An Ecological Perpsective. VRTI, January 1994. p2
[13] Analysis carried out by Janvikas Ecology Cell, described in an unpublished not titled "Rainfall Analysis."

not in fact changed over time[14]. As Vinay Mahajen describes, for a period of every 10 years, 3 years are near dry, 3 are of low rains, 3 are normal and 1 is above average[15]. Given this, it is factually incorrect to assume the rains are responsible for the dire water situation that the people of Kachchh find themselves in today. A closer look at the current water scarcity problem will be covered in the pages to come.

1.3 Geohydrology: A History of Water in Flux

> As you walk through the empty rivulets near Village Ashashpura, you see brilliant patches of earth displayed in the riverbed below. Each colour reveals something about the history of the land. If you look closely you will find fossils and seashells strewn within this telling record, evidence of a marine history. It is difficult to imagine that this arid land was once buried deep beneath the sea.

Understanding the geology of Kachchh and the process of land formation is important. It helps to highlight, once again, that there are only limited areas within the district where significant volumes of fresh ground water can be found, and as such, only limited areas where safe drinking water can be obtained.

The land of Kachchh is more than 180 million years old. It was buried beneath the sea at several points during its history as the tectonic plates parted and collided over time. The process of sediment deposition and rock formation occurs constantly, regardless of the sea level. Therefore, the rocks that formed while this land was the sea floor (marine formations) became saline. The water stored in such rocks is, as a result, inherently saline[16]. Any recharge that occurs over these marine formations is rendered unsuitable. Even where sweet water is found, it becomes saline at greater depths. The constant process of sedimentation meant that rocks formed when the sea levels receded, and these rocks store water that is inherently sweet. Only 15 percent of mainland Kachchh stores such water, and as such, only a small zone has the potential for substantial groundwater withdrawals.

One of the most remarkable remains of the marine history of the district is the Rann of Kachchh. The Rann is a special geological formation unique to the world. At one point in time, the Great Rann was an extended arm of the Arabian Sea – an estuary[17] where the sea met the great Himalayan rivers. As rivers like Yamuna, Saraswati and Indus traveled through what is now Kachchh, they brought and deposited rich silts over the land. This process of silt deposition went on for thousands of years until both the Indus and Yamuna gradually changed their courses, westward and eastward respectively. Siesmic disturbances only accentuated this change. As a result, the fresh waters gradually stopped flowing into the area, while saline water continued to flood the Rann through Kori Creek[18].

Earlier the salt water brought from Kori Creek was diluted by the fresh water flows of the Himalayan rivers. As a result no salt layer was formed on the land below. With this

---

[14] See Appendix 2 for a short term record of rainfall in Bunni. This graph displays the erratic nature of the rainfall typical to Kachchh. It is not uncommon for a drought year to be followed by flood year.
[15] Mahajen et al. "Virdas to Waterpipes," p3
[16] Rocks store water in their pore spaces. It is this intra-rock water that is pulled upwards when bore wells are drilled.
[17] An estuary describes where salt water meets fresh water.
[18] Mahajen et al. "Virdas to Waterpipes," p 10-11

diversion in river courses, the process of salt deposition began because salt-rich waters continued to flood the land each year, now undiluted. During the monsoon, creek water entered the Rann lands and remained there since they are low-lying areas. When the water evaporated, it left a layer of salt[19]. Overtime even the waters of Kori Creek stopped entering the mainland of Kachchh.

The Rann of Kachchh occupies over half the district of Kachchh. Its inherent salinity limits our capacity to use its land for agriculture or its water for drinking.

.

Characteristic of Water Resources in Kachchh:

1. Low and erratic nature of rainfall results in high rates of runoff and low rates of ground water recharge. This is further depressed by the topography and drainage pattern of the area.
2. Kachchh has no perennial rivers and only a small portion of utilizable groundwater.
3. The only renewable source of water is rainfall as Kachchh is a self-contained geo-hydrological unit.
4. There are vast portions of land where the topography is favorable for recharge but the inherent salinity of the land renders it unsuitable.

2.0 Coping with a Low Water Endowment – Tradition

Human societies have been constantly evolving new methods to harness natural resources for their survival and betterment[20] – foraging for food, finding fuel wood, searching for clean sources of water, learning the medicinal value of indigenous plants and roots. Each method develops on the existing knowledge base of the people, their experiences and their successes. Human ingenuity has been the key to survival for humans inhabiting arid and semi-arid lands such as Kachchh. Water is perhaps the most significant limiting factor to settlement; without it no plants, animals or humans can survive. Considering this, it is quite remarkable to learn about and see the ways that the people of this land have dealt with their great limitation.

