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BUILDING AND ENERGIZING WATER INSTITUTIONS: A CASE STUDY OF IRRIGATION MANAGEMENT TRANSFER IN GUJARAT

D. D. TEWARI
Professor, School of Economics and FInance
University of Kwa-Zulu Natal, South Africa

S. KHANNA
Consultant, Satpura Integrated Rural Development Institution, Bhopal, India

ABSTRACT

Internationally speaking, irrigation management reform has a history of 50 years, but significant work has only been done in the past two decades. The experience of Gujarat province of India is relatively new and needs to be analyzed. The success of irrigation management transfer programs in Gujarat is attributed to the evolution of institutional rules which brought a variety of positive socioeconomic changes in terms of increased household income and reduced migration from villages—an unprecedented change in the area's history. The study explains how credible institutions were built, how new institutional rules were innovated and applied, how open information flow among the beneficiaries and stakeholders of the program was facilitated, and finally how the program promoted competition by exposing the scheme to the reality of scarce water resources. Some important lessons are gleaned from the scheme. The success of irrigation management transfer depends upon: developing a systematic method of collection of water charges; developing a system of repair and maintenance; developing a documentation system for beneficiaries; developing a responsible democratic governance; developing a culture of learning skills, ensuring a regular reliable supply of electricity; and finally on a culture of institutional endurance.

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INTRODUCTION AND OBJECTIVES

As the problem of absolute water scarcity grows, irrigation management institutions require radical reform so as to ensure sustainable delivery of water to farmers. In the 50-year international history of modernized irrigation management, significant work has only been done in the past two decades. The experience of Gujarat province of India is relatively new and has not been reviewed comprehensively. The success of irrigation management transfer in Gujarat depends upon building credible irrigation cooperatives. Our study highlights how this was achieved and describes the current irrigation management transfer (IMT) experience in Gujarat with special reference to lift irrigation. The more specific objectives are as follows:

- to discuss the institutional aspects of irrigation cooperatives that enabled a successful IMT outcome;
- to identify the social and economic impacts of the IMT experience; and
- to extract policy lessons that are transferable outside the province in Gujarat in India and beyond.

This study has eight sections. Section two provides a brief historical review of the IMT in Gujarat; data details and analytical procedures are given in section three. The fundamental institutional rules that govern IMT are discussed in section four. Social and economic impacts are delineated in section five. Major constraints of this experience are reviewed in section six. Policy lessons are extracted in section seven, followed by conclusions in section eight.

A BRIEF HISTORICAL REVIEW OF IRRIGATION MANAGEMENT TRANSFER IN GUJARAT

Gujarat state is located on the west coast of India. The average annual rainfall in the state is 840 mm, but is highly erratic, varying from 525 mm to 1070 mm during last 20 years. Within the state, rainfall varies from 1350 mm in South Gujarat to about 270 mm in the Kutch (northwest of Gujarat) region. In western Gujarat, annual rainfall is most erratic and varies from 300 mm to 660 mm. These regions face acute water scarcity. The average annual rainfall in the eastern hilly region varies from 870 mm to 1700 mm; this region receives good rainfall but due to the rocky terrain rainwater does not percolate and flows away to the sea. In spite of having high rainfall, the eastern tribal hilly region has less than 10% area under irrigation [1]. Furthermore, rainfall is confined to only four months from June to September; the number of rainy days lies between 10 in Kutch and 50 in South Gujarat. There is an unequal distribution of rainfall during the season. Sometimes 40 to 50% of the season's total rain falls in only seven and eight days [1]. The dry spells after a few days of rain are

long and cause crops to fail. "Irrigation Management Transfer," a participatory approach to developing irrigation resources has been implemented on canal and lift irrigation in Gujarat.

A study group appointed in 1985 by the Irrigation Department, Government of Gujarat, found that revenue from collection of water rates constituted only 8% of the total cost of delivering water, and hence recommended a gradual increase such that this proportion would reach about 33% by 1991/92. Because of low rates and poor recovery, the revenue was just enough to cover only 20% of the total cost of operation and maintenance [2]. This made the sector highly subsidized and non-viable. Water rates in Gujarat were not revised since 1960 because of political pressure. In 2001 there was a significant increase in water rates from Rs. 1700 to Rs. 4000 per hectare, straining the relationship between farmers and the Irrigation Department (ID).

Farmers perceived that the Department was not working efficiently and therefore not worth paying, while the Department ascribed its inability to maintain the system to various causes. For example, one obvious reason was that the Irrigation Department was diverted by its many other activities (such as elections, immunization, the census). The Department receives outside assistance from non-governmental organizations (NGOs) which are often better able to build popular rapport. The government of Gujarat realized the strength of the NGOs and agreed to collaborate with them. A few NGOs, mainly the Sadguru Water Foundation (known as Sadguru) and AKRSP (Aga Khan Rural Support Program), undertook some small-scale water-related activities, promoting lift irrigation, check dams, recharge structures, and percolation tanks, in the late 1970s and 1980s. From 1985 to 1987, Gujarat faced one of the worst droughts of the century; it left an indelible impression on the minds of farmers that irrigation and new irrigation schemes throughout the state, were essential. The status of the irrigation sector was highly unsatisfactory. Even the majority of the minor irrigation schemes (for areas under 1000 hectares) were not functioning. In most places, tail-enders did not have access to water. Participatory irrigation management practices, emphasizing the formation of water users' associations, also were tried. Since these associations were formed to satisfy the requirements of external development agencies but did not establish rapport with the people, convincing the public of the benefits of participation proved difficult, and participation was minimal.

