

**IRRIGATION DEVELOPMENT FOR TRIBAL FARMERS IN SURAT  
DISTRICT OF GUJARAT**

**A STUDY OF LIFT IRRIGATION SCHEMES INSTALLED BY THE  
GUJARAT WATER RESOURCE DEVELOPMENT CORPORATION LTD.**

**SHILP VERMA [IWMI-Tata]**

**MANAS SATPATHY [PRADAN]**

**CENTRAL INDIA INITIATIVE**

CONTENTS

---

<b>CONTENTS</b>	<b>2</b>
<b>ACKNOWLEDGEMENTS</b>	<b>3</b>
<b>LIST OF ACRONYMS</b>	<b>4</b>
<b>BACKGROUND</b>	<b>5</b>
<b>THE AREA AND THE PEOPLE</b>	<b>7</b>
<b>PROBLEM STATEMENT AND OBJECTIVES</b>	<b>9</b>
<b>STUDY METHODOLOGY</b>	<b>10</b>
<b>LOCATION OF THE LIFT IRRIGATION SCHEMES</b>	<b>11</b>
<b>IRRIGATION TECHNOLOGY</b>	<b>13</b>
<b>ABOUT THE SELECTED LI SCHEMES</b>	<b>14</b>
<b>IMPLEMENTATION OF THE IRRIGATION SCHEMES</b>	<b>15</b>
<b>SOCIO-ECONOMIC IMPACTS OF THE LI SCHEMES</b>	<b>16</b>
<b>MANAGEMENT OF THE IRRIGATION SCHEMES</b>	<b>20</b>
<b>UTILIZATION OF SCHEMES</b>	<b>24</b>
<b>ENCOURAGING AND DISCOURAGING FACTORS FOR TRIBALS TO GET INTO THE VENTURE</b>	<b>29</b>
<b>RECOMMENDATIONS FOR GWRDC</b>	<b>32</b>
<b>CONCLUSION</b>	<b>34</b>

## ACKNOWLEDGEMENTS

---

The authors would like to thank Mr. Trivedi, Superintending Engineer, Gujarat Water Resource Development Corporation Pvt. Ltd (GWRDC), Vadodara Circle, Vadodara for suggesting this study and for providing full support in terms of data and staff time for the study. We would also like to thank Mr. Sidhpuria, Section Officer, GWRDC for his useful inputs during the fieldwork. Our acknowledgements are also due to all the staff at the Vadodara, Vyara and Dolwan Offices of GWRDC for helping us in the selection of schemes and data gathering.

We also feel indebted to the eleven M. Phil. students of IIT, Mumbai (Archana Sahare, Chandrani Ohdedar, Dnyanesh M Patil, K R Sharma, Minal Parab, P Rachana, Rafiul Ahmed, Ravinder Kaur Bajwa, Sheshagiri G, Subhash S and Surabhi Sinha) who did a week long exploratory fieldwork in the region and whose work was of great help to us in determining the methodology and defining the terms of reference for this study. The primary and secondary data collected by them during their fieldwork has also been extensively used by us to expand the scope of our analysis.

We would also like to extend our warmest gratitude to Mr. Nayan Rajput, who helped us in the collection of data by eliminating the language barrier during discussions with the villagers and government officials. Last, but certainly not the least, we would like to thank all the people in the villages who extended full co-operation and support during the study.

**LIST OF ACRONYMS**

---

PRADAN	Professional Assistance for Development Action
IWMI	International Water Management Institute
GWRDC	Gujarat Water Resource Development Corporation Pvt. Ltd.
IIT	Indian Institute of Technology
LI	Lift Irrigation
Ha.	Hectares
GCA	Gross Cropped Area
CCA	Culturable Command Area
LBMC	Left Bank Main Canal
SO	Section Officer
ST	Scheduled Tribes
SGSY	Swarn-jayanti Gram Swa-Yozgar Yojana

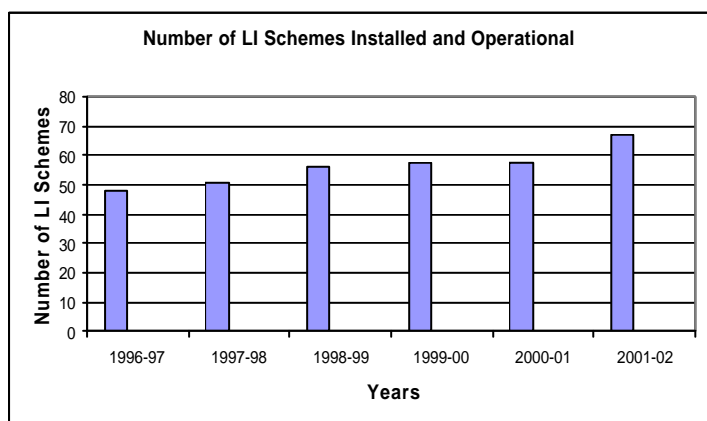
## BACKGROUND

Ukai is the largest multi-purpose project undertaken by the State of Gujarat and is only next to the Narmada Project in terms of the promised and potential benefits that it offers. Ukai forms the terminal reservoir harnessing nearly half the water of the Tapi River. The Ukai Left Bank Canal originates from the head regulator at Ukai. It is a lined canal upto 73 kms and another 48 kms is unlined. The total length of the distribution system is 990 kms. The main canal with 6.5 M x 3.0 M section at the head carries a design discharge of 1,236 cusecs. The GCA<sup>1</sup> covered by Ukai Left Bank Canal System is 1,21,410 Ha. (3,00,000 Acres) of which 85,000 Ha (2,10,000 Acres) is cultivable. After the construction of the Ukai dam on Tapi River in 1972, a green revolution took place in the state of Gujarat with subsequent introduction of the canal network.

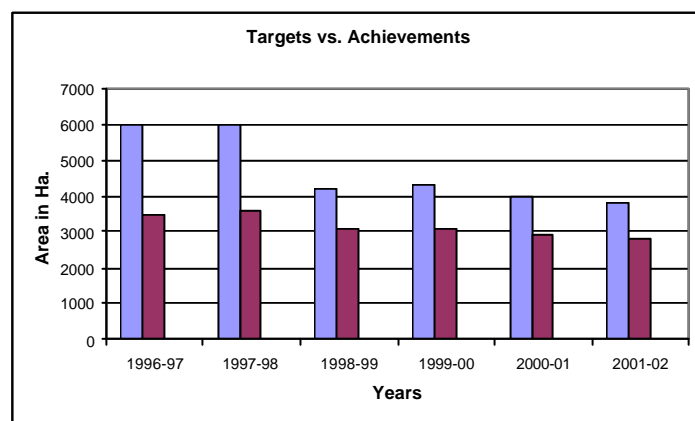
### Box 1: About the Study

This case study is prepared as a part of the **Central India Initiative**<sup>1</sup> to identify clues for designing interventions for sustainable irrigated agriculture supported livelihoods among the tribals. It is based on the discussions with GWRDC<sup>1</sup> officials and the community involved; the fieldwork report of the eleven IIT Mumbai M.Phil. students; review of relevant literature, documents and records and observations made by the authors during the fieldwork of August 2002.

With the target of taking the benefits of irrigated agriculture to the poor tribal farmers, who could not get flow irrigation from the canal, the Government initiated Lift Irrigation (LI) schemes in the periphery of the canal command. At the time of inception of the LI schemes, an additional command area of 32,000 Ha was demarcated; the financing of the scheme was initially done through a provision in the government budget but later, the financing was done through loans from NABARD. The state entrusted the GWRDC with the responsibility of installing and managing the lift irrigation schemes on the left bank canal of Ukai dam to irrigate the uplands of mostly the tribal people in Surat and Valsad districts. The massive effort to install 78 motor-operated lift irrigation schemes for irrigating nearly 15,000 hectares started in 1981 with funds from Agricultural Refinance and Development Corporation (AR & DC), Mumbai. The average cost of a single LI scheme has gone up from Rs. 10-12 lakhs at the time of inception of the scheme (1978) to about Rs. 30 lakhs now. The average execution period for a single scheme is 1 to 1.5 years. This period includes electrification of the area, which takes the maximum time. Thus far, 67 of the 78 proposed schemes have been completed and are operational.



**Figure 1:** GWRDC LI Schemes over the years



**Figure 2:** Targets vs. Achievements for GWRDC LI schemes

These 67 schemes are managed by two subdivisions of GWRDC located in Vyara and Ukai. The Vyara subdivision, headed by the Deputy Executive Engineer (DEE), has three sections at Valod, Dolvan and Anawal to oversee 22 such schemes. The Executive Engineer, based at Vadodara, oversees two

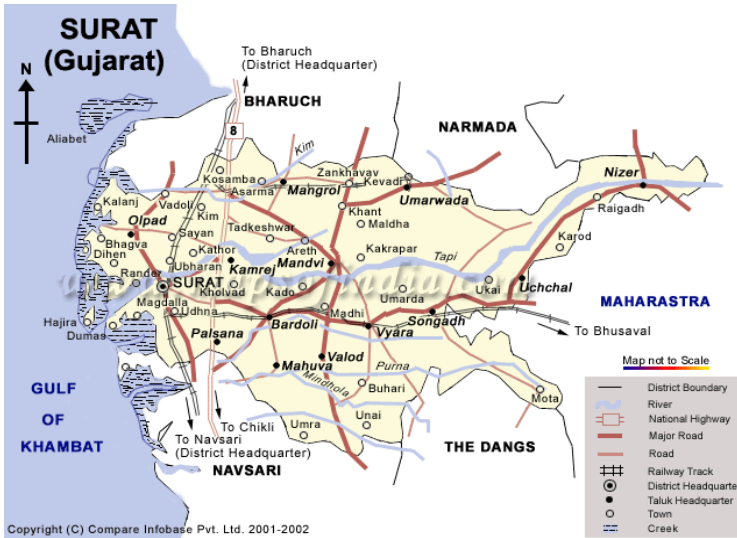
<sup>1</sup> Gross Command Area

more subdivisions in addition to these two. After an initial increase in the utilization of the schemes there was severe decline in utilization due to poor management by the corporation. Following the introduction of the principle of Participatory Irrigation Management by the Government of Gujarat in June 1995, GWRDC started offering the users' associations to take over the management of the schemes. However, only 4 such associations have come up in Vyara subdivision and 4 others in Ukai sub division till date.

THE AREA AND THE PEOPLE

Surat district in southern Gujarat receives an average annual rainfall of 1538.08 mm and the climate here is semi arid to dry sub-humid. The net sown area is about 55% of the geographical area (7800 km<sup>2</sup>) of the district and roughly 30% of it is under irrigation. Canals account for around 65% of the irrigation and the ground water sources irrigate the rest. Deep black and coastal alluvial soils are found here. The land productivity here is Rs 7,983 per Ha of GCA as compared to the state's average of Rs 3,895<sup>2</sup>. The district has around 1.2 million (36%) tribal population. The tribal population in Vyara taluka, where the study of GWRDC schemes was carried out, is nearly 99%. Choudhury, Gamit and Dhodia Patel are the dominating tribes here which are subgroups of the Bhil tribes. The infrastructure facilities in the region are good and most villages are well connected to State Highways.

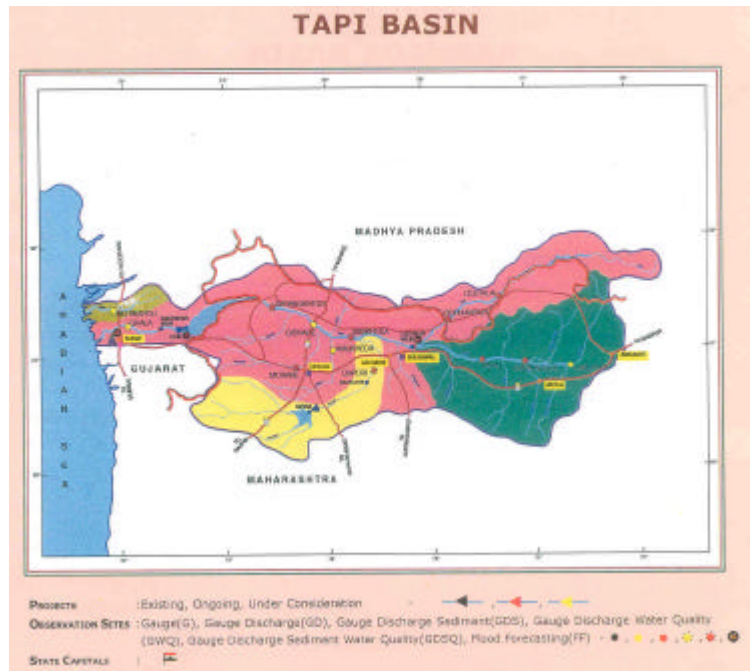
Figure 3: Map of Surat



Deep black and coastal alluvial soils are found here. The land productivity here is Rs 7,983 per Ha of GCA as compared to the state's average of Rs 3,895<sup>2</sup>. The district has around 1.2 million (36%) tribal population. The tribal population in Vyara taluka, where the study of GWRDC schemes was carried out, is nearly 99%. Choudhury, Gamit and Dhodia Patel are the dominating tribes here which are subgroups of the Bhil tribes. The infrastructure facilities in the region are good and most villages are well connected to State Highways.

Before canal irrigation, the whole area was under rainfed agriculture. Long duration paddy, jowar, groundnut and cotton were the major crops grown in this area without the use of any high yield varieties and/or chemical fertilizers. A few varieties of pulses were also grown with the residual moisture during the *rabi* season. Diamond cutting in Surat, forests and livestock were the other sources of income for the people. Kakrapar weir, constructed across the Tapi River in 1954, was the first irrigation scheme in the area. Later in 1972, the Ukai dam brought a large portion of agricultural lands under irrigation. Even though initially people took wheat, vegetables and pulses with irrigation; soon, sugar cooperatives brought a large part of irrigated area under sugarcane cultivation through extension. The lift irrigation schemes in the left bank canal of Ukai dam came up during 1981 to 1990. Since there was a well-established market for both inputs and produce, farmers in the command area of these schemes shifted to sugarcane cultivation within no time. In most of the villages, farmers' cooperatives for agricultural inputs have been successfully functioning. Dairy

Figure 4: Map of Tapi Basin showing the Ukai Reservoir



<sup>2</sup> Obtained from the ARPU report

cooperatives, promoted and supported by the SUMUL dairy, are also present in many villages. Table 1 (below) gives the population, sex ratio, literacy and urbanization figures for Vyara Taluka, Surat District and for Gujarat State.

**Table 1: Population, Sex Ratio, Literacy and Urbanization Figures**

	Total Population			% Literacy			% Urbanization
	Male ('000)	Female ('000)	Sex Ratio	Male	Female	Total	
<b>Gujarat</b>	25208	23178	919	80.49	58.6	69.96	37.67
<b>Surat</b>	2722	2274	835	81.87	66.71	75	59.96
<b>Vyara</b>	125	125	998	71.18	55.34	63.24	14.5

**Source:** Census of India, 2001

## PROBLEM STATEMENT AND OBJECTIVES

---

Following the independence in India, development of irrigation received prime attention for food security as well as for improving the standard of living of the rural people. However, the response to irrigation facility has been different from different communities. In the case of tribal communities, this response has been found to be extremely poor, especially in eastern India. Viability and sustainability of irrigation schemes in a tribal region has always been a concern for both private and government agencies engaged in their promotion.

The obvious questions that guide this study therefore are:

- Can irrigation projects be made feasible for sustainable livelihood generation of tribal communities?
- If yes, then how and under what conditions?

The broader objective of this study thus is to study an intervention made to settle tribal community in irrigated agriculture and identify factors crucial for formulating future interventions on irrigation for them.

The specific objectives of the study are to:

- Collect and review the data on the performance of selected irrigation schemes implemented by GWRDC mostly for tribal community in Vyara taluka of Surat district of Gujarat.
- Examine the operation and management structure in these schemes to know what works and what does not.
- Estimate the impact of these schemes on income and standard of living for the community who regularly use them.
- Identify the factors that make such a community benefit from irrigation and recommend programmatic solutions for future irrigation development for such communities.

## STUDY METHODOLOGY

The study looks at the performance of eleven LI schemes of GWRDC in Vyara taluka, a tribal dominated region of Surat district. Based on the information provided by the GWRDC, a mix of well performing, moderately performing, poorly performing and schemes managed by users' cooperatives were selected for the study to adequately explore the factors affecting performance.

**Table 2: Selected Irrigation Schemes<sup>3</sup>**

Scheme No.	Year Installed	Villages Covered	Managed By	Performance Rating <sup>4</sup>
5	1987	Dolwan, Mohuwaria	LI Society	Good
5/A	1987	Dolwan, Bamnamaldur	GWRDC	Poor
28/1	1981	Champavadi	LI Society	Good
29/1	1986	Kataswan	GWRDC	Poor
32/A	1980	Goria Phalia	LI Society	Moderate
32/2	1980	Panihari	LI Society	Moderate
32/3	1986	Khusalpura	GWRDC	Good
42/1	1989	Bagalpur, Gangpur	GWRDC	Poor
48/1	1990	Bagalpur, Vankla	GWRDC	Poor
51	1986	Sindhai	GWRDC	Good
53	1986	Sindhai	LI Society	Moderate

Case study method was adopted to examine the situation and both primary and secondary data sources were used. Structured investigation was made to know the intervention and its technology. This helped to know the issues involved in this type of irrigation and designing the checklist for discussion with farmers. Focussed group discussions and unstructured interviews were held with the promoters and the farmers to understand the systems of operation and management. A sample of five farmers was surveyed with a questionnaire in six sites to gather their considerations for using or not using the irrigation service. The sample was selected to include users, non-users, late users and dropouts among the tribal community as well as a few non-tribal farmers. A checklist of questions used for the fieldwork is presented in Appendix 2. Records were looked at, wherever available, to triangulate the data collected or observed.

The following key informants were interviewed for each irrigation scheme studied:

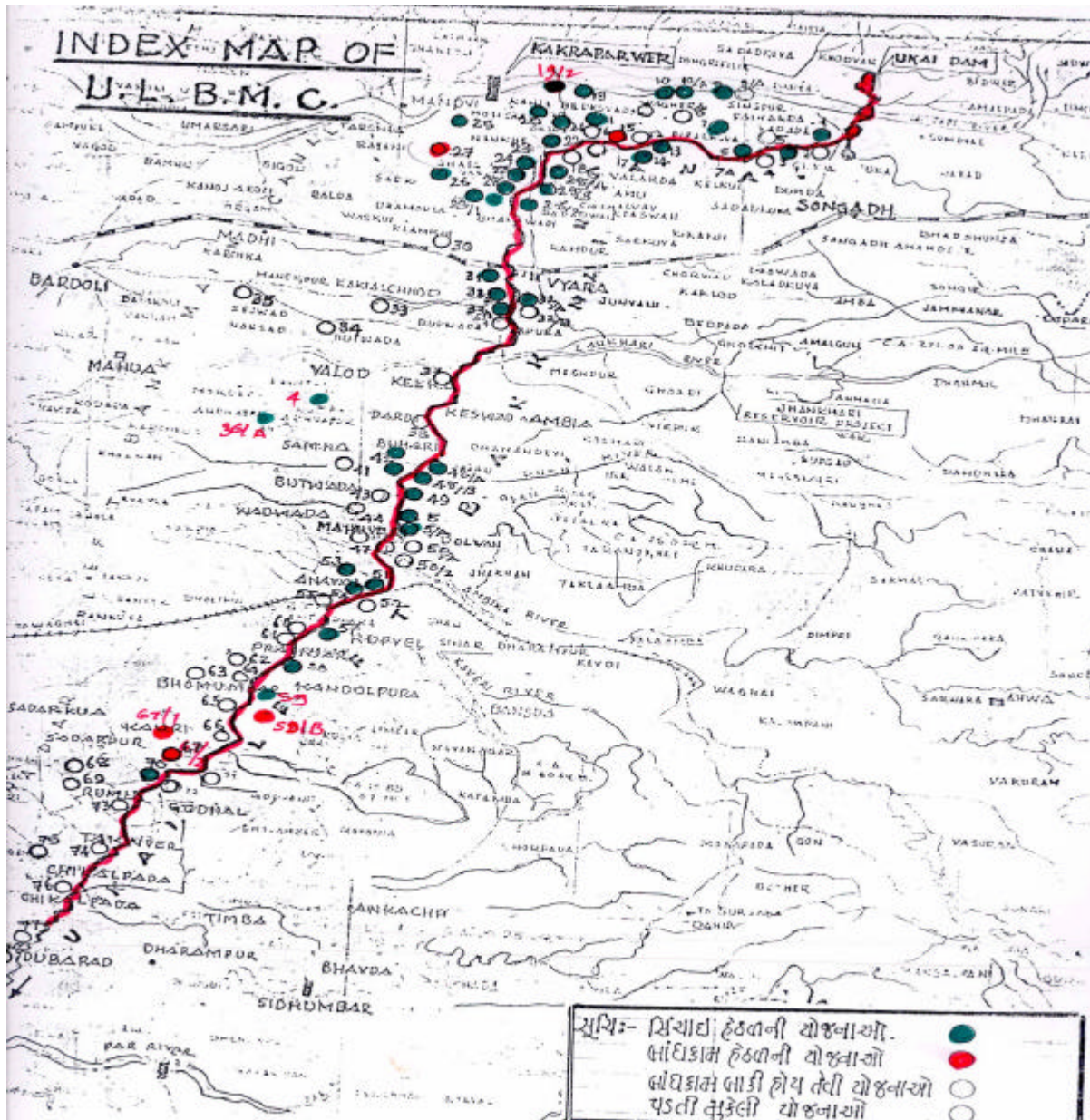
- GWRDC staff at different levels
- Users, Non-users, Early Adopters, Late Entrants and Drop Outs
- Office bearers of the cooperatives managing the schemes

<sup>3</sup> Data for Schemes 28/1, 29/1, 32/A, 32/2 and 32/3 was gathered as part of the exploratory fieldwork done for the IWMI-Tata program by M.Phil. students of Indian Institute of Technology, Mumbai.

<sup>4</sup> The performance rating given in this table is as perceived by the officials of GWRDC which in turn is largely calculated in terms of percentage of GCA for which demand for irrigation is received year after year and the percentage of targets achieved.

## LOCATION OF THE LIFT IRRIGATION SCHEMES

**Figure 5:** Index Map of Ukai Left Bank Main Canal



The map above (Figure 5) shows the layout of the canal and the locations of the lift irrigation schemes on the Ukai Left Bank Main Canal (LBMC). For various reasons, the GWRDC ran into financial difficulties and found it highly unprofitable to manage the irrigation schemes. In the 1990s, the corporation offered to turnover the management of these irrigation schemes to farmers in their commands with the following conditions:

- At least 50% of the farmers in the command area (certified by revenue official) have to agree to take up the irrigation scheme on lease from the corporation
- They have to form and register a Lift Irrigation Cooperative under the Gujarat Cooperative Societies Act and accept the model bylaws designed by the corporation

- The cooperative has to pay back all the dues by farmers to the corporation before turnover
- The cooperative has to make a security deposit of Rs. 5,000 with the corporation
- The cooperative has to hire staff to run and manage the scheme in the interest of its members
- The cooperative has to bear the cost of electricity, repairs and maintenance as may be needed with its own resources

The selected schemes for the study are all located on the southern part of Vyara taluka, which is around 70km away from the district headquarter at Surat.

## IRRIGATION TECHNOLOGY

---

The LI schemes abstract water directly from the canal by using electrical pump sets kept inside the pump houses constructed along side the canal. Two quarters with two very small rooms each are there in each site for the operator and the watchman. Cast iron pipes of 20-30 cm diameter are used on the suction and delivery sides of the pump sets. Mild steel pipes of 20-35cm diameter are used in the rising main to take the pumped water up to the distribution tank constructed at the highest point in the command area. Depending upon the difference in elevation and the discharge to be delivered, hume pipes of 25-45cm diameter are used in the buried distribution system to carry water from the tank under gravity. Sufficient numbers of outlets are provided in each distribution pipe so that the area to be irrigated from each outlet does not exceed 25 acres.

A 'V' notch is installed in each outlet to record the discharge. Farmers construct the earthen channels to take the water to their respective fields from the outlets. To limit the discharge in each outlet to 25 LPS 5-6 outlets are opened simultaneously and only one farmer takes water from an outlet at any point of time. Instead of using a single pump set to deliver the required discharge, normally two are used so that running one pump for double the designed hours of operation can save the crops whenever one goes out of order. This also helps in a situation when fewer farmers require water. The design assumptions are:

- The pumps will have 60% overall efficiency and will be run for 16 hours a day
- Velocity in distribution pipe will be kept within 3 ft per second
- Transit loss of discharge will be 30% and pipe losses will be 10%

The following table shows a typical estimate of one such scheme.

**Table 3: Cost estimate of Scheme No. 53 as per the 1981-82 schedule of rates:**

Item	Amount (Rs.)	%age of Total Cost
Preliminary Survey	5,000.00	1.34%
Acquisition of Land	3,500.00	0.93%
Pump House and Quarter	62,280.00	16.64%
Rising Main	17,280.00	4.62%
Distribution Tank	6,940.00	1.85%
Distribution System	1,86,165.00	49.74%
Pump and Motor	25,000.00	6.68%
Contingency	9,184.95	2.45%
Work Charge	6,123.30	1.64%
T & P	37,505.21	10.02%
Provision for Price Escalation	15,308.25	4.09%
<b>Total</b>	<b>3,74,300.00 (rounded)</b>	

## ABOUT THE SELECTED LI SCHEMES

When the schemes were started, all of them were run by the GWRDC. In the late eighties and early nineties, there was an initiative on the part of GWRDC to involve the beneficiaries in the vicinity of the command area to participate in the operation and management of the LI Schemes. Hence, the farmers came forward and created the “*Goria Phalia Piyat Shahkari Mandali*” (Scheme # 32/A) in 1989; the “*Champawadi Piyat Mandali*” (Scheme # 28/1) and the “*Dolwan Piyat Mandali*” (Scheme # 5) in 1998; and the “*Sindhai Sahakari Piyat Mandali*” (Scheme # 53) in 1999, which took over the responsibility of operations and management of the schemes. In 1998, the *Goria Phalia Piyat Shahkari Mandali* was expanded and farmers of the command area of Panihari (Scheme # 32/2) were also included as members of the cooperative society. The other schemes remained under the management of the GWRDC.

The schemes studied vary in size as well as in management and performance. The smallest scheme is the User Managed Irrigation Scheme in Panihari village (Scheme No. 32/A) with a designed Gross Cropped Area (GCA) of 68 Ha. and the largest scheme is in village Khusalpura (Scheme No. 32/3) with a GCA of 311.74 Ha. The highest and lowest installed capacities are 120 HP and 25 HP and the largest and smallest motor used in the schemes are 40 HP and 10 HP respectively.

**Table 4: Salient Features of the Selected Schemes**

Scheme No	Year Installed	Designed GCA (Ha)	Max Utilization (Ha)	Installed Capacity (HP)	Head (m)	Managed By	Performance Rating <sup>5</sup>
5	1987	138.00	277.63	40	16.00	LI Society	Good
5/A	1987	266.00	152.29	120	21.00	GWRDC	Poor
28/1	1981	121.00	Not Available	20	9.17	LI Society	Good
29/1	1986	196.00	Not Available	60	15.95	GWRDC	Poor
32/A	1980	68.00	Not Available	30	12.96	LI Society	Moderate
32/2	1980	193.45	Not Available	40	10.51	LI Society	Moderate
32/3	1986	311.74	Not Available	120	16.52	GWRDC	Good
42/1	1989	206.00	64.51	30	15.00	GWRDC	Poor
48/1	1990	162.00	275.60	30	20.00	GWRDC	Poor
51	1986	245.00	468.75	60	12.00	GWRDC	Good
53	1986	116.00	282.87	25	10.20	LI Society	Moderate

<sup>5</sup> The performance rating here is as perceived by the officials of GWRDC which in turn is largely calculated in terms of percentage of Gross Command Area for which demand for irrigation is received year after year and the percentage of targets achieved.

## IMPLEMENTATION OF THE IRRIGATION SCHEMES

---

All the schemes were initiated, designed and implemented by GWRDC through contractors without any request from the farmers. Lift irrigation Scheme 28/1 (Champawadi) was one of the pilot schemes on Ukai Left Bank Canal System. The Pilot plan for this scheme was prepared in 1979 and the scheme was sanctioned on 27<sup>th</sup> May 1981 for an estimated cost of Rs. 1.80 lakhs. In the original project report the Gross Command Area (GCA) was 300 acres, however in order to benefit a larger non command area, it was extended to 340 acres. The water requirement and crop planning was considered according to the sanctioned project and during the execution of the project, it was directed that the command area under each block should not exceed 10 Ha. Initially, Rs. 163 per acre of the CCA was provided for the proposed project. However, due to considerable rise in the cost of diesel, petrol, spares and wages of labor, 20 per cent increase was proposed. Finally, Rs. 195 per acre operation cost was calculated and approved. The Benefit Cost ratio at 9.50% interest worked out to be 1.81 in the pilot plan.

Except for the Schemes # 42/1 and 5/A, people did not have many complaints against the quality of installation and execution. In these two schemes people blamed the contractor for the poor quality of execution due to which the full command area has never been irrigated. The faults have been there since the very beginning and water has never reached all the outlets. In Scheme # 5 too, people pointed out that a nearer outlet has to be kept open whenever an outlet in the tail end has to be operated. This makes the farmers near the distribution tank gain more. However, this problem can easily be overcome by proper scheduling.

Though the farmers were very enthusiastic about the installation of the schemes, there was little or no involvement from the community at the time of implementation of the schemes. Even the placement of outlets was done without any consultation with the farmers for which some farmers expressed dissatisfaction. Recently a sugar co-operative has sanctioned a sum of Rs 10 lakhs to GWRDC for the revival of a few schemes<sup>6</sup> where utilisation has seriously dropped. Even now, people have complaints that they have not been consulted regarding what repair work should be done and how..

Even though the original layout of the schemes could be obtained for all the schemes, the initial beneficiary list could not be traced anywhere. Irrigation target is declared every year without any discussion with the farmers and a schedule of irrigation is prepared. There is no system to trace who is a bona fide user of a scheme the irrigation facility. The command area utilisation is the only parameter monitored by GWRDC. The focus on people seems to be missing in the whole approach.

---

<sup>6</sup> Schemes 42/1 and 5/A among the studied schemes are to be revived with these funds

## SOCIO-ECONOMIC IMPACTS OF THE LI SCHEMES

### Changes in Cropping Pattern and Cropping Intensity:

Before the inception of the LI schemes by the GWRDC, people were largely dependent on rainfed farming (*Aakash Kheti*) and were taking only one crop in a year. Farmers were growing only local varieties of rain-fed crops like rice, groundnut, jowar and cotton. With the residual moisture some of them were taking pulses in the *rabi* season.

After the introduction of the LI schemes, there has been a marked shift in the cropping pattern as well as the cropping intensity in the area. People are now taking upto three crops in a year and this has largely been made possible due to the increased availability of water in the non-monsoon months.

#### Box 2: Mangubhai Chhotubhai Gamit

**Mangubhai Chhotubhai Gamit** is a tribal farmer of village Gangpur. He owns 2.70 acres of land in the command area of **Scheme # 42/1**. Before lift irrigation he was only doing rainfed agriculture. To meet the balance requirement he was either working as an agricultural labour or was going to work in the diamond cutting enterprise. Seeing other farmers taking benefit from the lift irrigation, he too saved some money and took sugarcane in his land. After a few years he faced problems in accessing the lift irrigation as the system deteriorated. With his savings and a bank loan of Rs. 20,000/- he constructed a well and continued practising irrigated agriculture. He has paid back 50% of the bank loan. Now he takes sugarcane in 3.30 acres of land and paddy in 2 acres of land by taking an additional 2.70 acres of land on rent. He pays the land owner one third of the yield as per the prevailing system in the village. He gets a yield of 20 tons of sugarcane per acre and 2 tons of paddy per acre. Since there is no co-operative in the village he procures inputs from a nearby co-operative either by paying cash or at a higher interest rate of credit (3% per month). He prefers to sell his produce in the khandasary as he needs the payments instantaneously. He said that the factories give preference to the big farmers. They harvest the crop of small farmers only after the big farmers and this affects the price which they receive. Since LI takes half the time to irrigate a patch of land, he prefers irrigation from the LI scheme to well, but is helpless as all his land is not in the command. The well is used only for 6 hours a day during *rabi* and 2 hours during summer.

With the arrival of irrigation, people initially went for improved varieties of rice, wheat and some vegetables. However within the next 3-4 years, most farmers shifted to sugarcane cultivation, influenced by the extension work and credit support by the sugar cooperatives. Today, nearly 90% of the command area is under sugarcane cultivation.

Tribal families with less land and enough family labour prefer to take vegetables, which are more profitable than sugarcane if we do not take the imputed value/ opportunity cost of family labour into consideration. Rice

is cultivated mainly for consumption in between two sugarcane crops. Crops like cotton and jowar have been almost completely phased out.

### The Economics of Sugarcane Cultivation

Sugarcane is the most preferred crop by farmers due to the following reasons:

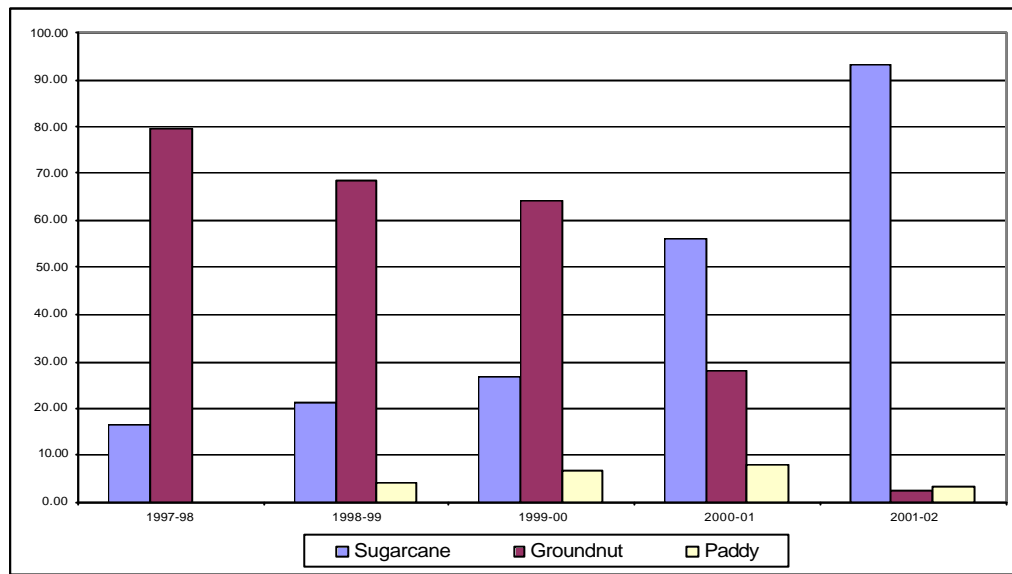
- **Less Laborious:** Once planted, it is at least harvested twice and again is not disease prone and requires water at larger intervals unlike vegetables.
- **Remunerative:** It fetches a net profit of at least Rs 10000 per acre in a year and again bulk payments are received unlike vegetables that fetch regular but small income.
- **Rotation Policy:** For the past few years, canal water is not regularly available and the government has initiated a policy of rotation under which water is available once in 15-20 days only. In 2000, the government announced that considering the policy of rotation, canal water will be given only for sugarcane even in the flow-irrigated command areas. Under these conditions, it is difficult for crops like paddy to survive without water.
- **Demand Pull:** The demand pull created by the sugar cooperatives in the region which not only provide a remunerative price for the sugarcane but also provide a lot of extension support

and training to the farmers. Credit, know-how and marketing support are available and the farmers have contracts with the factories for marketing.

- **Cheap Irrigation:** Even though it is a high water (3-3.5' of water) consuming crop, irrigation is available quite cheap and at the right intervals.
- **Complementary Activity:** Poor farmers in the region get regular income from dairy supported by SUMUL Dairy to meet their daily requirements. Sugarcane provides fodder for the animals.

Figure 6 below, clearly depicts the shift towards sugarcane in Panihari Village (Scheme # 29/1) over the last 5 years.

**Figure 6:** Percentage of GCA under different Crops in Scheme # 29/1



Sugarcane is the preferred crop compared to other cash crops as well. One of the reasons for the people preferring to grow sugarcane over other cash crops like groundnut is that it can survive without water for 15-20 days while most other cash crops require watering every 2-3 days. Thus, sugarcane is the one cash crop that matches higher returns with comparatively lower risks of crop failure in case of water unavailability.

The yield of sugarcane varies widely. High crop yields (up to 60 tons/acre) were reported at Sindhai village (Scheme # 51), where the non-tribal (*kanwi patels*) population is comparatively high. The average yield per acre however was found to be 30 tons for tribal farmers. This huge gap between the potential and average yield shows that there is a scope to increase the productivity of the crop. Experts said that a low seed rate than the usual and proper field preparation could reduce investment and increase output. Farmers use different varieties of seeds

**Box 3: Haribhai Kaurji Dhodia Patel**

**Haribhai Kaurji Dhodia Patel** is a tribal farmer from village Dolvan. Out of his 9.00 acres of land 6.00 acres are wasteland. He was growing rainfed paddy in 3.00 acres of his land. He started taking water from the lift irrigation (**Scheme # 5/A**) in the second year and replaced rice with sugarcane. For three consecutive years he did not face any problems. Subsequently the irrigation supply was affected by irregular supply of electricity. The villagers damaged the pipeline in a competition to get water. He then shifted to wheat as the competition for water was less during *rabi*. However with further deterioration he could not access any irrigation and was forced to shift back to rainfed agriculture. As he got acquainted to cultivating high yield varieties of crops after the introduction of irrigation, he now gets 2.40 tons of paddy from an acre of land as against the previous yield of 1.40 tons. With the income from irrigation he now does dairy that brings him a net income of Rs. 12,000 a year. He neither needs to go to the jungle for fuel wood nor to the town in search of employment as before. Occasionally he goes to work as an agricultural laborer. He is still interested in irrigation and is hopeful now to see the repairing work being undertaken at the earliest.

and the seed rate varies widely. Progressive farmers produce their own seeds to reduce the cost of cultivation. One variety (91132) that does not yield much gives an assured yield as compared to the variety (707) which yields more but is much more disease prone and its second crop cutting is worse in terms of yields. Most of the tribal farmers (around 70%) with poor knowledge of pest and disease management and high interest in the second cutting that requires very less investment prefer to grow the first variety. The sugar factories however do not prefer these varieties, as sugar production from these is lesser. Recently the sugar factories have declared a deadline beyond which they will not procure the sugarcane of varieties that do not produce adequate sugar. So now the farmers are gradually moving towards the cultivation of high yield varieties with appropriate use of pesticides. Block officials and KVK<sup>7</sup> staff in Nawsari, besides the experts of sugar factories help farmers in the region to acquire better agricultural skills. Mostly the better off, non tribal farmers approach them and the poor ones learn from the local skilled farmers. The village cooperative in Sindhai (Scheme # 53) had organised a training programme for its members on improved sugarcane cultivation by getting outside experts.

Most of the sugarcane growers are the members of more than one sugar cooperatives in the region. These cooperatives have come up following the execution of a wide network of irrigation canals. Each such sugar factory consumes 5000 to 10000 tons of sugarcane daily for six months in a year. They not only provide buy back arrangement to the farmers but also provide a credit of Rs 6000 per acre in cash and kind together and technical know-how to grow better crops. The arrangement to procure sugarcane at the farm gate is also quite convenient for the farmers. The farmer only needs to inform the cooperative in advance and the cooperative hires labour to harvest the crop and also to take the produce to the factory.

The payment is made in three instalments on predetermined dates. The first two instalments of Rs 300/- each are paid after one month and four months of harvesting respectively. The final instalment of the balance amount is paid after one year, depending on the selling price of sugar in that year. Deductions for the inputs taken by the farmers are made from the first instalment itself. These co-operatives, in addition, provide dividends and sugar at a cheaper price<sup>8</sup> to its members. Small private sugar mills (called *khandsari*) consuming 500 tons of sugarcane per day have also come up in the area. They pay less but pay the whole amount immediately after harvesting. This attracts the small farmers who prefer immediate payment. Again these units engage better off farmers by paying a higher price than the factories to supply them the required sugarcane from the small farmers. Poor farmers complain that they even have been cheated in weight by these units. To compete, now the sugar factories have started procuring the produce from non-members as well, who are offered Rs 25 per ton of sugarcane less than the members.

### **Other Impacts**

The yield from wells in the area was very less before canal irrigation started. Introduction of canal irrigation in the area, apart from direct irrigation, has also increased the yield of the wells. Lift irrigation is preferred to well irrigation as the labour cost in well irrigation to manage the water efficiently is higher. Wheat and pulses are cultivated with private wells and bore wells that do not yield water in summer when sugarcane needs a lot of water.

Overall, income from agriculture has gone up manifold with irrigation. An average family with 2 acres of irrigated land does not depend upon wage earning anymore. Farmers using the irrigation facility have acquired various assets like TV, motorcycle and cars (only by non tribal farmers). Investment in the education of children has drastically improved. In Champawadi (Scheme # 28/1), for example, the

---

<sup>7</sup> Krishi Vigyan Kendra (KVK)

<sup>8</sup> At Rs 11 per kg as against the market price of Rs 15 a kg.

entire second generation has been educated. Both boys and girls go to schools and colleges. The Sarpanch is a woman and has studied up to her second year of graduation. In Kataswan (Scheme # 29/1), a few of the farmers have attained graduate degrees and mostly all the children are attending the school in the village which is up to 7<sup>th</sup> standard and later these children go to Vyara for higher education. This has been possible because of the increased savings from agriculture due to the L.I. Schemes. In Gorla Phalia (Scheme # 32/A), some of the female respondents were found to be aware of gender issues and showed eagerness to educate their daughters. One of the female respondents showed willingness to form a mahila mandal to address the issues of women in the village. In Panihari (Scheme # 32/2), it was found that some women farmers were educating their children and hence had leased out the land to others, as they had to send the children to school and be involved in their upbringing. However women's involvement in the L.I. Schemes was still very little. Khusalpura (Scheme # 32/3) boasts of two primary schools (one up to Standard III and the other up to Standard VII) and twenty-five graduates. The village sarpanch's son is an engineer working with the Gujarat Electricity Board. His daughter would be completing studies to become a doctor very soon. There is an increased desire to attend schools and colleges among the people.

**Table 5:** Comparison of Investments and Returns from Sugarcane and Paddy

Crop Under Irrigation	Investment per Acre (Rs.)	Output per Acre (Rs.)	Return per Acre (Rs.)
Sugarcane	10500	22500	12000
Paddy	3000	8000	5000

**Source:** Primary Data collected by the authors during their field visit, 2002

A large-scale land transfer from poor to better off took place at the time of beginning of canal irrigation, but the trend is no more prominent. The land prices have gone up from Rs 500-1000 per acre to Rs 25000-30000 per acre during the last decade after irrigation. Still the labour supply is very high in the area for which the local wage rate is Rs 30 per day except during the sugarcane-harvesting season when it goes up to Rs 60 per day.

**Box 4:** Scheme # 53 – Sindhai Lift Irrigation Society

In a completely tribal (Choudhury tribe) dominated village of Mohuwaria, private 10 HP diesel engines are run from the river Ambika and irrigation is provided to the farmers at Rs. 10 per Hr. Now about 85% of the agricultural land is irrigated in this village and 50% of the irrigation is done from wells and river with private pump sets. So the low cost canal irrigation followed by GWRDC's lift irrigation schemes seems to have created a demand for irrigation among the tribal people here.

## MANAGEMENT OF THE IRRIGATION SCHEMES

Out of the 11 schemes covered under this study, 6 are still being managed by the GWRDC whereas Schemes # 5, 28/1, 32/A, 32/2 and 53 have been transferred to the users' cooperatives. Initially the schemes were leased to the cooperatives for a year and later, the lease was extended for 5 years considering the satisfactory and effective operations.

GWRDC is supposed to place one operator and one watchman in each of the schemes that they manage. However, the section in Dolwan has only 3 operators and 6 watchmen to look after 7 schemes. So only one person is placed in each of these schemes and the two extra persons are engaged in the administrative work of Dolwan office. In addition the section office has a clerk to assist the section officer, a diploma engineer.

Each year is divided into three cropping seasons as below:

**Table 6:** Cropping Seasons and their Period

Cropping Season	Period
Kharif	21 June to 20 October
Rabi	21 October to 20 February
Summer	21 February to 20 June

Before each season farmers have to get an irrigation pass from the section office by clearing all the previous dues and paying an advance at the rate of Rs 200 per acre plus Rs 10/- towards the clerical charge. The pass is given only to the landowner for specific amount of area. The pass does not restrict the number of irrigations or the crops to be taken. The operator gives water to farmers only after receiving the passes and in the sequence they are issued provided the concerned farmer has arrived. He notes down the supplied depth of water over the 'V' notch and hours of irrigation. Wherever energy meters are there, the operator is required to note down the meter reading so that he has less scope to play false. He submits this with the Section Officer (SO), who with the help of the clerk prepares the demand list. The present subsidised<sup>9</sup> rate of irrigation water is Rs 1.20 per 10,000 litres, which was only Rs 0.80 in the beginning. Farmers deposit the money directly in the bank account of GWRDC maintained at the Section Office. This money is subsequently transferred to the subdivision, which pays for the electricity charges. The present water charges can be better understood from the following table:

**Table 7:** Computation of Water Charges

Depth of water (in inches) over 'V' notch	Discharge (LPS)	Water Charge (Rs/Hr)
6	12.6	5.5
6.5	15	6.5
7	18	8
8	25.6	11

The design assumption for the depth of water over 'V' notch is 8 inches and the water charges are calculated with this assumption in most places, even if the actual discharge (especially in the tail) is less. In none of the schemes were the charges different within the scheme; thus, tail-end farmers often ended up paying more for lower discharge. An annual interest of 12% is charged when the dues are not

<sup>9</sup> Irrigation is provided to the tribal farmers at Rs 1 subsidy per 10000 litres. The actual rate is Rs 2.2 per 10000 litres.

paid for two seasons. When the system needs any repairing, the operator makes a written complaint to the SO, who makes an estimate of the repairing required and sends it to his senior officials for sanction. The DEE can sanction up to Rs 500, the EE up to Rs 5,000 and the SE upto Rs 10,000 for the repairing. When the required amount is more than Rs 10,000, the sanction has to be obtained from the head office in Gandhinagar. The normal time taken for repairing the motors varies from a month to even a year depending on the magnitude of the problem. The following table shows the income and expenses of the Vyara subdivision for two financial years.

**Table 7:** Income and Expenses for Vyara Subdivision of GWRDC

Item	Year 2000-2001		Year 2001-2002	
	Amount (‘000 Rs.)	%age	Amount (‘000 Rs.)	%age
<b>Salary</b>	1593.53	80.46%	1461.25	83.44%
<b>Travel</b>	27.94	1.41%	16.20	0.93%
<b>Electricity</b>	322.49	16.28%	241.86	13.81%
<b>Repairing</b>	36.61	1.85%	31.87	1.82%
<b>Total</b>	<b>1980.56</b>		<b>1751.20</b>	
<b>Demand for water charges</b>	36.48		351.75	
<b>Collection of water charges</b>	358.59		284.84	

This shows that the water charges are just enough to meet the electricity charges and very little is left for repairs and maintenance. Thus only the motors are repaired to keep the schemes functional and repairing of civil works is rarely done.

In case of schemes managed by the cooperatives, the president manages the affairs assisted by other executive committee members and hired staff.

The executive committee members meet every month to review operation and present the affairs with all the members in an annual meeting. The secretary issues the pass to the irrigators who clear all the previous dues and pay an advance of Rs 100 (the old rate of GWRDC) per acre. The operator provides water after getting the pass and records the discharge and duration and reports to the secretary. The secretaries (who have studied only up to class 7 in both the cooperatives Schemes # 5, 53) maintain standard books of accounts as per the instruction from the department of cooperation that carries out audit every year. The helper helps the operator in operating the outlets and guarding against any stealing of irrigation water. The water charges are Rs 20 and Rs 12 per hour in schemes # 5 and 53 respectively. These rates are fixed irrespective of the discharge in the outlet. Initially the water charge was Rs 15 per hour in Scheme # 5. However, they revised it to Rs 20 after the first year of operation. Both Schemes # 5 and 53 are making profits every year since their inception. Income and expenditure of these cooperatives in two consecutive years are shown in Tables 8 and 9.

**Box 5:** Scheme # 5 - Mahuwaria Lift Irrigation Society

The committee in Scheme # 5 (Dolwan, Mohuwaria) has 11 members. Te eleven trustees of the cooperative society pooled-in money to clear the outstanding dues of the farmers and waited for the society to become financially sound before they got their money back from the profits of the society. Without these interest free loans from the trustees, the turnover would not have been possible. 3 out of the 11 members do not themselves directly benefit from the scheme and 6 of them are very small farmers. All the committee members have either retired from jobs or holding some posts in local bodies. The president of the cooperative society, **Kikubhai**, is a retired mechanic from irrigation department who repairs the motors whenever they break down without charging anything for his services. Following his retirement in 1997 he played a vital role in the process of taking over the scheme from the GWRDC and now he irrigates 3 acres of his land from the scheme out of a total holding of 10 acres. The cooperative has employed 3 persons (operator, secretary and helper) at monthly salary of Rs 1200, Rs 1100 and Rs 850 respectively. They had started with a monthly salary of Rs 800, Rs 500 and Rs 800 respectively in the first year of transfer as compared to the average monthly salary of Rs 3500 for a government operator or watchman.

**Table 8:** Income and Expenses of Dolwan, Mahuwaria (Scheme # 5) Lift Irrigation Society during the financial year 2000-2001 and 2001-2002

INCOME					EXPENDITURE				
Item	2000-2001		2000-2001		Item	2000-2001		2000-2001	
	Amount (Rs)	%age	Amount (Rs)	%age		Amount (Rs)	%age	Amount (Rs)	%age
<b>Water Charges</b>	112,708	99.86%	91,610	99.68%	Salary	23,800	21.09%	26,100	28.40%
<b>Interest</b>	156	0.14%	294	0.32%	Stationary	2,281	2.02%	1,184	1.29%
					Repairing	33,056	29.29%	2,325	2.53%
					Conveyance	735	0.65%	625	0.68%
					Misc. Exp.	303	0.27%	550	0.60%
					Light Bill	20,010	17.73%	13,340	14.52%
					Labour	2,450	2.17%	645	0.70%
					Other Expenses	13,639	12.08%	2,620	2.85%
					Profit	16,590	14.70%	44,515	48.44%
<b>Total</b>	<b>112,864</b>		<b>91,904</b>		<b>Total</b>	<b>112,864</b>		<b>91,904</b>	

**Table 9:** Income and Expenses of Sindhai (Scheme # 53) Lift Irrigation Society during the financial year 2000-2001 and 2001-2002

INCOME					EXPENDITURE				
Item	2000-2001		2000-2001		Item	2000-2001		2000-2001	
	Amount (Rs)	%age	Amount (Rs)	%age		Amount (Rs)	%age	Amount (Rs)	%age
Water Charges	134,173	93.90%	113,224	99.29%	Mail Exp.	207	0.14%	191	0.17%
Interest	993	0.69%	815	0.71%	Salary	24,000	16.80%	43,500	38.14%
Machinery	4,000	2.80%	-	-	Stationary	1,777	1.24%	769	0.67%
Income					Repairing Exp.	-	-	7,500	6.58%
Bank interest on reserves	335	0.23%	-	-	Conveyance	990	0.69%	670	0.59%
Recovery of last years' dues	3,382	2.37%	-	-	Misc. Exp.	1,076	0.75%	840	0.74%
					Light Bill	50,629	35.43%	29,379	25.76%
					Labour	1,260	0.88%	1,470	1.29%
					Insurance Prem.	-	-	2,394	2.10%
					Meeting Exp.	1,062	0.74%	1,288	1.13%
					Transport	400	0.28%	-	-
					Rent				
					Interest	1,420	0.99%	-	-
					Audit Fee	145	0.10%	-	-
					Profit as on 31st March	59,917	41.93%	26,039	22.83%
<b>Total</b>	<b>142,883</b>		<b>114,039</b>		<b>Total</b>	<b>142,883</b>		<b>114,039</b>	

A quick comparison of Table 7 with Tables 8 and 9 shows that while more than 80% of GWRDC's costs fall under the head of salaries, the user groups manage to restrict this component of their costs to a maximum of 40%. This in turn leads them to higher savings for repairs and maintenance. Also, while for GWRDC, the only source of revenues is the water charges, user groups manage to earn a significant amount from other sources as well. Their recovery rates are also better and they can further expand their revenues by offering inputs and output marketing for their members, which some of the user groups are planning to do in the near future.

While taking up the responsibility of management of the schemes from the government the executive committee members had paid all the previous dues to government from their pocket and took it back from the first year's profit. All these dues were therefore collected back from the farmers. Those who never returned to take water from the schemes are still dodging. There were 70 members when the Scheme # 5 was transferred to the cooperative. In 3 years time, the membership has gone up to 118 and the irrigated area has crossed the previous maximum of 125 acres in any single season to reach 150 acres. Except four *Brahmins*<sup>10</sup>, belonging to a single influential but helpful family, rest of the members belong to Scheduled Tribes (ST). Even though regular elections are held in the cooperatives as per the bylaws, the same people get elected every time. In Scheme # 53, only the president has been replaced when he became very old and could not handle the affairs of the society. The cooperatives are still finding it difficult to discipline the farmers during distribution of water.

The prices of water have gone up after the taking over of the operations and management by the users. This is because they no longer enjoy the enormous subsidies which were being provided to them by the government. Even then, people have preferred to manage the schemes on their own as they were very unhappy with the way the GWRDC was managing the schemes. People have shown their willingness to pay, as much as Rs. 10/- per hour extra, for the improved service.

The following factors influenced farmers to come together to take over management of irrigation schemes:

- Deterioration of the scheme year after year due to poor maintenance
- Poor service by government operators
- Tail end farmers, who suffered more, took more interest in managing the affairs themselves
- The leaders agreed to bear the initial cost of taking over the scheme
- Relatively small and homogeneous community with high stakes in agriculture

Overall, therefore, we can conclude that the user groups have performed much better compared to the GWRDC in managing the LI schemes. They, however, do face a lot of difficulties at the time of forming the user groups. These include, among others, convincing at least 50% farmers in the command to join the group; the lengthy and effort-intensive activity of registering the cooperative under the Gujarat cooperative societies Act; and clearing past dues of the defaulters before the transfer can be complete. The authors feel that if this transfer process is made simpler, the efficiency, utilization and reliability of all the schemes would improve significantly under user-group management.

---

<sup>10</sup> One of them is the director of a sugar cooperative and is also a member of the irrigation cooperative. He always backs the group and provides financial help when required.

UTILIZATION OF SCHEMES

Table 10 show the utilization in each of the eleven schemes since 1986. The figures below (Figure 7 and Figure 8) compare the utilization in the schemes against the design GCA of the schemes. The trend lines in the figure indicate the percentage utilization in the scheme (Percentage Utilization = Actual Irrigation Area in the Year as a percent of the Design Gross Command Area). Figure 7 looks at Percentage Utilization in Schemes # 5, 5/A, 42/1, 48/1, 51 and 53 for the period 1990 to 2001.

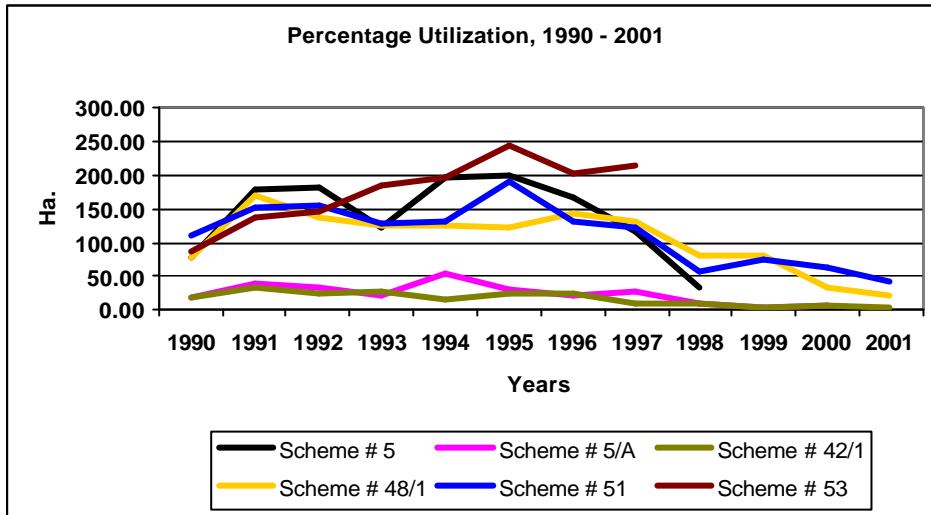


Figure 7: Percentage Utilization, 1990-2001

Figure 8 looks at the same variable (Percentage Utilization) for schemes 5/A, 28/1, 29/1, 32/2, 32/3, 42/1, 48/1 and 51 for the last seven years. There is a clear downward trend across all the schemes over the last seven years. The main reasons for this are the increasing scarcity of water available in the canal and the decline in hours of energy supplied to agriculture. Also, the irrigation department has adopted a Rotation policy of water supply in the canal. This has also contributed to the decline in utilization of the schemes.

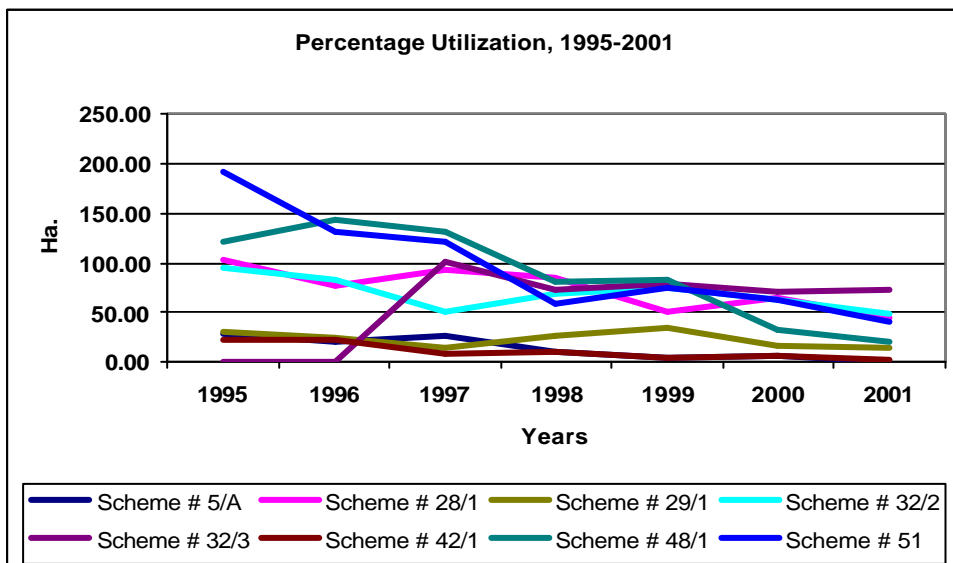


Figure 8: Percentage Utilization, 1995-2001

**Table 10:** Actual Irrigated Area (Ha.) in different schemes since inception

<b>Scheme #</b> →	<b>5</b>	<b>5/A</b>	<b>28/1</b>	<b>29/1</b>	<b>32/A</b>	<b>32/2</b>	<b>32/3</b>	<b>42/1</b>	<b>48/1</b>	<b>51</b>	<b>53</b>
<b>Years</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>	<b>Utilization (Ha.)</b>
<b>1986</b>	NA	NA	NA	NA	NA	NA	NA	NA	NA	84.53	31.18
<b>1987</b>	44.18	63.75	NA	NA	NA	NA	NA	NA	NA	129.93	34.88
<b>1988</b>	54.43	74.54	NA	NA	NA	NA	NA	NA	NA	145.59	45.63
<b>1989</b>	57.38	50.09	NA	NA	NA	NA	NA	6.47	NA	168.50	56.28
<b>1990</b>	109.94	49.53	NA	NA	NA	NA	NA	39.28	128.72	274.29	102.43
<b>1991</b>	248.44	104.61	NA	NA	NA	NA	NA	64.51	275.60	375.54	161.77
<b>1992</b>	250.76	85.69	NA	NA	NA	NA	NA	50.46	223.91	382.73	169.60
<b>1993</b>	170.73	53.55	NA	NA	NA	NA	NA	53.54	203.61	315.95	216.16
<b>1994</b>	270.09	152.29	NA	NA	NA	NA	NA	32.57	204.45	327.29	228.27
<b>1995</b>	277.63	74.70	124.72	59.22	NA	183.98	NA	45.46	198.82	468.75	282.87
<b>1996</b>	233.28	54.60	93.79	48.90	NA	162.93	NA	46.51	233.57	321.74	236.38
<b>1997</b>	163.57	70.51	112.91	28.76	NA	97.01	321.00	18.33	214.77	299.50	248.42
<b>1998</b>	43.51	24.18	104.69	49.02	NA	135.17	230.00	19.22	131.77	147.29	Transferred
<b>1999</b>	Transferred	11.40	62.61	66.45	NA	148.08	250.00	7.00	135.59	187.55	NA
<b>2000</b>	NA	16.10	78.73	32.53	NA	124.66	222.00	10.67	51.87	158.32	NA
<b>2001</b>	NA	NA	53.30	28.45	NA	92.37	230.00	5.32	31.84	98.20	NA

NA = Data Not Available

As is evident from Table 10 and Figure 7, utilization increased in the beginning and reduced drastically after nearly attaining the full potential. In Schemes # 5/A and 42/1, however, the potential was never reached due to problems in design of the infrastructure. Initially, only the progressive farmers came forward to use the schemes. Seeing their performance other comparatively poorer farmers also joined the venture and the initial adopters increased the area irrigated by taking other farmers' lands on lease/shared cropping basis. During the initial years since the GWRDC staff was too much concerned about increasing the cropping area under each irrigation scheme and maximizing coverage, there was a relative laxity in collection of water charges to lure farmers to use the irrigation facility.

Apart from the risk aversion attitude, the poor farmers could not access irrigation in the beginning due to the fact that most of them were defaulters<sup>11</sup> and could not obtain crop loans. In a village, where most of the farmers are poor, people find it difficult to even run a *Seva Sahakari* society. In village Gangpur, for example, farmers have not been able to start such a society yet. The failure of a co-operative in a nearby village due to the dishonesty by the leaders has scared them a lot. Again it is difficult for the poor farmers to get guarantors for availing the loans from formal sources. Even to get credit from sugar co-operatives one required two guarantors and a certified copy of land record from the *talati*, a government staff, which was not easy for an average tribal farmer. Rich farmers are the only source of credit for them where the interest rate is very high and hence they go to them only in emergency. Most of them entered irrigated agriculture a little later with their own capital accumulated through wage earning and rent received against leasing of land to well-to-do farmers. The following types of tribal farmers had used the irrigation facility in the beginning:

**Box 6:** Scheme # 51

Nearly 40% of the farmers in **Scheme # 51** are non-tribals, 50% of which are influential *kanwi patels*. Till 1997 there was no serious problem. In 1998 the utilisation reduced as the distribution tank of the scheme broke and GWRDC took three months to repair it. It was repaired only after the farmers agreed to bear 15% of the cost of repair. To avoid delay the big farmers having high stake put the money and collected it from others afterwards. In 1999 the use increased. Again in 2000 both the motors got burnt and required a huge sum to be repaired that could not be arranged by the GWRDC. So the farmers had to approach the minister along with the local MLA (Member of Legislative Assembly) for a special sanction. The work was completed only in 2001 but due to water scarcity in the dam again the utilisation dropped. This is the experience of a group where farmers can go up to the state capital to mobilise resources. Still they are not interested in taking over the management of the scheme as the scheme is large and includes families from multicassts who will be difficult to manage. They rely more on their influence to set things right. Actually during all these years, actual area under irrigation did not change much as most of the farmers here have their own source of irrigation.

- Farmers who already had access to some kind of irrigation
- Farmers engaged in small-scale vegetable cultivation side by side other activities
- Families who were engaged in agriculture for generations and had never worked as agricultural labourers
- Families having one or more member in regular jobs
- Literate farmers who could access loans from formal sources of credit
- Families having more members to work in the field as their capital requirement was less

The major problem that led to decline in utilization is the inordinate delay in repairing the pump sets whenever they went out of order. The long official procedure for carrying out any repairing work basically caused this delay. Power cuts and intermittent supply of water in the canal further increased the magnitude of the problem. While the schemes have been designed to operate for 16 hours a day to irrigate the full command area, availability of power supply hardly exceeds 8

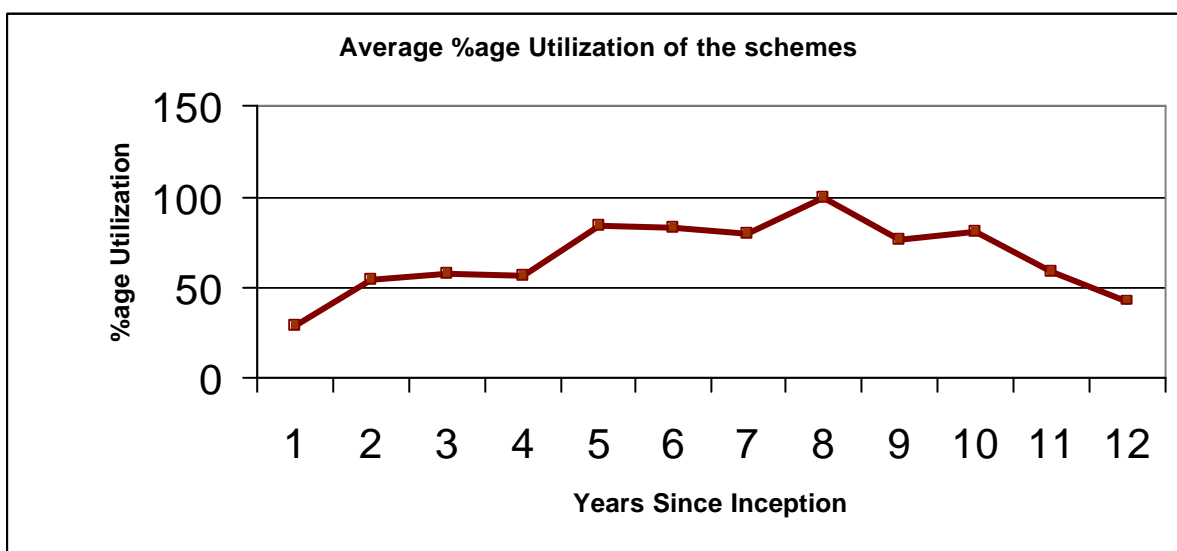
<sup>11</sup> The GWRDC official informed that around 30% of the tribals in the area are defaulters of bank loans even today and lack access to loans.

hours a day during the peak irrigation seasons. A stiff competition set off, when the farmers after getting the benefits of irrigation for a few years had to struggle to access irrigation water due to these problems. They mishandled the outlets and pipelines in the process and damaged them beyond repair. Availability of water in the canal, power supply, access to immediate repairing and the government operator on the site can result in smooth operation of irrigation schemes, which proved to be a tough proposition in the government managed schemes. However, by having the funds at their disposal and their own operators who could be made to operate the scheme whenever canal water and power supply were available, the users' cooperatives could significantly improve the performance.

**Box 7: Rasik Bhai Gamit**

**Rasik Bhai Gamit** is a tribal farmer of village Vankla in the command area of **Scheme # 48/1**. He has 2.30 acres of land. He has dropped out after taking water from the lift irrigation scheme for two consecutive years. He had started taking sugarcane in all his lands after seeing the successful farming by others. Due to leakage in the pipeline the discharge reduced in the outlets. His fields are 300m away from the outlet for which the reduction in discharge affected him the most as he received half the discharge at the outlet. He again was getting the irrigation at the end that delayed all his operations by at least a month. By the time he was getting a single irrigation big farmers were irrigating their fields twice. When he raised his voice, one farmer stopped water to him as the field channel was passing through his field. When he met the GWRDC official for justice, water was stopped for both of them. He remembers that it took 9 hours for him to irrigate an acre of land as against the average of 5 hours. Finally he got half the average yield in the area. Of course he had invested only Rs. 8,500 in an acre of land as compared to the average investment of Rs. 10,500. Now he takes only rainfed crops in his lands. He takes paddy in 1.70 acres of land and jowar in the rest 0.70 acre of land that gives him enough to meet the annual food requirement of the family. Besides he has two buffaloes that fetch a net income of Rs. 6,500 in a year. He works as an agricultural laborer too for around 180 days in a year to earn Rs. 30 per day. He is still interested in irrigated agriculture provided the full discharge at the outlet is delivered in his field through construction of field channels. He even wanted to go for a well but could not arrange the capital of Rs 40000. He is now looking forward to *Swarn-jayanti Gram Swa-Yozgar Yojana* (SGSY) loans for the construction of a well that involves a bribe of Rs. 3,000 and is primarily available to better off farmers.

Assuming the maximum utilization to be 100 per cent utilization the following average trend was observed in different years of operation for six schemes.



**Figure 9:** Average Percentage Utilization of Schemes # 5, 5/A, 42/1, 48/1, 51 and 53 for twelve years since their inception.

This shows that it took 3-5 years for almost all the farmers to come forward to use the irrigation service and after nearly 5-6 years of good utilization, things started deteriorating. Nowhere was it observed that people dropped out on their own after utilising the irrigation service once. Everywhere the dropouts are forced by deteriorations in the system or lack of water. Again, an increase in command area does not necessarily mean that the number of farmers utilizing the irrigation service increases too. No secondary data was available to actually know the increase in number of farmers using the schemes because even when the lessee cultivates the land the irrigation pass is given to the actual landowner and his name is recorded in the books. This would mean that an increase in the number of members taking water from the scheme would not necessarily imply that all the people whose name appears in the list are actually taking water and vice-versa. Therefore, the data shown below for three of the schemes cannot be used to draw and conclusive inferences.

**Table 11:** Number of 'recorded' members for three LI schemes.

Year	Season	Number of Members		
		Kataswan (Scheme#29/1)	Goria Phalia (Scheme#32/A)	Khusalpura (Scheme#32/3)
<b>1997-98</b>	Kharif	0	7	1
	Rabi	17	76	66
	Summer	18	80	71
	<b>Total</b>	<b>35</b>	<b>163</b>	<b>138</b>
<b>1998-99</b>	Kharif	1	14	0
	Rabi	23	86	52
	Summer	33	84	51
	<b>Total</b>	<b>67</b>	<b>184</b>	<b>103</b>
<b>1999-00</b>	Kharif	7	23	4
	Rabi	39	103	60
	Summer	40	104	71
	<b>Total</b>	<b>86</b>	<b>230</b>	<b>135</b>
<b>2000-01</b>	Kharif	9	13	22
	Rabi	28	102	51
	Summer	23	103	51
	<b>Total</b>	<b>50</b>	<b>217</b>	<b>124</b>
<b>2001-02</b>	Kharif	5	29	NA
	Rabi	21	100	NA
	Summer	19	101	NA
	<b>Total</b>	<b>45</b>	<b>230</b>	<b>NA</b>

With the list of farmers presently using the irrigation, an attempt was made in the studied schemes to identify the farmers giving their lands on lease. The tenant farmers, usually better off, were found to be cultivating nearly 20% of the irrigated land. However, this figure is based on *guesstimates* provided by the farmers and may not be accurate. Also, they were not very sure if the same was true in all schemes and across cases. On the whole, there was an opinion that the cultivation by the landowners was expanding and also the rent of land had increased from Rs1500/acre/year to Rs 4500/acre/year. Very poor families or the families without farming male members are giving their lands on lease.

## **ENCOURAGING AND DISCOURAGING FACTORS FOR TRIBALS TO GET INTO THE VENTURE**

From the above narration of the lift irrigation schemes implemented by GWRDC, the following factors seem to have encouraged tribal farmers in the region to adapt to irrigated agriculture:

### **ENCOURAGING FACTORS:**

**Prior Exposure and Linkages:** Due to the availability of canal irrigation in neighbouring villages, people in the region were exposed to the merits of irrigated agriculture even before the

**Box 8:** Amrut Bahadur Dhodia Patel

**Amrut Bahadur Dhodia Patel** is a progressive tribal farmer from village Bamnamaldur. He has 6 acres of land. He started using the lift irrigation (**Scheme # 5/A**) facility from the first year itself. He was used to sugarcane cultivation as with canal irrigation he was growing the crop in 2 acres of his land. Now he grows sugarcane in 7 acres of land by taking 3 acres of land on lease from other farmers. About 2 acres of his land are wasteland used only for grazing. He gets a good yield (40 tons per acre) from his sugarcane crop. He takes rice in these 7 acres of land for own consumption in between two sugarcane crops. The rice yield is 12 quintals per acre. He had a very small house and a few assets before irrigation. Now he possesses a very big house and owns a tractor. He had purchased the tractor with a bank loan and the tractor now fetches him a net income Rs. 20,000 per year.

intervention started. The linkages to procure inputs (including knowledge and credit) and to market the produce for cash crops like sugarcane already existed in many villages. Sugarcane is not only remunerative but also less backbreaking. Once sown, this crop again can be harvested more than once, sometimes even three or four times! It was found that a few tribal farmers have taken back their lands from the lessee and harvested the second/third crop with a modest application of fertilisers. The arrangement to procure sugarcane at the farmgate by the sugar cooperatives is a very farmer friendly practice. Once informed, the cooperative takes care of everything from cutting, transporting and processing. Apart from the credit and marketing support provided by the sugar cooperatives, most of the villages in the region have *Seva Sahakari Mandalis* to provide seeds, fertiliser

and cash on credit to the farmers at an interest rate of 10% per year. The sugar cooperatives also conduct training and awareness programs for the farmers from time to time.

**Low Cost Irrigation:** Initially, the government provided canal irrigation at Rs 400/year for an acre of sugarcane plantation. Subsequently, the lift irrigation schemes were implemented on grants to provide water at Rs 0.80 per 10,000 litres. This roughly comes to Rs 550/year for an acre of sugarcane crop. Whereas if one goes for sugarcane cultivation in an acre of land with a diesel pump set, the cost of irrigation would be at least Rs 2000. Even with the revised water charges of Rs 1.20 per 10,000 litres, the annual cost comes to only about Rs 800 for an acre of sugarcane. This gives us an idea of how cheap the irrigation water from these LI schemes is. This low-priced irrigation provides poor farmers some scope to try out and learn cultivation of new crops. This is why the farmers in Scheme # 51 (Sindhai), who are able to influence government for repairing of their scheme, are not interested in taking over the management of the schemes. The water charge is more<sup>12</sup> in the cooperatives who are managing the lift irrigation schemes of GWRDC. Everybody prefers irrigation from these schemes, of course next to canal irrigation, even when they have access to well irrigation. While it is not rare to find wells within the command area of the schemes, they are used only for protective irrigation during times of scarcity or between two irrigations provided by the LI schemes. Due to low specific yield of the aquifer, smaller pump sets are used, thereby increasing the duration of irrigation per unit of land. Moreover, their yield depends upon the discharge in the canals. Most of these wells go dry during the summer season making cultivation of sugarcane very difficult without the LI water.

<sup>12</sup> It comes to roughly Rs 1000 and Rs 1500 for an acre of sugarcane in a year in the Schemes # 53 and 5 respectively.

**Significant Benefits:** The first thing the farmers attained through irrigation is food security. With assured water they initially went for food grain production with high yielding varieties of seeds and better practices of cultivation. This changed their traditional way of paddy cultivation, which was not very economically rewarding. Subsequently, they got into the cultivation of sugarcane that gives a net return of Rs 10,000-12,000 per acre. A farmer having 2 acres of land does not need to migrate in search of employment anymore. An acre of sugarcane cultivation roughly generates 100 labour days of employment in a year. So several poorer farmers, who could not access irrigation due to lack of capital or facility, have an opportunity to accumulate resources through wage earning and go for irrigation at a later stage. A low wage rate of Rs 30 per day certainly indicates that the supply of labour is still quite high. However, during the four months of harvesting of sugarcane the wage rate goes up to Rs 60 per day. Increased biomass production has also helped the poor farmers sustain a remunerative dairy economy and this is another regular source of income which allows them to avoid forced out-migration.

**Management by Cooperatives:** The decision to transfer the management of lift irrigation schemes to users is welcomed by most farmers. Even though this increases the cost of irrigation for the farmer, more timely repair and maintenance ensures greater returns to the farmers. However, success of such cooperatives calls for a very cordial relationship between the small group of farmers entrusted with the responsibility of looking after the affairs of the cooperative and the rest of the members. The failure of a few cooperatives in the locality due to fraudulence on part of the leaders has made the farmers somewhat sceptical about cooperatives. On the other hand, the failure of GWRDC in providing quality irrigation service is putting pressure on farmers to try and build cooperatives to manage the schemes on their own. Some of the biggest hurdles that are preventing transfer of more schemes to user groups are: GWRDC's insistence on formation of formal, registered cooperatives; the baggage of past dues which needs to be cleared by the farmers before they can take over the schemes and the poor infrastructure in some of the schemes.

#### **DISCOURAGING FACTORS:**

**Poor Infrastructure:** As observed in the Schemes # 42/1 and 5/A, poor workmanship of the schemes meant that the full command area of the scheme could not be brought under irrigation even once. The maximum utilisation in these two schemes is only 31 and 57 per cent of the design respectively whereas the maximum utilisation in the other schemes is well past the design. The foot valves in many places get clogged during use due to lack of protection and this adversely affects the discharge. The poor infrastructure also leads to lower reliability of the system and farmers look for alternative arrangements, wherever possible.

**Rotation Policy of Water Supply:** Due to severe drought conditions during the last three years, the canal water supplied from the Ukai dam has become unreliable and insufficient. The irrigation department has adopted a rotational system of water supply in the canal under which water is released in the canal once in 15 or 20 days. Now a farmer can get water only when canal water, electricity and the operator are all available at the same time. This policy has also affected the yield from the wells.

**Irregular Electricity Availability:** Of late, the supply of electricity is available only for 8 hours in a day during *rabi* and summer seasons while the schemes have been designed to operate for 16 hours per day to cater to the full command area. Moreover, the electricity is supplied during the difficult hours of the day, like; in scheme 48/1 the supply was from 1:00 AM to 6.00 AM during the last season when it is difficult to have the government operator at the site to operate the

pump. The co-operatives, however, are able to make their operators run the scheme whenever there is electricity.

**Poor Repair and Maintenance:** Due to inadequate maintenance over years, all the components of the schemes have deteriorated. The pumps break down frequently and the pipes leak profusely. In Scheme # 5/A, water is presently delivered only through 4 out of the 31 outlets. GWRDC takes a considerable amount of time to repair them due to long official procedure and financial constraints. About the leakage they are hardly doing anything and the designed discharge is not available at any of the outlets. Water lost due to leakage is charged to the farmers. Due to the leakage, again, water is not retained in the pipeline and every time the pump is started, a significant amount of time is spent in filling up the pipe before water reaches the outlets. This eats away the utilisation time resulting in an increase in the irrigation interval that affects the crop yields. The co-operatives were found to be investing certain amount every year towards the maintenance of the schemes and the repairing is done swiftly without significantly affecting the irrigation schedule.

**Social Inequities:** The authors observed that the influential people managed to take more water from the schemes in times of scarcity and that water rights were not clearly established in these schemes. Every year an overall target for irrigation in each scheme is fixed by GWRDC, but the right for each farmer in the command area is not worked out. This has caused the damage of the pipelines in most of the schemes. Farmers, who do not get irrigation during scarcity, break the pipe either to steal water or to stop irrigation to others. Moreover, there is a strong conflict between the families affiliated to different political parties. This is the primary reason for the farmers to be unable to come together for the formation of user groups in many schemes. The cooperatives could be formed in Schemes # 5 and 53 largely because majority of the users shared common political affiliations. GWRDC's only concern is the coverage, in terms of total area for which irrigation is demanded and revenue, in terms of the total water charges collected. They are not concerned about equity issues within the systems as long as the total demand targets are being met. Such an attitude has, in some cases, lead to the alienation of the small and marginal tribal farmers.

**Lack of Involvement in Decision-Making:** Farmers are seldom consulted by GWRDC in matters of repairs and maintenance. Two of the studied schemes are getting revived by grants from a sugar cooperative. The users there showed dissatisfaction as they hardly know about the budget and the plan of renovation. They had a lot of meaningful suggestions to offer, but did not think that the work will be done as per their priorities.

**Lack of Access to Credit Facilities:** Capital is the problem for most of the poor tribal farmers who are still not able to take the benefit of irrigation in spite of having land in the command area. The problems that they face in accessing credit have already been enumerated above.

## RECOMMENDATIONS FOR GWRDC

The GWRDC was set up as a government owned registered company in 1971 with the two main objectives of increasing the area under irrigation through government tubewells and ensuring equity in distribution of water, particularly to resource poor farmers (Shah & Ballabh). The Corporation has constructed over 4000 tubewells including more than 300 in Anand District. Under increasing pressure from state's political leadership, GWRDC decided to turn over tubewells to farmers in the command area. In an ITP study of the GWRDC's Tubewell Transfer Program in Anand, Deb Roy and Kishore (2002)<sup>13</sup> bring out the following factors as the in-built merits in the Transfer Model that have possibly led to relative success of the scheme: [1] Simple Process; [2] Flexible Approach; [3] Low Interference; [4] Good Monitoring; [5] Secure Lease; [6] No past baggage.

A quick comparison of the tubewell transfer models with the transfer process in Surat reveals that the LI transfer model has miserably failed to emulate the factors which made the tubewell transfer model a success in Anand.

**Table 12: Quick Comparison of GWRDC's Tubewell Transfer Model and LI Schemes**

	<b>GWRDC Tubewell Transfer in Anand</b>	<b>GWRDC LI Schemes in Surat</b>
<b>Process</b>	Simple and Quick	Time Consuming and Effort Intensive
<b>Flexibility</b>	Initial insistence on forming cooperatives diluted leading to greater success in transfer	Formation and registration of cooperative under the Gujarat Cooperative Societies Act a pre-condition for transfer
<b>Independence</b>	Total freedom in Operations and Management	Total freedom in Operations and Management
<b>Monitoring</b>	Strict yet Smart and Simple	Strict scrutiny and submission of audited accounts to the registrar of cooperatives
<b>Past Baggage</b>	Cooperative/ <i>Juth</i> not allowed to sell water to past GWRDC defaulters; no burden of clearing past dues	Cooperative burdened with past dues and clearance of past dues a pre-condition for transfer
<b>Lease</b>	Secure renewable leases (Five Years for cooperatives and One Year for <i>Juths</i> )	LI Schemes are transferred to the cooperative for a token annual rent of Rs. 11 only.
<b>Pricing</b>	Cost of Irrigation reduced after transfer	Cost of Irrigation increased after transfer due to removal of subsidies
<b>Exit Costs</b>	Relatively high	Negligible
<b>SUCCESS RATE</b>	<b>Moderate to High</b>	<b>Very Low</b>

The table clearly illustrates why only 8 out of the 67 operational LI schemes commissioned by the GWRDC have been transferred so far. The LI schemes transfer model fails to match up on almost all the success factors identified for the success of the Tubewell Transfer Program.

The schemes which have been successfully transferred so far depend heavily on traditional leadership and benevolence of a small group of individuals who pooled their resources to pay-up

<sup>13</sup> Aditi Deb Roy and Avinash Kishore: *Irrigation Management Transfer: The case of GWRDC's Tubewell Transfer program in Gujarat*, 2002

the past dues on behalf of the entire group. Once the schemes were transferred, they recovered their investments from the profits of the cooperative<sup>14</sup>. Such instances of people going out of the way to make a transfer successful cannot be relied upon if the transfer is to be made a success on a large scale.

Recovery of past dues and formation of a registered cooperative should not be pre-conditions for transfer. The GWRDC should not try to use the transfer process to make up for its past inefficiencies in collection of water charges. In many instances, the defaulters are no longer living in the area or were those who had taken the land from the tribals on lease and/or shared cropping. The owners of the land should not be held responsible for the defaults of such people. The policy of not allowing the users' group to sell water to past defaulters can act as an incentive for the defaulters to pay up if they still wish to get water from the LI scheme.

Going a step further, in case there are some enterprising individuals willing to run the LI scheme as a business venture, they should be encouraged and schemes should be transferred to them through a simple and quick process. However, one thing which the GWRDC must keep in mind while transferring the LI schemes to individuals or small informal groups is that there is a need to build in some *Exit Costs*. This would ensure that people don't become disinterested in the schemes if they fail to deliver in a bad monsoon year. Such costs can be built in by revising the token rent (currently fixed at Rs. 11 per year) to a more realistic amount.

For schemes such as Scheme # 42/1 and 5/A, where the scheme design itself is faulty, the GWRDC would need to make investments, in consultation with the people, and ensure that the system operates at 100% efficiency before they can expect to transfer the scheme to the users.

---

<sup>14</sup> In Scheme # 5, eleven trustees of the cooperative society pooled in money to clear the old dues of the government and waited for the society to become financially sound before they could get their money back from the profits of the society. Without these interest free loans from the trustees, the turnover would not have been possible. One of these trustees, Kikubhai, a retired engineer, is also the president of the cooperative lift irrigation society.

## CONCLUSION

This study intended to explore irrigation intervention in a place where tribal farmers have responded well to a large-scale irrigation programme by the Government of Gujarat. The clue to this success, among other factors, lies in the large scale and reach of the intervention. An isolated approach would not have been able to create the kind of marketing linkages that this initiative has done. A single sugar factory requires nearly 7.5 lakh tons of sugarcane in a year. Without bringing a large chunk of land under irrigation, creation of such linkages would not have been possible. The other important factor, ofcourse is the provision of irrigation at a very low cost to the tribal community. Hence, the scheme is not directly comparable with the relatively smaller scale interventions made by NGOs and the high costs at which irrigation is offered under those schemes. In a typical PRADAN LI intervention in Jharkhand, each hour of irrigation service costs anywhere between Rs. 30-40 for a farmer (which would include the cost of one litre of diesel – Rs. 20 PLUS additional costs for the wear and tear and for covering the management costs). In this case however, the cost per hour is as low as Rs. 12-20 even in the user managed schemes which no longer enjoy the huge subsidies of the government. Table 11 summarises the advantages and disadvantages for the farmers under the two management regimes.

**Table 12: Advantages and Disadvantages for the farmers under GWRDC managed and User Managed LI Schemes**

G. W. R. D. C. Management	Co-operative Management
<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>→ Cost to the farmer is lower as the government provides huge subsidy</li> <li>→ Technical supervision and back-stopping is better</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>→ Procedural delays in repair and maintenance</li> <li>→ In case of dues, provision of L.I. water is stopped</li> </ul>	<p><b>Advantages</b></p> <ul style="list-style-type: none"> <li>→ Procedural delays are less and the users have greater freedom in the operations and maintenance of the system.</li> <li>→ Provision of water is not stopped in case of non-payment of dues and informal arrangements are made</li> </ul> <p><b>Disadvantages</b></p> <ul style="list-style-type: none"> <li>→ Lack of technical supervision</li> <li>→ Paucity of funds to undertake repair</li> <li>→ Costs to the farmers are also higher</li> </ul>

The conclusions of the study can broadly be listed as follows:

1. Projects that are managed by users' cooperatives have performed better than GWRDC managed projects in terms of managing their overhead costs and regular & prompt repair and maintenance services. The only exception to this was in GWRDC managed Scheme # 51 where the farmers are quite influential and use their political muscle to take government's services and therefore the performance of this scheme has been far better than others.
2. Large size of schemes, absence of institutional support, run-down infrastructure, requirements of capital in the beginning to clear the past dues, insistence on formation of cooperatives, low water charges and lack of unity among farmers discourage the transfer of management from the corporation to the cooperatives.
3. Well established backward and forward linkages have helped farmers make higher investments in agriculture and shift to profitable cash crops.
4. Removal of pre-conditions of formation of registered cooperatives and clearance of past dues will significantly facilitate the process of turn-over of the operations and management of the schemes to the users.

## Lessons for the Central India Initiative

The study offers many lessons for the Central India Initiative. It looks at “Next Level” issues in making irrigation projects feasible for sustainable livelihood generation for tribal communities. What are the factors which encourage and discourage the tribal farmers to associate themselves with irrigation schemes and their management under conditions where the demand for irrigation is not a problem? The study also brings out the impact which a large-scale government intervention can create in terms of encouraging the birth of market linkages which a small scale intervention cannot create. Another important issue which the study points to is regarding the provision of subsidies for irrigation. Subsidies are often criticised for the fact that they create dependencies which cannot be corrected in the long run. This case however, illustrates that once the farmers are convinced about the benefits of irrigated agriculture, they show a willingness to pay higher rates for improved irrigation services even after the subsidies have been removed and also are willing to take over the operations and management of the schemes, provided that a conducive environment is created for the same.

The user managed schemes levy higher water charges and collect a much greater proportion of levied charges compared to the GWRDC managed schemes. Hence they have more money to invest in repair and upkeep of the hardware of the schemes. The management costs (including salaries) are also proportionally much lower in the case of user managed schemes. Some of these schemes have also tended to enlarge their own roles by assisting farmers in input or output side of the value chain.

**Upward ratchet of user managed schemes:** *“Higher charges-higher collection-more surpluses-regular upkeep-flexible operating policy-better service-greater reliability-greater benefit to farmers-greater willingness to pay”*

**Downward spiral of GWRDC schemes:** *“Low tariff-indifferent collection-absence of own funds to maintain-dependence on higher ups-poor responsiveness-irregular maintenance-poor service-lower reliability-particularistic treatment of powerful users-alienation of ordinary members-indifference and anomie-high entropy systems”*

In terms of organisational setup, it was found that the user managed schemes came up successfully only when a small group of individuals went out of their way to bear the transaction costs of collective action. They pooled their personal resources to pay the outstanding dues of the farmers; made extra efforts to complete the process of registration of the cooperative and also devoted time to the organisation and management of the cooperative. Such successes largely depend on individual benevolence and cannot be acceptable as replicable models. If indeed the model would be successful, it would motivate people to take up the management of the schemes without having to depend on benevolent leaders.

The individual caselets also illustrate that even within the tribals, there exists a hierarchy in terms of response to irrigated agriculture (Dhodia Patels, Choudhuries and Gamits; in that order), in terms of capital investment in agriculture and in terms of the agricultural practices and cropping pattern. Some people readily adopt high yielding varieties and irrigation facilities as soon as they are available while others are constrained by resources or facilities. These people initially can access only the incidental benefits of irrigated agriculture such as increased labour availability and later join the others in practicing intensive irrigated agriculture.