Archeological findings show that human existence here in Kachchh dates back 150 thousand years[21]. Currently, excavations are taking place in village Dholavira. This unearthing is shedding light on the availability and sources of water in the region 5500 years ago. Evidence of systemic water planning and rainwater harvesting[22] shows that even thousands of years ago water was scarce, contrary to what is commonly believed.

> The excavated town has very well designed mechanisms like several reservoirs to collect and store rainwater. The palace tank has a fine system of getting river water through underground channels…There are wells also…Each house has a well planned drainage system where the

---

[19] Mahajen et al. "Virdas to Waterpipes," p 10-11
[20] Mahajen et al. "Virdas to Waterpipes," p16
[21] Mahajen et al. "Virdas to Waterpipes," p16
[22] 'Rainwater harvesting' involves the collection and storage of rainwater aimed at the harvesting of both surface and groundwater, the prevention of losses through evaporation and seepage, the conservation and efficient use of water in areas of low water endowment. Some examples of *rainwater harvesting* include percolation ponds, surface and subsurface check dams and recharge wells.

used water was collected in large earthen pots outside every house from where it is lead to the city's main drainage system[23].

As this example of Dholovira shows, natural water scarcity lead the people of Kachchh to come up with creative solutions to ensure their survival. Up until the recent past, the water needs of a community were planned locally and met by that community itself. *At no point in time was one solution ever adopted for entirely different regions, communities or needs. Each solution was tailor made to suit the needs of each individual community; each solution was context specific.* But today in Kachcch, as we will soon see, blanket solutions have replaced creative solutions and local ingenuity.

Rivers have been the most important source of water as civilizations such as Mesopotamia and Egypt clearly show. But Kachchh has never had any perennial rivers, and has been forced to survive mainly on rainfall. The high slopes, drainage patterns, high run-off rates and elusive rainfall patterns had forced the people of Kachchh to develop various methods of water supply that focused on slowing down and harnessing the meager rainfall, with little dependency on surface river flows. Following are descriptions of some of the more common water supply technologies developed in the past.

2.1 Groundwater[24]

The primary method of extracting groundwater was through the construction and use of *virdas, wells* and *vavs*. Each of these methods extracts water from different levels of the water table[25]. The use of these traditional technologies ensured that extraction remained in balance with recharge, to avoid overexploitation[26]. This is a major oversight of the current system of pipelined supply.

2.1.1 Riverbed Virdas

Rivulets were rarely used for drinking water since the land rendered the water too saline for humans to consume. However, riverbeds of dry rivers were very important sources of water and still continue to be in some areas. Small pits called *virdas* are dug in these dry riverbeds, which store sweet rain water from the previous season in small quantities. As mentioned previously, the ground water in certain regions of Kachchh is inherently salty. The infiltrating rainwater gets collected at a level above the salty ground water because of its low density. *Virdas* harvest this upper sweet water layer[27]. *Virdas* appear to be the oldest and simplest form of extracting drinking water. The history of their use dates back thousands of years, when Kachchh had a predominantly pastoralist economy.

---

[23] Mahajen et al. "Virdas to Waterpipes," p17

[24] See Appendix 3 for a simple diagram depicting ground water and the water table with relation to surface water.

[25] The watertable is the top surface of groundwater.

[26] 'Overexploitation/ over extraction' describes the withdrawal of more groundwater than is annually replenished through processes of natural recharge. Signs of overexploitation include a continuous fall in the water table, drying up of wells and the deterioration of water quality.

[27] Centre for Environmental Education, Traditional Water Harvesting Systems, Ahmedabad, Gujarat, date: unknown. Pg. 14

With time simple *virdas* evolved to incorporate the knowledge and experiences of generations previous, taking into account soil conditions, topography and water needs. *Virdas* are still used in some parts of Kachchh.

Floods ravaged through the area I lived in this August. Much damage was made to the pipelines, the primary source of water to the villages in the area; enough damage that water stopped coming to the village. Although a large percolation pond and check dam has been built on the fringe of the village, the water contained in it is much too murky to drink (although sufficient for cleaning and washing) since the intensity of the rainfall caused a lot of disturbance to the dry riverbed. A week after the floods subsided, the pipelines had not been repaired. Little Pooran invited me to join her and her younger sister on a quest to find drinking water. I followed them down the path to the stream with steel *matlas*[28]and a small steel *vaatee*[29] in hand. As we approached the stream, I noticed that only a tiny trickle made its way across the riverbed and I asked Pooran how she planned to collect enough drinking water from that? She explained, "Shezeenbhen, we use the *vattees* to dig a small pit in the *tareo*[30]. With our vattees we scoop out all of the murky water that quickly fills the pit. Then we wait and let clear water slowly fill the pit. It is this clear and clean water that we take home to drink. These pits are what we call *viardos.* [31]". A small group of my friends had gathered on the stream bed below, digging and filling, chatting and laughing. They giggled as I marveled at the clear, sweet water that slowly trickled into the pits they had dug. Ramma tells me, "Shezeenbhen, big men spend so much time digging deep wells. Us girls dig smaller ones and these ones will always be sweet!" A magnificent example of Kachchhi ingenuity…

2.1.2 Wells

It is probable that with time, simple *virdas* evolved into more permanent ones. These permanent structures were lined with wood and grass. As sedentary agricultural life began, a more permanent and plentiful source had to be established. It is popular belief that deeper dug wells have evolved from these permanent *virdas*. Like *virdas*, wells draw their water from the shallow levels, which get recharged with rains. However wells draw from a much wider range of the recharge zone. Dug to a depth of many tens of feet into the earth, water trickles into wells in much the same way as virdas, however, the quantity of water that is collected and stored in wells is much greater by virtue of their size. Earliest evidence of wells in Kachchh are found at the Dholavira excavation.

2.1.3 Selar Vav (Step Wells)

In a handful of places in Kachchh, *selar vavs* or step wells were an important source of water. A *vav* is a deep well with stepped access from ground level to the base of the well, with several intermediate landings. These architectural marvels served not only as sources of water but also as social gathering sites. However, these structures were generally built by royal or influential families, and thus have never been an important source of water.

2.2 Surface Water

Surface water is harnessed mainly through *talavs*, and *talavadis* [32]. These methods are completely rainfall dependent. Water from the catchment area upstream flows into these structures and percolates into the earth, a natural storage system.

[28] Matlas are vessels with which water is collected than stored
[29] Vattees are small stainless steel bowls
[30] Tareo means ground. In this case Pooran was referring to the base of the stream.
[31] See diagram of *virdo* and photograph sin Appendix 4
[32] Talavs are ponds while talavdis are smaller versions of the same

2.2.1 Talavs

Ponds or *talavs* have been developed by deepening natural depressions. *Talavs* receive run-off from the catchments, higher lands and hills. The water is collected in the pond and the overflow is directed back into a stream or other low-lying areas. With time, people began to understand that in semi-arid regions, losses through evaporation from open surfaces are high and that open water is not always safe for drinking. With this experiential knowledge, a new method was developed that combined the benefits of the two systems by making wells within *talavs*. This way *talav* water recharged the watertable of the wells so evaporation losses were reduced. Additionally, cleaner and more abundant supplies of water were available even during scarcity years.

3.0 The Decline of Traditional Systems

Though the traditional systems are still used in some parts of Kachchh, there has been a visible decline in their use and maintenance as pipelines have rolled in, swiftly replacing them. How was the new system of water supply able to sweep aside these well honed and time honored systems? Mahajen suggests several deep socio-economic processes that allowed for this switch. He states that at the macro level, the process of decline has its roots in the colonization of India by the British. The British asserted their power and control over India's well-developed trade and agricultural sectors. Under the guise of increased efficiency and production, technology was imported en mass and they began to systematically plan the centralization of power and resources on a grand scale. As Mahajen explains, technological exchange certainly occurred in India before the arrival of the British but these "exchanges" improved the existing systems and built on the knowledge base of the people. "Unlike before, this time it was not 'exchange' but conscious, forceful 'imposition' not just of technology but a wholly different social system without any participation of Indian people in the decision making.[33]" With time, local institutions lost their capacity to manage and maintain their systems.

The formation of independent India brought with it even more pervasive systems of centralization. With several generations having lived under these imported systems, it was difficult to break from them; instead they were carried forth with even more fervor by the Indian State. Policymakers and planners left no place in the new system for traditional systems, be they education, natural resource management, or drinking water. These traditional systems were not considered to be appropriate even as supplementary to the new systems[34].

With time, the domestic water use pattern has changed resulting in a marked increase in water demand. As preferences and lifestyle patterns have changed, increased pressures have been placed on the natural environments around us. This holds true for the entire global community. Now more than ever, people all over the world see water, air, soil and plants as resources to be consumed rather than gifts to be looked after responsibly for the generations to come. Just as industry and agriculture have become more water-intensive, so have our lifestyles. Growing demands for finite resources such as water cannot always be met by traditional systems. These traditional systems kept demand in check with supply; people used what they needed, while taking into account the stock for the years to

[33]Mahajen et al. "Virdas to Waterpipes," p37
[34] Mahajen et al. "Virdas to Waterpipes," p37

come. Because this is no longer the case, our traditional and modern systems are being overexploited; this overdraft is leading to decreased yields at many sources such as *talavs* and *wells* and water tables are plummeting across the region.

Water is brought in from a source far away to meet the growing discrepancy between supply and demand[35]. The Narmada Project is one example of this: water from the Narmada dam located hundred of kilometers away from Kachchh is brought in by a pipeline. This is done at the expense of developing and maintaining traditional and local water systems.

Another factor that has lead to the decline of traditional systems is choice. As the more convenient pipelined sources, however effective, have been introduced in the villages, people now have a choice of which system to use. There is a preference for the pipelined sources and taps because they are more convenient; an entirely valid choice considering the energy women expend each day just to acquire water. This movement towards the pipelined source has catalyzed the process of abandonment of the traditional system.

As mentioned previously, the weakening of local institutions that used to manage such systems has not been compensated for by the creation of any other democratic community structures. This lack of accountability and involvement has also contributed to the deterioration of traditional systems and the lack of maintenance of the modern system.

Traditionally, the water for each village came from a source beneath their feet. Without romanticizing our past, it is safe to say that our ancestors had an innate connection to the land simply by virtue of being cognoscente of the water in the earth below their settlements, where it came from, which direction it flowed, whether it was fresh or saline. As a result of this knowing, people were much more conscious of their water use; conservation was instinctive. Although these concepts have not been forgotten entirely, with each generation that passes, this knowledge and wisdom is being lost.

3.1 Where Tradition Stands Today

Table 1: Present Status of Traditional Sources of Domestic Water in Kachchh

Details	**Virdas**	**Wells**	**Vav**	**Talavs**
Villages having respective traditional source (out of 100 villages surveyed)	23	72	9	87
Villages having more than one respective source each		50	0	40
Total No. of respective sources	69	194	9	170
No. of sources surveyed under each category	69	140	9	145
Built in the last 15 years	-	15	0	23
Built in the last 16-45 years	-	10	0	13
Built more than 45 years ago	-	94	9	109

Based on a survey of 100 villages carried out in January 1997 by Mahajen. Information on 21 wells was not available.

[35]No where in the current system has room been made for demand management. Arguably, these growing demands should be lowered to more sustainable levels as a first step rather than attempting to satisfy the growing gap. Demand management is a much more difficult task, perhaps, but much more sustainable in the long term.

Source: Vinay Mahajen and Charul Bharwada, Virdas to Waterpipes: Past and Present of Drinking Water Scarcity in Rural Kachch. June 1997, Ahmedabad. Page 35

From this survey we see that of the 100 villages surveyed, each has at least one traditional water source. However, with the exception of *virdas*, which are more temporary in nature, more than 76 percent of the *talavs* and wells, and all the *vavs* are over 45 years old. This is indicative of the efforts that have been made to contribute to these traditional systems in the recent past. The study found that the regular maintenance of these resources has sharply declined in the last 3 decades and is even lower in villages where piped water supply systems have been installed.

It was a scorching hot day in June, as I made my regular visit to Akli Gam where we are currently building a drinking water well. As we sat in the shade of his *bhoonga*, Tar Mohmad Kaka handed me a *karsio* full of cool water to drink. "Bhen, this water you are drinking comes from the Abdullah Wandh farm well. We don't drink the water that comes through the pipeline. Even if the line is much closer to our house we prefer to make the 1km walk to the well for clean drinking water." Kaka explained to me that he had been drinking this well water for years. The water in the pipes is full of *kachro*[36] and *deva*[37]. In his family it used only for washing clothes and cleaning. For Tar Kaka and many others who have not grown up with the modern pipelined system, the traditional methods of supply are still the most reliable even if they are less convenient in comparison.

4.0 The Present System of Supply

After Independence, public health became one of the major concerns of the Indian Government since high mortality and morbidity rates were negatively impacting the nation's newly developing economy. Waterborne diseases were a major cause for concern considering they were so widespread. As a result, the provision of safe drinking water was viewed as a priority.

In 1963-64, the Government of Gujarat conducted a survey to assess the drinking water problem in the state. As per drinking water availability, the study divided villages into four categories: no source, inadequate, unsafe and adequate. These categories were not based on well-established criteria, however, and were rather notional and speculative[38]. The results of the survey showed that of 18,114 villages, 1,043 had no facility for water and 3,219 did not have adequate facility for water[39]. Various schemes were initiated to provide water to these "no source" villages. The existing traditional sources were considered "unhygienic," and were virtually ignored. As India underwent nation-wide modernization, the rationale for introducing modern methods and abandoning the old was further justified.

[36] *Kachro* means garbage or dirt
[37] *Deva* means medicine or solvents
[38] Mahajen, "Virdas to Waterpipes…", p40
[39] Meghna Phadke, Need for Water Harvesting. Center for Environmental Planning and Technology. Ahmedabad, July 1998. p31

Villages that were declared 'no source', were to be provided with free water. With no policy in place to accommodate the other two problem categories, all villages wanted to be declared 'no-source.' The process of identifying, categorizing and providing drinking water to no-source villages still continues today. As a result the number of no-source villages has risen to 14,370[40]; 80 percent of villages do not have a reliable source of drinking water.

Depending on the population and water availability, a no-source village could be covered under various schemes: hand pump, dugwell, tubewell, or piped water supply. The vast majority of villages have been provided piped supply; hardly any attempt has been made to create new sources at these problem villages through harvesting and conserving the annual precipitation.

The Center for Environmental Education (CEE) highlights the central failure of the government program. According to their study, the program has failed at the operation and maintenance level. The reason for this is that the local people were not involved in the process of solving the problem. "The people were neglected and in turn they neglected the upkeep of the sources made available by the government departments.[41]" Had people been involved from the start to create and develop sources in their villages themselves, they would feel not only invested but also responsible for the upkeep of these sources.

An important paradigm shift resulted in the decision-making process of the government regarding water, post-independence: whereas the provision of water and the maintenance of the sources was considered the responsibility of each community up until that point, the government was now taking over this responsibility entirely. The provision of water was now the state's responsibility. And with this shift came a shift in accountability, in perceived responsibility, and in use patterns. Now when the water does not come it is the *sarkar's* (government's) fault, when the pipes are broken or the valves to the village are shut, it's the *sarkars* fault, and since the *sarkar* sends the water for free through the pipelines, it is easier to use more than would be otherwise.

Most people in Kachchh consider piped water as both the permanent fix to the drinking water problem and as the most preferred solution. Changes in lifestyle and the declining prevalence of traditional sources are mostly likely responsible for this preference. Of the 948 villages in Kachchh, 787 have been declared no-source. Out of these, 92 percent are covered by piped water supply while the remaining 8 percent are covered under the hand pump or simple well scheme[42].

In the years past, the Gujarat Government has constructed 131 major and medium dams to ensure water supply. The state has created about 90 percent of its reservoir capacity from 131 reservoirs, instead of creating 18,273 decentralized water reservoirs for 18,273 villages[43]. Potable water from a source in one region is taken to distant areas through pipelines. Local source development has been virtually ignored. The shortsightedness of this plan has disastrous affects: continuously drawing water from one source area without

[40] Phadke, "Need for Water Harvesting," p33
[41] Centre for Environmental Education, Water Harvesting and Sustainable Supply in India, *pg5*
[42] Mahajen, "Virdas to Waterpipes," p44
[43] Phadke, "Need for Water harvesting…", p33.

sufficient planning to recharge the water, will inevitably lead to a drop in both yield and quality. The groundwater will run dry over a short period of time and new tubewells will have to be drilled, only contributing to the problem yet again. This reality is not too far off, if active steps are not taken now to address this.

4.1 Tankers: Emergency or Alternative?

How reliable is the current system of water supply? An interesting development is the increasing use of tankers as an alternative water supply source to the pipelines. Water tankers, trucks or tractors that bring water to villages, were originally used as an emergency measure to provide water to areas suffering extreme scarcity. This emergency source has become virtually institutionalized since then; it is now considered an alternative source to the pipelined system. Both the government and the people have become dependent on this artificial water system. As of 1997, 22 percent of villages in Kachchh were supplied by water tankers, and the number has surely risen since then. Although the proportion may seem small, it is quite alarming considering the efforts and resources invested into rural water supply here. What does this say about the current system of supply?

May-June 2003, Village Gandhi nu Gam

Gandhi nu Gam is a new village built after the devastating earthquake of 2001. There were no existing sources of water (although a well is currently being built) and as a result the village was connected to the pipeline network that runs throughout rural Kachchh. The water fills the village tank once every two days or so, providing enough water for the 18 families that live there.

In mid-May, a film company came to shoot a movie in the village and stayed for the month. Thirty staff members and actors stayed in the village during this time. It was decided that the company would pay for one tank each day so as not to put a strain on the villager's supply of water. During this month the village tank sat dry for nearly 20 days. As the days went by, the company found itself ordering more and more water to compensate for the shortage.

Why was the village tank dry for so many days during the month? What would have happened if the film company had not been there to fill the tank each day? The answers are simple and connected: the people who control water supply through the pipelines are connected to the people who provide water via tankers. The pipelined water is free and the tanker water costs between 200-350 Rupees per tank. If the pipelines are shut down for days at a time the company would be forced to order water – a lot of money was there to be had. And that it was…

5.0 Singed Earth, Soaring Thirst – A Water Crisis Looms

"Water is the biggest crisis facing India in terms of spread and severity, affecting one in three people…"

"Rural India, yet to be acquainted with the water-tap culture, is worse off [than urban India] as groundwater levels have plunged in 206 of the 593 districts. Villagers have the choice of trekking for miles or waiting for government tankers to fill a single pot."

- Shankkar Aiyar[44]

March 2003: A bore well is dug in village Ludiya to a depth of 150m. The water is saline.

[44] Shankar Aiyar, Cover Story, Thirsty India, Times of India, June 9 2003. p.38

May 2003: No water has come through the pipelines for nine consecutive days in village Gandhi nu Gam. The village sits thirsty.
June, 2003: A parched summer. The tankers have stopped coming to village Dorawar. The women and girls walk to village Rabiri each morning to collect water from a small rivulet. They leave their village at 6am and are not back till 8am. They spend hours just to survive.

The story is the same all over India. There is not enough water. In Kachchh, the monsoons have failed for three consecutive years and the situation is dire. Although this situation is not new for Kachchh, as this paper has shown, what has changed is the frequency of the drinking water scarcity people are facing today. Never before have people been as uncertain about their supply or as dependent on an outside source. The piped water supply reaches 75 percent of villages in Kachchh, however, the problem of drinking water scarcity increases each year. With this said, we must question the effectiveness and perhaps more importantly, the suitability of this modern system.

5.1 The Tragic Descent

Until independence, traditional water systems were the only source of drinking water. Some efforts were made to provide the colonial elite with pipelined water supply but rural water supply never became part of any centralized system. Meghna Phadke describes how before independence, drinking water was rarely cited as a problem in Gujarat, even in drought years. The situation is very different now: Gujarat is facing an acute and growing problem of water scarcity; a problem that particularly affects the quality of life of the state's rural poor. The main difference between the current system and the past is the ground water situation; the availability of ground water was much more favourable in the past.[45] The demand for water has increased tremendously over time with India's growing population and with its rising consumption patterns. As a result there has been a consistent decline in the per capita availability of water.

Although many are quick to blame the failure of the monsoons or naturally uneven distributions of water for our current water crisis, some would argue otherwise. Drought and uneven distributions of water are not new phenomena. However, what has changed is the management and consumption of water resources. Over the years, traditional methods of water supply that use rainwater stored in the upper reaches of the earth, have been replaced by 'modern' systems, which suck deep into the earth's valuable ground water reserves. In Kachchh, groundwater development for irrigation, industrial, and domestic needs has markedly increased discharge rates in the past four decades. However, as mentioned previously, the hydro-geological set up of Kachchh confines its source of groundwater *re*charge mainly to precipitation falling directly over the area during the monsoon. The high rates of discharge are not being met by these natural rates of recharge in many areas. We are extracting water at a higher rate than it can naturally be replaced and this is resulting in groundwater over-exploitation. The table below illustrates how Kachchh's ground water potential has changed from 1984 to 1991.

[45] Phadke, "Water Harvesting…", p27

Table 2: Ground Water Potential of Kachchh (1984-1991)[46]

	Total 1984	**Total 1991**
Total groundwater recharge (MCM/year)*	802.93	517.07
Utilizable groundwater recharge (MCM/year)	682.51	439.50
Gross Ground Water Draft (MCM/year)	281.58	381.56
Ground Water Balance (MCM/year)	485.41	118.89
Level of groundwater development (%)	28.88	86.80

*MCM/year = million cubic meters per year

From this we can see that groundwater draft has increased significantly, tipping the groundwater balance. This imbalance has become even more marked since 1991. The rapid depletion of groundwater has negatively impacted both the quality and quantity of this water.

A Glimpse at Water Resource Development in Kachchh

Soon after independence, the government of India took on the lofty goal of food self-sufficiency as one of its top priorities. Thus there was a need to radically increase food production. Little importance was placed upon traditional agricultural methods; an inherited approach from the colonial regime. Instead these methods were thought to be obsolete and inappropriate for the objectives of the time. The government began its quest to develop surface water potential. Large-scale dams sprouted all across the country[47]. Similarly, new methods were developed to extract water from deeper aquifers. In Kachchh, where surface water supply is relatively low, the quest for groundwater began. In the 1950s, surveys were carried out to locate groundwater zones in Kachchh. From this, medium and minor irrigation schemes were developed across the district. These schemes are currently operating at 35 percent and 25 percent, respectively, of their stated irrigation potential. High rates of siltation, evaporation and improper management are cited as the main reasons for this low return.

Groundwater became the main source of irrigation and new technologies have been developed to tap this source. From diesel pumps to electric motors, from bore wells to tube wells, water was drawn from deeper and deeper sources at increasing rates, as groundwater levels receded. With the advent of large scale groundwater withdrawal came modern, water-intensive agriculture. This has only further negatively impacted the tipping ground water balance[48].

6.0 Now What? Concluding Observations and Ideas for Change

Kachchh is currently facing a drinking water crisis, as this report has shown. The causes of this crisis go beyond natural limitations such as low rainfall or high topographical gradients. These limitations have been stretched beyond their sustainable capacity by the current process of development. Post-independence policies, modern agriculture, one-

[46] 1984 figures: Raju K.C.B, 1992 from Mahajen 1997, p102
1991 figures: Raju K.C.B, Effect of Over Development of Ground Water Resources and Remedial Measures Required in Kachchh District, Baroda, 1999. p57.
Please note that the figures in the table do not seem to add up correctly. They have been copied into the table above as per published by the author. Despite this setback the general trend is visible: there has been an increase in groundwater extraction and a decrease in groundwater recharge over the 7 years studied. This means that while more water is being pulled out, less water is being replaced. Since the time of the study the situation has surely become worse as no serious remedial measures have been taken.

[47] These large dams schemes were called "Temples of Modernization," perhaps inappropriately having seen their effects today.

[48] Mahajen, "Virdas to Waterpipes," p68-69

sided consumption, and inappropriate technology are all equally responsible for the perilous situation in Kachchh. *What is clear from the on set is this: in order to make positive and sustainable change, a paradigm shift is necessary – we need to reassess who is and should be responsible for services as critical as water supply; we need to rethink our current consumption patterns and realize that our current path is not sustainable.*

There is currently a unilateral orientation towards consumption. What has changed in the recent past is our ability to access copious amounts of water. Technology has allowed each of us to access water taken from deeper and deeper within the earth: bore wells and tubes, pipelines and tankers. A rush to dig deeper, to access more, has had many harmful repercussions. For one, the mindset with regard to water has completely changed: borewells and tubewells are now considered "sources" of water in official parlance rather than a means to tap water[49]. Geologists and hydrologists are concerned that such one-sided consumption will lead to the drying up of many of our sources – a valid concern considering the rate at which watertables are plummeting and wells are drying. We need to seriously rethink the sustainability of simply digging deeper or bringing water in from sources far away in order to satiate ever-rising demands. Does this ensure a safe supply for the generations to come? Not likely. Instead, we need to reanalyze and prioritize the need to manage our demands. Lasting change will be brought about only by tackling the problem at its source.

Regulating groundwater use will also be critical to any sustainable change. At present all agencies in Kachchh withdraw primarily from one small tubewell zone. Since it is a common resource, or gift, used by all there should be a common plan in place to regulate and manage its use. Currently, water is not divided on the basis of availability of its supply but rather on the basis of agency – and naturally the most powerful wins privilege here. Each user plans independently; there is a definite lack of coordination between users and this must change.

We must question the suitability, reliability and overall effectiveness of this current system of supply. Are blanket solutions really fitting? Technology is surely an instrument of change but unless the direction of this change is consciously planned, technology can lead to disaster. The new system of water supply adopted after independence was implemented without understanding the natural limitations of the area. Upon planning and implementing this new system, our traditional knowledge was simply put aside; it was deemed unfit. However, as time has shown us, societies evolve by building on their past – their past knowledge, mistakes, experiences and lessons. Taking a look back at the evolution of technology developed by the people of Kachchh, we see its contextual appropriateness. Contrarily, we adopted a system that was not ours. The effects of this are blaringly obvious when we take a look at the number of no-source villages that seem to increase rather than decrease with each passing year despite government efforts to curtail this.

With growing populations and increased demands, both domestic and industrial water consumption has increased. In order to cope with this increase (while, of course, simultaneously aiming to decrease demand) we need to increase the amount of usable

[49] Mahajen, "Virdas to Waterpipes…" p 86

water. To say that our traditional systems alone could handle this task would perhaps be short sighted. However, instead of lofty projects that are often socially and ecologically inappropriate, we should concentrate on developing our local sources as we have done in the past, building on the wisdom that lies in our traditional systems. Remarkable small-scale watershed development has been carried out in Kachchh both by the government and by Non-Governmental Organizations in the area. Sahjeevan, one such NGO based in Bhuj, has focused many of its efforts to develop village water sources using local technology, labor and knowledge. In village Khari, Sahjeevan is currently carrying out a groundwater recharge project. A series of small- and medium-size check dams have been built along with a number of farm bunds and farm ponds. Wells have been dug both for domestic and agriculture purposes. With the recent floods, these checkdams and ponds have filled and the water is recharging the aquifers below; this community is sure to be cleared of any water problems for the years to come with copious amounts stored in the land beneath its feet.

Another factor contributing to the water problem in Kachchh and the failure of the current system is the lack of coordination between government-driven watershed efforts and government water supply boards. Although plenty of water is recharged each year as a result of these projects, little seems to be used directly by the government for drinking water supply; water continues to rush in through pipelines for most of Kachchh. A concerted effort needs to be made by the government to coordinate its different divisions - watershed and water supply in this case. Similar coordination should take place between NGOs and the government working to similar ends. Focusing efforts will not only save time and money – it will mean an even greater benefit for the people these programs aim to help.

Mahajen takes a holistic approach to the water problem and suggests the importance of a "region-wide social process". According to him, "the success of any of these efforts primarily lies in the consciousness of the people towards rationalizing the use and knowledge of the technical system for increasing useable water[50]." As a long-term seal of sustainability, the people themselves need to be constantly aware and conscious at every step of the way of the need to conserve water. Mahajen outlines this social process: enabling people to know and understand their region, especially with respect to water resources, enabling people to understand the reasons for the current water supply crisis and how its impacts will irreversibly affect people's lives, addressing several widely spread myths surrounding water issues, disseminating the expert knowledge base to become a part of the common consciousness[51]. Although this sort of social process would indeed be valuable, it is important to remember that policy level change needs to occur simultaneously. What happens at the user level often has relatively little negative impact when compared to grander agencies and policies. However all too often, in the name of "education" or "conservation" the users are blamed for the crisis simply because their actions are most visible out of all the players involved. In reality, as this paper has shown, even water consumption is governed by larger processes of development. This education and "enabling" that Mahajen describes is still valid however, because affecting policy level

[50] Mahajen, "Virdas to Waterpipes…" p92
[51] Mahajen, "Virdas to Waterpipes…" p 92

change takes a very long time; the situation is urgent and thirst begs speedy solutions. Working with villagers to encourage them to revert back to their traditions, to conserve water and to learn about their land, is a necessary supplemental step but should not be seen as the simple solution to a much larger systemic problem.

The issues are complex and in order to pull ourselves out of the state we find ourselves in today, changes will have to be made at every level. Changes to mind every last drop; to treat this drop like the gift that it is…

Glossary

- *Aquifer:* a geologic that is water bearing. A geological formation or structure that stores and/or transmits water, such as to wells and springs. Use of the term is usually restricted to those water-bearing formations capable of yielding water in sufficient quantity to constitute a usable supply for people's uses.

- *Groundwater:* --(1) water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table. (2) Water stored underground in rock crevices and in the pores of geologic materials that make up the Earth's crust.

- *Overexploitation/ over extraction:* withdrawal of more groundwater than is annually replenished through processes of natural recharge. Signs of overexploitation include a continuous fall in the water table, drying up of wells and the deterioration of water quality.

- *Perennial Rivers:* rivers that flow all year round; rivers whose flows are

- *Recharge:* water percolates through the soil and is added to the aquifers below; the replenishment of groundwater with surface water.

- *Rainwater harvesting:* collection and storage of rainwater aimed at the harvesting of both surface and groundwater, the prevention of losses through evaporation and seepage, the conservation and efficient use of water in areas of low water endowment. Some examples of *rainwater harvesting* include percolation ponds, surface and subsurface check dams and recharge wells.

- *Riverbeds:* the underlying part of a river where water meets the earth below.

- *Runoff:* That part of the precipitation or irrigation water that appears in uncontrolled surface streams, rivers, drains or sewers.

- *Watershed:* the land area that drains water to a particular stream, river, or lake. It is a land feature that can be identified by tracing a line along the highest elevations between two areas on a map, often a ridge.

- *Watertable:* top surface of groundwater.

BIBLIOGRAPHY

Aiyar, Shankar . June 9, 2003. Cover Story: Thirsty India, Times of India. New Dehli.

Centre for Environmental Education. Date unknown. Traditional Water Harvesting Systems. Ahmedabad.

Kanzaria, M.V. January 1994. Soils of Kutch : An Ecological Perpsective. Paper presented at the workshop jointly organized by the Gujarat Ecological Commission and Shree Vivikanande Research and Training. Bhuj.

Mahajen, Vinay., Bharwada, Charul. June 1997. Virdas to Waterpipes: Past and Present of Drinking Water Scarcity in Rural Kachch. Ahmedabad.

Phadke, Meghna. July 1998. Need for Water Harvesting. Center for Environmental Planning and Technology. Ahmedabad.

Raju, K.C.B,. April 1998. Importance of Recharging Depleted Aquifers: State of the Art of Artificial Recharge in India. Boroda.

Raju, K.C.B,. December 1999. Effect of Over Development of Ground Water Resources and Remedial Measures Required in Kachchh District. Boroda.