In 1987, the AKRSP helped the Irrigation Department establish lift irrigation cooperative societies in Bharuch, a tribal district of Gujarat. Despite an 1100 mm average annual rainfall, Bharuch district had only 6% of its area under irrigation [3]. Increasing the irrigated area became the prime objective of these cooperatives. They charged their own rates for water, three to four times the rates determined by the government. The positive experience of lift irrigation management transfer later led to the spread of this model for canal irrigation in the district. This experiment showed that people were willing to pay if water supply was satisfactory.

For the scheme to be acceptable to farmers, it was essential for the facilities to provide sufficient water efficiently, reliably, and equitably.

After a series of "exposure visits" and workshops with government officials, the Government of Gujarat passed a resolution in 1995 that participatory irrigation management (PIM), based on partnership between farmers associations and the government, should be established as a "Turnover Program" for administration and economical management of water resources through lift irrigation schemes. In Gujarat, the lift irrigation schemes have been introduced for small-scale irrigation. Fifty to 100 hectares of land typically can be irrigated through one scheme [4].

Lift irrigation can take the form of surface lift irrigation or groundwater lift irrigation. Lift irrigation refers to the process of raising water from lower elevation to make it available as an input to agriculture. The sources of water can be rivers, streams, tanks, open wells, or tube wells. In the lift irrigation scheme, water is pumped from the source to the highest point in the command area through a rising main, and from there distributed into fields by gravity via a network of underground pipes or open field channels.

In surface lift irrigation, water is lifted from rivers, canals, backwaters of irrigation dams, or tanks. In canal irrigation, since the construction of field channels takes a long time, the Irrigation Department uses water lifting technology (pumps) to provide water through irrigation cooperatives. In hilly areas, where it is very difficult to construct irrigation channels, lift irrigation schemes were also introduced. Almost all rivers in Gujarat are non-perennial; hence, it is difficult to get water throughout the year. Sadguru, working in the northeastern part of Gujarat, introduced a technique of building check dams on streams in the early 1980s to ensure availability of water for irrigation for most of the year through lifting. This technique was subsequently adopted by AKRSP. Check dam were used for either direct irrigation or indirect irrigation from dug wells which get recharged. Both NGOs carried out this work with farmer participation through irrigation cooperatives.

The irrigation cooperatives played a crucial role in the collection of water fees, the distribution of water, repair and maintenance, and the audit of accounts. One of the major purposes of forming a lift irrigation cooperatives was to benefit from efficiency of scale. It is far more efficient for a group of farmers to draw water from one motor than for each farmer to operate a separate pump. Even the poorest farmer or smallest landholder had access to irrigation as she/he has to pay only in proportion to land-holding size.

The Gujarat Government had made efforts to involve people in minor irrigation schemes. For example, the state government introduced the Sardar Patel Participatory Water Conservation Program on a large scale in January 2000 with the active participation of beneficiary farmers in the Saurashtra and Kutch regions. The government contributed 60% of the total cost. The objective was to conserve rain water in order to recharge groundwater, which otherwise flowed

into the sea. In 2000-2001, a total of 13,746 check dams were constructed in 2,315 villages under this program [5].

The groundwater lift irrigation was accomplished through tubewells and dugwells. Although tubewells and dugwells were privately owned, the government tried to popularize groundwater lift irrigation through cooperatives. The government established the Gujarat Water Resource Development Corporation Limited (GWRDC) for the investigation, exploration, development, and management of groundwater resources through public tubewells and lift irrigation. The Corporation has so far drilled 3,521 tubewells and commissioned 3,494 tubewells for irrigation, adding some 210,000 hectares of potential irrigation. It also completed 63 lift irrigation schemes.

In 1987, the government decided to hand over functional tubewells to beneficiaries or construct new tubewells for them [5]. The condition is that a minimum of 11 beneficiaries submit their demand for a tubewell after forming a society. Only landholders can become members. Formal registration of the society can be made after commissioning of the tubewell. By 2002, the GWRDC had handed over about 1,800 tubewells to the people. The beneficiaries irrigation society contributes 15% of the cost in cash or labor, and is responsible for repair and maintenance of the tubewell. The government provides the pump set, underground pipe-distribution system, and residential space for the pump operator, whose salary is paid by the society. Tubewells for irrigation societies are drilled on public or private lands. In the latter case, the land is donated to GWRDC by the owner.

DATA AND ANALYTICAL PROCEDURE

A "triangulation approach" was used in this study. This required a descriptive approach for policy and irrigation management assessment, and case studies of several schemes to generalize the results. The first part included interviews with government officers and review of documents from the Gujarat government and non-governmental organizations working on irrigation management. The second part made field surveys of several lift irrigation schemes to evaluate their impacts on the overall irrigation management program.

More specifically, primary information was collected from:

1. officials from irrigation, electricity, and economics/statistics departments and the Water Resource Development Corporation;
2. NGOs such as AKRSP, Sadguru, and the Development Support Centre; and
3. lift irrigation cooperatives.

Interviews with government officials and members of non-governmental organizations were conducted using questionnaires. Information from lift irrigation cooperatives was collected through questionnaires, participatory research methods, and field observations. Five head- and five tail-ender farmers were interviewed separately in each lift irrigation cooperative to assess the benefits from cooperative irrigation schemes. Group discussions with beneficiaries were organized through

the Participatory Rural Appraisal (PRA) methodology. Data on operational and managerial concerns were collected by interviewing chairpersons and committee members. All data in the tables in this article are based on this field survey.

Samples for the case studies were selected from three districts in different areas: Junagadh, Bharuch, and Dahod. Junagadh district is a non-tribal area in the western coastal region, Bharuch is a tribal area and in the southeastern high-rainfall hilly region, and Dahod is also a tribal area, in the northeastern part of Gujarat. The sampling covered the different types of lift irrigation cooperatives, as classified in Table 1. Fourteen cooperative societies from the three districts of Gujarat were selected. