IWMI-TATA WATER POLICY RESEARCH PROGRAM

ANNUAL PARTNERS' MEET 2002

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A Quantitative Idea of the Groundwater Recharge in Saurastra and North Gujarat Regions – What Energized the Popular Movement?

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Preamble

Saurastra and North Gujarat are the two most draught prone regions of Gujarat state in Western India. In the decade of 80's, most part of these regions experienced 6-7 years of draught of varying intensity. In the regions that are almost fully dependent on rain-fed or groundwater irrigation, sufficiency of ground water is basic to sustainable agriculture for water availability has deep socio-economic and political consequences. Though Saurastra has over 100 river basins; barring four- Bhadar, Aji, Shatrunji and Machchhu- all the rivers are highly seasonal, shallow and, rapid flowing with limited potential for surface water based irrigation projects. The regions' agriculture is therefore going to remain heavily dependent on Groundwater. The high frequency of draughts and its consequent impact on the economy of the region in the absence of any significant surface water based irrigation system led to the emergence of a popular movement that aimed at conserving the rainwater and recharging the ground water resources/ table as a more dependable measure of draught proofing. Over the last 3-4 years the movement has grown in both intensity and reach. Its impact can be more clearly seen in years of draught in places where the movement has resulted in building an infrastructure large enough in size/ number to effectively address the localized problem of water shortage. The popular movement has adopted two basic approaches. First- recharge of open wells by directing the surface runoff through a percolation-cum- filter pit directly in to the wells and the second- collecting the surface runoff at points convenient through a series of check dams build on streams either natural or artificial and allow the collected runoff to sep in to recharge the groundwater table.

This study aims to address three basic questions. First, *'What energized the popular movement to build recharge structures on open wells or check dams as a means of draught proofing in Saurastra'*; Second, *does large scale build up of check dams in the basin of an existing surface water irrigation system result in any significant reallocation of available runoff taking Aji basin as a case*, and finally, *how effective the CD's have been in draught proofing in a localized situation to answer water problem in face of serious draught situation and are the experiences rich enough to warrant a support for the movement* now spearheaded by the Saurastra Jaldhara Trust and supported by the Government of Gujarat as Sardar Participatory Water Conservation Project (SPPWCP).

This study has been carried out in three parts. In the first part, an attempt was made to develop a "*quantitative idea of the scale of groundwater recharge work in Saurastra and North Gujarat through private wells, through check dams, ponds, hidden dams across streams, and other means*" through extensive field work and discussion with Swadhyay Pariwar members, with local activists, with farmers and Government officials. In the second part Aji river basin has been studied to ascertain if the "*check dams built so far result in any significant reallocation of the water available during the years of severe draught and, at the current levels of infrastructure build-up do the*

check dams have any impact on draught proofing the basin". The third part of the study aims at carrying out case studies in a couple of villages where there has been a sufficiently large number of check dams built in the last couple of years to study the experience and see if it is reasonable enough to prove the "*efficacy of the Check dams as an effective way of draught proofing"*.

1.0 Water and Draughts in Gujarat; A brief review

The western Indian state of Gujarat has three distinct regions. The western most Saurastra region comprising the districts of Bhavnagar, Amreli, Junagarh, Rajkot, Surendranagar, Jamnagar and Kutch is the most rainfall scares region and receives annually between 380 mm (in the northern part of the region) to 680 mm (in the southern part) of rain. It receives, less than normal rains in three out of four years. The development of irrigation in the region is mainly open-well / shallow tube-well based[1], that often dry out within couple of months of the end of monsoon season and, in case the rainfall is insufficient, as is normally the case, the wells do not have enough water even to protect the main kharif crop of Groundnut and coarse cereals- Bajra and Jowar. Failure of Groundnut crop in Saurastra and consequent rise in the price of Groundnut oil in Gujarat has often lead to serious political battles in the past. During the decade of 80's, the region experienced draught and crop failure in almost all the districts atleast for 5-6 years, when more than half the villages in each district were severely hit by water scarcity.[2] Insufficient rainfall also causes a major drinking water/ domestic use scarcity in the villages and towns. Draught relief measures are most frequently required to be taken by the Government often requiring transport of

[1] Irrigation data by source in saurastra brings out wide year- to- year variation in area irrigated and the region's dependence on wells for irrigation. In a good year of Monsoon represented by 1984-85 in table below, the irrigated area nearly doubles. More than half the wells either go completely dry or do not have sufficient water to irrigate normal crops.

	Area irrigated by source					
[00Hect 86-87,(84-85)]	Jamnagar	Rajkot	Junagarh	Bhavnagar	Amreli	S'nagar
-by wells	474(1135)	938(1721)	869(1308)	869(1100)	356(572)	828(857)
-Net area irrigated	486(1185)	938(1924)	922(1339)	1030(1453)	358(599)	833(982)
-Gross area irrigated	593(1411)	966(2120)	983(1619)	1164(1464)	362(604)	904(1035)

Note the sharp variations in the area irrigated in two years under reference. Also the wells emerge as the principal source of irrigation for over 95 % of the net area irrigated except for Bhavnagar, where the wells irrigated area id about 84% of net irrigated area. Sufficiency of Groundwater is therefore basic to sustainable agriculture in the region.

[2] Draught incidence- Year-wise number of villages affected

Year	Jamnagar	Rajkot	Junagarh	Bhavnagar	Amreli	S'Nagar
Village Nos	694	856	1034	865	595	648
81-82				300		
82-83				62	371	
83-84		868		175	237	
84-85		868		787	196	611
85-86	676	867	957	673	607	659
86-87	522	867	139	900	56	659
87-88	684	867	960	903	608	
88-89		868	61	903		
89-90		653		903		

Source: District census handbooks (1991)

large volumes of water to villages and towns at a considerable cost to the exchequer. Further the region is arid, the topography, barring parts of Junagarh around Girnar hills and parts of Rajkot, is flat; the soils are shallow with depths of barely a feet or so covered with black clayey loam in Rajkot, Junagarh and Jamnagar and, a stony sub-strata with permeable levels between 50 to 100 feet followed by the hard rock strata. While parts of Bhavnagar and most part of Surendranagar have yellowish-white china clay that has extremely poor percolation capacity. The region therefore suffers from faster surface run-off of rainwater and extremely slow recharge. The growing number of open wells and tube wells has created a situation where the wells often run dry within few days after the end of the monsoon season. Attempts to explore ground water at depths of about a 1000 feet often results in saline, brackish, and hot water (at 40-45 degrees Celsius) that is neither suitable for irrigation nor the domestic use. The entire region does not have aquifers and water seeps in mainly through open lineaments, dykes into fractures and fissures in the sub-strata that is capable of retaining water to meet the irrigation and domestic use needs for most part of the year, depending upon the localized water use pattern.

2.0 Water recharge in the wells

The peculiarity of the geo-hydrology of the region, and absence of a major river basin, (the four seasonal rivers in Saurastra fed by seasonal streams/tributaries that become active with arrival of rains and run dry soon thereafter) leaves no scope for an elaborate canal system for irrigation. Frequent occurrence of draughts and crop failures made some farmers to experiment with well recharge in 1988 in Dhoraji taluka of Rajkot. Their logic was simple. Why allow all the water to run -off into the sea? Why not collect it back into the well, and use it for irrigating the crops. This can well be said to be the first conscious effort by farmers themselves to find answer to a perpetual problem of water shortage that later grew into a popular movement. The movement gained further momentum following severe draught of 1999 monsoon when rains failed all over Gujarat state including south Gujarat that normally receives around 1800 mm rainfall.

Direct recharge of open wells and bore wells by collecting the surface runoff in collection tanks, lined with sand, gravel and stone filters, and then diverting it straight into the wells through a pipe opening directly into the well (in case of open wells) or diverting the water into the casing of the bore well. The method has been popularized in Saurastra region by ***Saurastra Lok Manch (SLM),*** a non profit making public trust, set up on 24th April 1989 by *Shamjibhai Antala*, a veteran journalist and social activist, with the sole purpose of creating awareness among the farmers about the well recharge technique and urging them to find their own solutions to the recurring water problem. The technique has been widely used by the farmers of Rajkot and Junagarh districts. The movement was supported by voluntary donations from Surat based businessmen originally hailing from Saurastra to mass produce literature on well recharge techniques and it's free distribution. Well recharge as a method was first reluctantly adopted by a few farmers, some of them belonging to the *Swadhyay* movement and drew the attention of other *Swadhyayis*. Later as the *Swadhyay* pariwar got convinced about the efficacy of the technique, it took initiative to popularize the

method mainly in Rajkot and Junagarh where soil conditions permitted direct recharge without the fear of mud clogging the fractures in the wells.[3]

The other important organization, that took to direct well recharge in Saurastra is the Swaminarayan Gurukul, Rajkot. It however, gave up on it after two years and took to Check dam activity aimed at recharging the water table. Many NGO's and other charitable trusts that are now engaged in rainwater conservation movement in Saurastra are still apprehensive about direct well recharge. Moreover, Saurastra Lok Manch, that initiated popularization of the technique on a wide scale, is now inactive for the last three years as Mr. Antala, the founder of the trust feels that they have achieved the objective of popularizing the technique and there is not much left for the trust to do.[4]

The third important organization that has worked on direct well recharge is the NGO- Agha Khan Rural Support Program, India (AKRSP). The NGO is active in the coastal Mangrol- Maliya Talukas of Junagarh district. In this part the farmers have been doing intensive irrigation through DTW's. Over extraction of groundwater has resulted in a large number of coastal shallow open wells and STW's turning saline, affecting both- drinking water supply, crop output and quality.

3.0 Recharging the Ground water table

There have been two principal examples as inspiration for ground water recharge movement in Saurastra. One: village Raj Samadhiyala in Rajkot taluka of Rajkot district. Located at 20 km from Rajkot city on Bhavnagar road, this village has, over a period of nearly 20 years built an infrastructure that enables all the village wells to recharge even when the annual rainfall is just about one third of normal. Water recharging through check dams started in 1978. To date they have build 45 Check dams / causeways and 13 percolation tanks/ earthen dams. Last year the rainfall was just about 8 inches, yet all the 240 wells in the command of the watershed were fully recharged and the water lasted for one full year for irrigation, apart from permanently solving the drinking water problem. RS has thus set a very fine example of coping with draught and is today seen as a model for replication all over Saurastra.[5]

[3] In a personal interview, a Swadhyayi, Mr. Chunibhai Kotak, who is an engineer and worked in the irrigation department for over three decades, explained that initially when they noticed that some swadhyayi farmers had started adopting the technique, he and others were apprehensive about it's adoption for fear of the muddy rain water clogging the fractures and causing a permanent damage to the wells. They studied a number of structures build by the farmers and found that their fears were ill founded. The collection tanks filter out all the mud and only clean water flows into the wells. This is so, because the first showers bind loose clay particles. The surface run-off starts only after the topsoil gets saturated. The seepage from the saturated soil is also clean. Mr.Kotak, then coordinated well recharge activity of the Swadhyay movement all over Saurastra. Major work on direct well recharge has been done by the Swadhyay pariwar.

[4] According to Antala, the sole objective of the SLM was to popularize the technique by enlisting the support of NGO's, a local Gujarati daily newspaper PhoolChhab (Antala was its circulation manager and the paper management allowed him to use the distribution network to distribute in towns and villages booklets of the trust on well recharge), other religious and spiritual organizations and the farmers. To achieve this he, along with other leaders of religious and spiritual organizations traveled all over Saurastra, organized public meetings in villages and motivated the farmers. The trust had no staff, as it was not constituted to implement the program. Its job was only to spread awareness. Now that the technique is widely known, there is no need for the SLM to continue any longer.

[5] Please See Annex 2.

Another example to emulate has been that of the work carried out by Tarun Bharat Sangh (TBS) in Alwar district of Rajasthan. Through a series of Check dams, the TBS has been able to raise water table in the wells of 660 villages, has revived a dead river- Arwari into a perennial river and has provided a low cost permanent solution to the problem of water scarcity and environmental degradation. Many private and public trusts from Gujarat have studied the work of TBS in Alwar, found it replicable in Saurastra and have taken technical assistance of the TBS to start the activities in their own area of operation.

4.0 Organizations in Groundwater recharge

1.Saurastra Jaldhara Trust, Surat (SJT)

Notable among the organizations who have done considerable work on Groundwater recharge, through building a series of check dams on the streams of the four seasonal rivers of Saurastra along with building a deep canal system with check dams to stop the rain water from quickly flowing away is the Saurastra JalDhara Trust, Surat. Promoted by the diamond merchants hailing from Amreli and Bhavnagar districts and based in Surat, drawing inspiration from TBS and RS, the trust built 200 check dams and 20 percolation tanks in village Khopada of Bhavnagar district in just one year-1998. With the first rain of 1999 monsoon season, all the CD's and PT's got completely filled and the water table in the village wells rose by an astounding 20 to 50 feet. This one recharge enabled the farmers to take irrigated rabi crop and the agricultural production in the village, according to the trust, doubled in one year. What is noteworthy here is that 1999 was a year of severe draught all over Saurastra including Bhavnagar. Moreover, Bhavnagar district had suffered from draught for 9 out of 10 years of varying intensity during the decade of 80's-of which the last 5 years were particularly severe affecting 100% of the inhabited villages.

During the current year the trust replicated the process after seeing the results of Khopada experiment in many other villages. In Dudhada village of Lathi taluka in Amreli district, all cart tracks measuring 42 km in length were converted into canals and 104 check dams were built at an average distance of 500 meters. Overflow from fields and the last check dam is collected in a drain built to carry the overflow towards Lathi, and the surplus of Lathi flows into Shutranji River. Entire work was completed this year in just 8 months. Peoples' contribution has been in form of: one, surrendering land to allow for widening of the cart tracks into canal and dumping of excavated earth on the other side to form as elevated road and two, as wage free labor. The village has 100 families, all own land including about 20 harijan families (a socially backward class) who are as much part of the program as others and are also to benefit from irrigation water. First rain of the current monsoon season-about 4-5 inches has just filled up the canals and the recharge has begun. Within 24 hours after the rain the collected water level in newly dug canals dropped by 2 feet. Expectation of the farmers is that, for the first time, all the 65-70 wells (Operational + defunct) will have recharged water to irrigate entire 4500 Bigha of cultivated land. The village had earlier tried direct well recharge. It worked better than normal recharge in a year of normal monsoon when barely 5-6 wells got fully recharged, but was still not very satisfactory. They now hope that all the wells will get recharged fully once the rainfall of about 8-10 inches is received. During the year similar structures were built by the SJT in Jharakhia, Kerada, both villages contiguous to Dudhada, Trust activities now extend to 220 villages of Gadhra, Botad, Vallabhipur and Mahuva talukas.

2.Sardar Patel Jalsanchay Abhiyan Trust, Paanch Tobra, Lathi Taluka, Damnagar-Garidhar Road.

This trust, again promoted by Surat based diamond traders from the village, also drew inspiration from the achievements of RS and Alwar. In order to find a permanent solution to the acute water scarcity, the village decided to use it's own resources to build a canal-check dam structure to conserve rain water similar to what had been done in RS. The peoples' contribution was, by consensus fixed at Rs. 200-300 per bigha and wage free labor. The trust provides cement for construction of check dams. Before starting the work, the trust held a village meeting in which a resolution was taken that no one from the village would incur any expenditure on religious and social ceremonies and instead use the saved funds for water recharging infrastructure. . Another major decision taken and promptly implemented was to fill up all bore wells deeper than 200 feet, and the resolution was promptly implemented. Since the diamond traders who normally help the villagers at the time of need with funds were the motivators, the village placed their entire trust in their judgment, thus there was no difficulty in getting the above resolution unanimously accepted and promptly implemented. The villagers understood that they have everything to gain from the leadership of the diamond merchants. The trust activities now cover 222 villages in Gariadhar, Sihor and palitana Taluks with Check dams and water conservation activities.

3.Agha Khan Rural Support Program, India (AKRSP)

In Saurastra region, the AKRSP is active in Mangrol-Maliya taluka of Junagarh district covering 427 villages. The focus of the program is to check salinity ingress, which has been affecting the entire coastal belt. Due to intensive irrigation with DTW in the coastal region and cultivation of water intensive crops like sugarcane, wheat, coconut etc, the salinity ingress has been increasing at an annual rate of 500 meters turning all the shallow wells and drinking water sources saline. The increased salinity in soils is resulting in a steady decline in the yield of Ground Nut and Sorghum, the size of coconuts is reducing and the water in the nuts is turning saline. In other parts of the district, bore wells up to a depth of 400 feet fail to yield water for more than a season. AKRSP initiated its activities in the area of water in 1995-96 and has till date (1999) three types of activities related with water: -

- Drinking water, underground storage tanks: For domestic water use, the activity involves construction of underground tanks at household level to collect rainwater. Each household gets a tank of 20000 liters capacity. To date 460 tanks have been constructed with GOG funding @ Rs.18000 per family and family contribution of Rs. 2000.
- Construction of 129 check dams to recharge ground water levels and surrounding wells. This activity is financed jointly on cost sharing basis by the GOG-75%, AKRSP-25%, and a 5% voluntary contribution of the beneficiaries (farmers' whose wells fall within the command of the dam and feel that they would benefit from recharge of wells)
- Direct well recharge: 150 numbers (Out of some 6000 wells with recharge structure in the area. Others have been done by the Swadhyay pariwar.)

4. Shri Swaminarayan Gurukul, Rajkot

The Gurukul, a religious and educational body has under taken recharge activity under the name- Dharmjeevan Jal Sanchay Abhiyan. Motivation for starting the activity came from the Chief of the Gurukul, Swami Madhavpriyadasji, who himself visited number of villages to motivate people. The Swami has earlier traveled to a number of villages and held village meetings with Shamji Antala and other social activists to motivate villagers to adopt direct well recharge. The Gurukul had two years ago started with direct well recharge and recharge structure was built for 269 wells in 9 villages of Rajkot Taluka. 1080 sections of poly-pipe measuring 4331 feet were distributed among the farmers who wanted to build the recharge structure. The beneficiaries, with recharged wells were able to take winter crop, but as the concept did not go too well with a larger number of farmers, this activity has now been totally replaced by promotion of check dams. Bulk of the work done so far is in Amreli district followed by Rajkot and Junagarh. To date 175 CD's have been completed and 234 are planned to be build soon after the monsoon of 2000. The Gurukul's assistance to beneficiaries- village communities- is mainly in kind, i.e as cement. The total storage capacity created, when all 175+234 CD's are ready will be 80.5 MC Feet (5511 cubic meter per check dam). The activity of the Gurukul also extends to constructing/ deepening ponds, wherever feasible like in Keria-Na-Gaas (a village 5 km from Amreli town) after removing *prosopis sp.* locally called Ganda Baval. (*prosopis* initially promoted to solve the fuel wood problem of the villages, is a water guzzler, spreads very fast and is now perceived as a major problem for water recharge.)

On a much smaller scale, a number of organizations have undertaken the task of recharging the groundwater table at local levels. Some of them have done exemplary work in terms of achieving a high degree of peoples' participation. Much of this work has been done in just two years- 1998 -2000. Some of these organizations are:

- Village Panchayat, Gadvadar: The village panchayat built 51 Check dams in one strokes in the 51st year of India's independence and an obvious reaction to lack of Government effort to solve the problem even after 50 years. Village saw water collect to recharge their wells for the first time in 50 years. People's contribution was fixed at Rs. 200 per Bigha owned. Key person who motivated and spearheaded the movement is Mr. Mansukhbhai Patel.

- Jambudi village 12 km from Virpur, Jetpur Taluka, presents a different kind of participation. The Government built a village pond on its own in the village in mid 80's. In 1988, the embankment of the village pond breached following heavy rains, villagers saw the embankment slowly give in but made no efforts whatsoever to save it simply because they did not identify the pond as their own. The Breach resulted in the embankment give way flooding the entire village causing extensive damage to houses and property. Last year, in a similar situation following the cyclone, the villagers saved the pond from breach working in heavy rain throughout the night facing the cyclonic storm by widening the weir to let off excess water. This was after the management of the pond was transferred to the village community.

5.0 Government of Gujarat in Water Conservation through Check Dams

5.1 Sardar Patel Participatory Water Conservation Project, (SPPWCP) in Saurastra:

It was in response to this popular public perception that the government of Gujarat responded by launching the SPPWCP on 17th January 2000. It also became apparent, in wake of the draught of 1999, (when out of the total storage capacity of 2200 MCM in 113 dams in Saurastra region, only 140 MCM of water was received) that a quicker solution to the recurring problem lies in adopting a participatory approach to rain water harvesting and ground water recharge. The accumulated water in the dams in 1999 was not adequate even for drinking, leave alone irrigation. This was perceived as the worst ever situation in the last 10 years. Emigration of livestock and humans appeared a certainty. The Government had to respond on a war footing with organizing water movement to villages and towns for drinking purposes by road tankers and rail. What however saved the day in places that suffered the most in the past was the infrastructure built by the people on their own during the last two years. More than 1000 people had visited Khopada, RS and other places, seen for themselves what their own collective effort can do- and do it better and faster and in their own small way had initiated a process that was soon to culminate, with government support under the SPPWCP, into the most notable sustainable development effort undertaken with people's participation in such a short time anywhere.

The Government, after having failed in the last two years to attract the attention of public institutions/NGO's to avail of the 90% subsidy for building check dams (only 200 were build over a two year period), decided to reduce the subsidy to 60%. It simplified the procedures for approval and release of funds, empowered the engineers down the line to approve the projects, organize survey of completed projects by private survey agencies, and recommend release of 60% government contribution. In the process, the average cost of the CD came down from 5 lakhs to 2 lakhs, as the contribution of the village very often in terms of locally available materials and labor resulted in considerable savings[6]. Gauging the public response to the scheme, cement companies reduced the price of cement from Rs 125 per bag and fixed it at Rs. 105/- per bag delivered at site. It all happened after Mathurbhai Sevani, Chairman of SJT successfully negotiated a *delivered at site price* of Rs 105 per bag with Ambuja cement and purchased 300,000 bags for the purpose. Other companies like L&T soon followed suit. Now all the cement companies have decided to support the popular movement by supplying cement at this price.

So strong was the public response to the simplified scheme-despite its lower subsidy that in a short span of seven months (17.August 2000). 9875 check dams were built, while another 1224 were in progress in Saurastra. Most of these projects have been implemented through NGO's, Voluntary organizations, religious/ spiritual bodies/

[6] The Secretary, Irrigation department to the Government of Gujarat, in a personal interview explained that, the cost of labor, overheads, and the contractor's profit, in a normal procedure cost as much as 30%. When the communities execute the projects directly, they use locally available materials like sand and stone and that further brings down the cost. Reduction of GOG contribution therefore was well planned and since the village communities had to contribute no more than locally available free materials and labor, the program received such a massive response, than the earlier 90:10 scheme, where the villagers had nothing much to contribute. The earlier scheme therefore did not give them a sense of ownership. That seemed to be a major reason for the failure of the earlier scheme, despite a higher proportion of subsidy. It makes one thing very clear. The villagers are looking for ownership of the resources, and not cheap funds or subsidies.

local leaders etc. The beneficiaries have contributed 40 % of the cost either as labor, cash contribution (Lok Phada) or locally available materials like sand, and stone.

At many places private initiative of farmers, to get advantage of the GOG's 60:40 scheme has also resulted in CD's getting built. E.g. at GalKotdi village in Babra Taluka of Amreli, 2 brothers who own land on either side of the road have build a small CD. Such structures, after survey by an approved agency, are reimbursed 60 % of the construction cost by the government as per the approved formula/scheme.

To sum up, the popular movement for groundwater recharge, as a coping mechanism to draught, and to meet the needs of drinking water and irrigation have gained unstoppable momentum. It now seems probable that in the coming couple of years, the popular movement will result in dotting the entire Saurastra region with over 35000 check dams, percolation tanks, recharge wells, renovated and deepened existing tanks, and other structures for water recharge.

5.2 Measuring the extent of ground water recharge

As for many of the structures built it is the first ever experience to receive the rainwater; actual extent of recharge cannot be precisely arrived at. However based on the estimated recharge, the estimated number of wells that will get recharged due to the structures built to date is as given in table below:

Table: Estimated Water recharge and irrigation potential created:

	Estimated Number Of structures	Water collection potential MCM	Wells to get recharge	Irrigation Potential in 000 acres @ 8 acres per well
Direct well recharge*	118200	35.46	118200	945.60
Check Dams by private trusts**	4100	22.55	41000#	598.19
Check Dams under SPPWCP***	9875 +1224 (in progress)	61.04	110990	887.92
Total		119.04	270190	2431.71

* According to Shamji Antala, an estimated 350000 wells (out of 700000 in Saurastra) now have recharge structures. Swadhyay partiwar on the other hand places the exact number at 98470- where they have been directly involved. No agency other than the SP has worked on a scale so large to build the recharge structures. Antala's estimate is not supported by hard data yet he believes that there is a fairly large number outside the SP ambit that has on its own build structures for rainwater harvest and recharge. Assuming that the 'others' have build some where close to 20 % of SP's numbers and includes the work of NGO's, Swaminarayan etc, the total structures work out to 118164, say 118200. I treat this numbers as safe for calculating the water recharge potential.

** Estimated number of all the trusts / voluntary organizations, built outside the SPPWPC.

Saurastra Jaldhara Trust and Sardar Patel Jal Sanchay Abhiyan Trust are mainly in motivating the villagers to take advantage of the Government's participatory scheme. They are not able to segregate the number they have fully funded through supply of cement out of their own funds. This is an estimate based on figures provided by various agencies on phone.

*** Includes only CD's built in collaboration with NGO's, religious and charitable trusts after the launch of the scheme. These figures are from the official progress report as on 17.8.2000.

5.3 Parameters to estimate the well recharge

- In case of direct well recharge structures, with 20"of rain and four fillings in a season, an estimated 300,000 liters of water goes in the well or 300 cubic meters equivalent.
- Each check dam recharges 8-10 wells, depending upon the spread of wells in the command and the command under each check dam. Normally a check dam recharges water table and wells within 2.25 Square km around it, However, wherever the check dams have been built in a series barely 500 meters apart, which has been the pattern in most cases where seasonal streams and recently dug new trenches/ canals have been used to build a series of check dams, the command gets reduced to 1.5 Sq. km. The advantage, however is that even with a rainfall as low as 100 mm, the surface run off gets collected in the CD's and recharge starts almost immediately thereafter. The average storage of a check dam is taken at 5500 cubic meters, based on the figures provided by the Swaminarayan gurukul for the Check Dams they have built.
- A recharged well stores enough water to irrigate 8 acres of land.

Based on the above parameters, it is estimated that the work done so far has created potential to recharge, either directly or through water table recharge, 270190 wells. This is approximately 40% of all open wells. The irrigation potential created is for 2.43 million acres. Even if the rainfall between 8-10 inches takes place to cause adequate surface runoff. This water shall be in addition to the normal recharge from natural percolation.

6.0 Groundwater Recharge Movement in North Gujarat

Popular response to water recharge movement in North Gujarat has however not been on the scale as large as Saurastra. North Gujarat region comprising the districts of Banaskantha, Sabarkantha and Mehsana also receives around 700 mm rainfall and is water scarce. Banaskantha and Sabarkantha, as the name implies are the basin area of the Banas and Sabar rivers whose catchments extend to the neighboring state of Rajasthan. Dams built on these two rivers brought canal irrigation to some parts these two districts. Mehsana on the other hand does not have a perennial river. Sabar and Banas rivers however flow through the eastern and western boundaries of the district, so the northeastern and northwestern parts of the district are irrigated on a limited scale by the dams built on these rivers.

Mehsana is an intensively cropped district. There has been a steady increase in the use of ground water for irrigation in north Gujarat in general and in Mehsana in particular. In most villages of the district, not serviced by canal network, there are on an average 100 to 150 Deep tube wells. The water table is receding at an alarming rate of 2 columns or 20 feet annually and the farmers have to lower column pipe in the bore wells by that much depth each year. It is estimated that 10 to 15% of the tube wells that were 300-500 feet deep, have become dysfunctional on account of receding water table.

For the entire north Gujarat well irrigation[7] continues to be the most vital accounting for over 95% of the net irrigated area. Though at present, ground water depletion by DTW's is not as serious a problem in Banas and Sabar, intensive irrigated agriculture in these areas with ground water (farmers cultivating rice in kharif and wheat in winter) may soon create a situation similar to that of Mehsana. Failed Monsoons in North Gujarat resulted in all the three districts suffering from severe draught in the last decade for four out of last 5 years when over 85% of villages (in the three districts) were affected.[8]

Ground water recharge activity through popular participation is relatively new in North Gujarat. Its scale is also limited due to the geo-hydrological features of the area. Most part of the region is a flat terrain with sandy loam soil. The hard rock strata are very deep-and is not reached even when DTW's are bored at a depth of over 1000 feet. There are however three aquifers at a depth of 70-150 feet, 200-300 feet and 400-600 feet. All the three-aquifer layers have been over exploited and the newer bores are being done at a depth exceeding 1000 feet. Farmers also drill new bores close to the existing failed bores, if they are unable to lower the column pipe any further. Gradually the diameter of the casing and the column pipes currently in use has increased to 10" and 5" respectively. The idea of the farmers is to use 48-52 HP motors and draw as much water as they can from as deep a strata as possible.

7Area irrigated by Source (oo) hectare. 1986-87

	Mehsana	Banaskantha	Sabarkantha
Irrigated by wells	2581	2523	1320
Net area irrigated	2643	2618	1379
Gross area irrigated	3825	2791	1414

8 Villages affected by draught

Year	Mehsana	Banaskantha	Sabakanthar
81-82			
82-83			
83-84	678	995	
84-85		172	
85-86	1110	924	1358
86-87	1111	1278	1365
87-88	1111	1279	1375
88-89			
89-90			

6.1 Organizations in water recharge

1.Swadhyay Pariwar

The realization following this massive over exploitation and the knowledge of the work done in Saurastra prompted some Swadhyay Pariwar[9] members to try and popularize direct well recharge. This has been attempted on a limited scale through village meetings and other normal awareness activities of the SP. The beginning made by building collection cum filter pits, on open community wells as a demonstration for others to follow has not met with a popular public response for large-scale replication. Individual farmers feel that since the underground strata is sandy, there is no guarantee that the benefit of their effort will accrue to them. Moreover the geo-hydrology of the region and the location of wells/ Bores on the farms at an elevation seems to have created doubts in the minds of the farmers about the economy and efficacy of the method.[10]

The focus of SP's work in north Gujarat has been more on drinking water and water for domestic use. They believe that 80% of the water used for domestic purposes is recharged, and if it can be collected near the use point in what is termed as the " Sokh Khada" or Soak pit lined with stone, gravel and sand filter, it will allow only the clean water to get into the aquifers. This practice is being promoted on bigger villages having approximately 500 or more households.

2.The MotiBhai R Chaudhary Foundation, (MRCF)

MRCF is perhaps the only organization that has taken up water recharge activity, to begin with, in Mehsana district of north Gujarat on any appreciable scale. The trust registered on 10 February 1997, as a public trust under the Bombay Public trust act of 1950, has among other things water conservation as one of the main objectives. Regarding water its objectives state, " to collect and conserve rain water, recharge groundwater resources by deepening ponds, using dysfunctional wells/bore wells to recharge the ground water table with rain water, to make recharge bores in ponds and, to promote judicious use of ground water, to improve water quality and to improve the irrigation methods etc"

[9] The Swadhyay movement, better known as Yogeshwar pariwar in North Gujarat has a well-organized set up. For example, in Mehsana, there are 16 sub areas with a person responsible to organize the activities. They organize village meetings of all SP members and others from the village to discuss the common problems and find solutions. More important on their agenda is the problem of drinking water. That is how their work on well recharge is more on common wells and is not as visible as that in Saurastra. Moreover, all the water that gets into a recharge well gets promptly soaked into the earth due to sandy nature of the soil. This may be one strong reason for not many individuals' farmers responding enthusiastically to direct well recharge. Whereas Saurastra farmers are sure of getting back almost all the water that gets into the well for self use, farmers of north Gujarat feel that the benefit of their effort may not be available to them at all. Moreover all the wells and bores that can potentially be recharged are situated at a higher spot on the farm to take advantage of gravity flow. Using them for recharge would mean reversing the slope of the land, and creating gravel filled column outside casing pipe for the recharge. This probably, being an expensive proposition does not appeal to a large majority.

[10] Ashwin Patel, a farmer from Jagudan village of Mehsana taluka, also an employee of the Mehsana oil union (MDTS) who works in the farmer's organization division feels that there is tremendous scope to recharge the defunct bores by removing the column pipes and using the casing for recharge. The location of the bores however has to be suitable for the purpose.

The Trust[11] has used its corpus to acquire earth-moving equipment to undertake mainly two activities. One, de-silting of existing ponds/ making new ponds wherever feasible; two, strengthening the embankments of existing ponds. At present they have 5-bucket excavators (JCB) and 11 tractors with trolleys.

Ponds deepening:
The MR Foundation has, since inception repaired and de-silted 40 village ponds. Since this work can be done only after the monsoon season, work in another 15 villages - equivalent to about one year's work with the resources currently available is yet to be undertaken. The modus operandi is that the village wanting to deepen the well has to contribute 20% of the estimated cost of the work (at Foundation rates) with the foundation. In many cases the 10% fund is contributed by the constituency's Member of Legislative Assembly (MLA) from his constituency development fund or by the MRCF. The balance is borne by the Gujarat Water Resources Development Corporation (GWRDC).

Well recharge:
The MRF has drilled 13, 200 feet deep recharge bores in tanks with collection pits measuring 20' x 20' x 20' to collect rainwater. The foundation also supplies, free of charge to the individual farmers willing to build a recharge structure with collection filter pit of dimensions 5' x 5' x 5' at their own cost, pipes to recharge failed bores, provided they are no deeper than 300 feet. The cost of doing the filter pit and laying the pipe is required to be borne by the farmer.

The work done by the MRCF has attracted the attention of many other charitable organizations both National and International. Though they themselves are not directly involved in water recharge movement, they have offered support to the MRF. These are:

1. L.D Jhaveri Foundation, Kobe, Japan. This foundation comprising mainly of Jain community based in Japan has supported the MRF with funds @ Rs. 100 per hour of work executed by them for water recharge in Gujarat and Rajasthan. Their support has been for 15 village ponds so far and more support is promised.

2. Sachhidanand Samaj Seva Trust, Unjha (Banskantha district): This trust too is involved in pond deepening and de-silting. They have I JVB and 6 Tractors. They have so far deepened 7 ponds and charge Rs, 500 per hour. The SSST has offered equipment to MRF.

[11] Motibhai Chaudhry, Chairman of the Mehsana District Cooperative Milk Producer's Union Ltd. since October 1970 was presented a purse of Rs. 11.0 million (equal to one days milk payment) by 1055 Village milk producer's cooperative societies (VDC) that are member of MDCMPU Ltd On his 75th birth day. Another Rs 8 million was collected as advertisement fund from VDC for the souvenir published on the occasion. The entire fund has been used to purchase two sets of earth moving equipment -1 JCB and 6 tractors with trolleys. The set is rented out to the villages that want to use it to deepen the village pond, build a new pond or strengthen the embankment at Rs 350/- per hour. The hiring party has to deposit Rs 35000 for 100 hours, the minimum time it takes to complete the work. The trust usually hires out the set for a maximum of 200 hrs. The effective rate of excavation works out to Rs 6.20 per CM, against the minimum rate of Rs 26.35 charged by the public sector Gujarat Water Resources Development Corporation. (GWRDC). The objective of the trust is to cover only the cost of fuel and lubricants etc. as contribution from the beneficiaries- the village.

In short, in north Gujarat, between MRCF and the SSST 48 ponds have either been de-silted/ deepened/ embankment strengthened. And only about 20 recharge bores made by all the agencies put together. The topography and geo-hydrology is more suited for working on ponds as water collection and recharge structures.

6.2 The SPPWPC in North Gujarat

The response to the scheme in North Gujarat has been very limited[12]. Only in Sabarkantha district, upto 17 August 2000, 70 Check dams were completed and other 40 were in progress. None were undertaken in Banaskantha and Mehsana, even though, the examples of Khopada and Dudhada, (where on a flat topography water harvesting structures have been built by converting the cart tracks into canals) are well known all over Gujarat. The poor response to the scheme may be for a variety of reasons including the geo-hydrology and the feeling among the individual farmers that the water can be endlessly drawn from the depths, which is not the case in Saurastra.

7.0 Analysis and Conclusions

1. People's participation: Saurastra Vs. North Gujarat:

On direct well recharge, the response from north Gujarat has not been as strong as that from Saurastra. The geo-hydrology appears to be a major reason for non-adoption of direct well recharge as a means to augment natural recharge. The inherent fear of the recharged water benefiting someone else (ones own efforts not paying off) due to sandy nature of the soil can be one of the strong reasons for poor response. There cannot be any doubt with regard to the effort put in on promoting direct well recharge by the Swadhyay Pariwar in north Gujarat- they are known for their dedication and commitment to the cause- yet the momentum gained is nowhere near that in Saurastra. Whereas the north Gujarat regions has continuous aquifers that farmers have exploited to the hilt, especially in Mehsana, the saurastra region has only broken fractures. Thus the water that gets into these fractures through a well remains available to the well owner for eventual use. This however is not a surety in North Gujarat.

Saurastra also has a number of voluntary agencies, religious and spiritual organizations that have come forward to lead the people in their quest fir water. By contrast, in north Gujarat, the only organization that has made a significant contribution is the MRCF. The approach for water recharge in Saurastra has relied more on the labor input from the potential beneficiaries for building the check dams and other structures. They have relied less on the funding from the Government. On the other hand, North Gujarat organizations have relied more on capital investment on heavy earth moving equipment and government funding (GWRDC) to deepen the ponds and strengthening the embankments. The time taken to complete the procedures to get funds from a government agency has slowed down the recharge movement, at the same time kept individual farmers at a distance. Moreover the resources available with organizations like the MRCF in itself is a constraint in rapidly expanding the recharge activity.

[12] Besides Sabarkantha, 31 Check dams were built in Ahmedabad and 281 in Kachchh. Projects in progress were 13 and 203 respectively. It is obvious that those who have suffered the wrath of the draught most in the past are responding better to the government support to the recharge movement.

2 Response to past experience

It is obvious that the people of Saurastra have suffered more often due to failure of rains. The fast and overwhelming response to the SPPWCP in Saurastra can be attributed to this phenomenon. In fact their own initiative- work done by the Saurastra Jal Dhara Trust and others in building check dams triggered a response from the government in form of the SPPWCP. No such initiative is evident in north Gujarat. If the SJT could convert the cert tracks into canals in Khopada, Dudhada and other villages and demonstrate the efficacy of the water table recharge in Saurastra, similar work could have been tried in the flat terrain of North Gujarat as well. Yet no has one tried it. For most farmers there are no success stories to emulate.

3. Well Recharge Vs. Water Table Recharge

The two distinct approaches tried in Saurastra have had their supporters and critics. The critics of direct well recharge do not find the technique suitable for all the places, and even in places it has been tried, they express grave concern regarding the future economic life of the wells that have recharge structures. They favor water table recharge through a network of Check dams. Technical experts on the other hand do not see anything wrong in the direct well recharge, especially in areas of Rajkot and Junagarh where it has been widely accepted. The farmers have benefited, many of them have been using these wells for irrigation and protecting their crops for well over a decade. There can be no two questions regarding wider applicability of the Check dam approach, but in the initial years it was the direct well recharge that attracted the farmers attention the most. Raj Samadhiyala experiment was there as a demonstration, but it became replicable on a large scale only after the trusts promoted by the diamond merchants arrived on the scene. Obviously the whole movement is leadership driven. The leaders too drew their inspiration from TBS' work in Alwar, Rajasthan and not directly from RS. It is now clear that as the check dams increasingly become more popular, direct well recharge is taking a back seat.

As yet another factor that seems to influence the choice of the technique is the speed of recharge. This season's rainfall to date provides some evidence to that. The first rains of about 4-5 inches had all the check dams in RS and other places full to the brim and the water level in the wells within the command of CDs had began to rise appreciably. On the other hand, in none of the wells with recharge structures, there had been any rise in the water level. The rainfall was not enough to saturate the topsoil and cause seepage/ surface run off good enough to permit direct well recharge.

Conclusion

To conclude, the most important aspect is that there is strong evidence of public consciousness towards water recharge movement in Saurastra, and over the coming years, as things are now, it should contribute significantly to coping with draught, provide answers for sustainable growth in agriculture and help solve the drinking water problem. North Gujarat on the other hand is yet to demonstrate this consciousness. MRCF in Mehsana, can possibly provide a strong basis to rapidly spread the movement in North Gujarat.

Annexes

Annex 1: Farmers' feedback on Well recharge

This feedback is from farmers of Mandlikpur, a village near Dhoraji and the neighboring village. The village has a history of being one of the most water-starved villages. It has 150 wells; of these some 130 have now recharge structures. Now most farmers are able to cultivate 3-4 bighas (2.5 Bigha make a standard acre) of irrigated crop and claim that their average income has gone up by about 60%.

Following is the feedback of some farmers in Mandlikpur and adjoining village, where the response to adoption of the technique has been very high.

Gunwantbhai is a Swadhyayi and he build the recharge structure with the help of other swadhyayis 8 years ago. Cost incurred was only on the pipe as labor input from swadhyay pariwar is totally free. According to his knowledge, around Dhoraji alone 150 wells have recharge structure. He owns 25 Bighas (10 acres) of land. Last year when the rainfall in his village was only about 8-10 inches, the recharged water lasted him till end of January, enabling him harvest good crops of cotton, castor and groundnut with protective irrigation. In a year of normal rainfall- after the structure was built, he has been able to harvest wheat on half his land as the water lasts till end of March- early April.

Wheat crop planted in late November needs 10-12 irrigations.

About the concern of muddy water getting into the fractures and thus reducing the economic life of the well, Gunwantbhai says that, since most parts of Rajkot and Junagarh, where maximum direct well recharge work has been undertaken in the last 10 years or so, the soil is clayey. With the first showers, the loose clay particles get bound with the soil and generally the water from the first showers does not find way to the collection pit/well. Thereafter any surface runoff is usually very low on mud content. The pebble-sand filter and the gunny placed at the end of the pipe further reduce chances of any mud going into the well. He therefore does not see in such soil conditions, any danger to the economic life of the well.

Chhaganbhai Bhutwad, his farm is located on Dhoraji- Jetpur road and he was one of the first adopters of the well recharging- did it 12 years ago, His well is 80’ deep. He has been able to take Rabi crop from recharged well for all the years except last year. He went in for a bore well 2 years ago and last year saved his GN and Cotton crops partly with recharged water and partly with bore water. Cultivates Wheat, Onion, Garlic and other vegetables; uses drip irrigation for garlic; investment in drip Rs. 4000 per bigha (55% govt. subsidy). 2-3 hours of drip irrigation covers 15 bigha’s of cotton, while flood irrigation in the same time covers only 3-4 bighas.

Vithal bhai - Undala: well recharge structure built 5 years ago. Recharged water lasted till Holi (march) last season, was able to irrigate GN (2 irrigations) and wheat (12 irrigations); uses 6 Hp diesel pump- 4”D discharge, farm takes 12 hours to irrigate.

Veljibhai jivrajbhai- undala has a open well, 70 feet deep, no recharge structure till last year, built one this season, water yet to come in the well as there have been no rains this season so far..

Bharatbhai Bhutwad; Bank Manager, 120 feet deep open well, did not believe in well recharging till now though his own brother built the structure 12 years ago and has benefited from it. Recently built rainwater collection pit near the roadside to collect water both from his farm and over flow from main road. However in the absence of rains, the well is yet to get recharged.

Annex 2: RS as a Model for Replication

Water recharging through check dams started in 1978. To date they have build 45 Check dams and causeways and 13 percolation tanks/ earthen Dams. When the first PT was built, the benefit was only to the extent of 2-3% in terms of additional water recharge over the normal. With the construction of all the 13 PT's the additional recharge increased to 10-15 % above normal. Check dams and causeways subsequently built increased the recharge to 50%. The society thereafter obtained a space imagery of the village from ISRO, identified lineaments and underground dykes with the help of ISRO scientists, which have been opened to speed up water recharge. The net result is that the water recharge has become faster in the last couple of years. Last year the rainfall was just about 8 inches, yet all the 240 wells in the command of the watershed were fully recharged and the water lasted for one full year. In the current monsoon season, with the first rain- just about 4 inches, the check dams and percolation tanks were full. Within a week the water level in the dams dropped by almost a meter- that is the extent of recharge that took place. The average recharge depth in the village is only 50 feet, and all the 240 wells have already water levels up from 25 feet- for the wells farthest from check dams and percolation tanks, and 40 feet for the wells closer to the structures. A farmer Mohanbhai Dershibhai Dabhi, who has his well located at one of the farthest points from a PT confirmed that after the first rain, the water level in his well increased by an average of 2 feet per day and after about 12 days now stands at 25 feet. His well was dry before the first rain. A dozen or so farmers contacted confirmed rise in the water level in the wells from 30-40 feet .In the village, the average dimensions of a typical well are 15' diameter and a depth of 70-80 feet. Since the recharge level is limited to 50 feet, rainfall in access of 8-10 inches does not add to further recharge of the wells within the village, but the recharge is seen in the nearby villages. They however are not able to give the number of wells that benefit from recharge outside RS due to efforts of RS.

The Panchayat has not made an estimate of the area of command of each check dam. All the check dams/causeways are built to cover the entire length of 4.5 km of the stream. The stream has an average width of 30 feet and the average depth is only 2 feet (higher depth- about 2 meters at the point of check dam).

The village has experimented with a DTW- depth 1000 feet. The discharge of DTW after March is of hot water - temp 40 degrees Celsius. However in the post monsoon period, the DTW yields sweet water that the village uses for drinking purposes. RS realizes that DTWs are not a viable solution for the village, and do not want to experiment with new ones. Most villagers-after having seen the space imagery can now easily identify underground dykes- these spots remain 'hot' even during winter- and lineaments, and share this knowledge and experience with other neighboring villages so that they can also open them and speed up the recharge process. People of RS are confident that even if the rains in the coming months fail, the recharge level is sufficient to see them through with the water needs of the entire village for one year.

The impact of recharge on environment has been very positive. The panchayat has focused on making the entire village conscious towards environment. The eleven-

member village panchayat, under the leadership of Hardev sinh Jadeja, has framed its own rules to govern the village. Heavy fines are imposed on person damaging a tree or polluting the environment. There were only 1600 trees in the village in 1978. At the end of 1999, there were 50000 trees. Most of the new plantation is that of fruit trees on the land of farmers. They plan to have 100,000 trees by 2002- turning RS into the greenest village of India.

The seepage from the largest PT recharges one of the three drinking water wells of the village. The well with a diameter of 20 feet is 80 feet deep, and begins to get seepage soon after the first rain. There was about 65 feet of water in the well at the time of visit- a net rise of about 40 feet from the pre monsoon level.

The total investment over 20 years has been 20.6 million. Of this 13.0 million has been on building the Percolation Tanks. Another 6 million have been invested in building the CD/Causeways, and 0.6 million on opening the lineaments and underground dykes.

The total area of the village is 2000 acres. Private area to the tune of 250 acres got submerged due to construction of percolation tanks and C/D's. This is a willing contribution of the villagers since the increase in irrigation potential and, crop output more than compensated the loss in terms of land lost. Now they are able to cultivate irrigated Bajra, Jowar, GN and Cotton and vegetables. Jadeja himself sold Tomatoes worth 0.5 million last year. No sugarcane cultivation is permitted. Village income last year from irrigated agriculture was more than the neighboring village (Without irrigation) by 25million. Raj Samadhiyala has now helped 15 neighboring villages build 200 CD's.

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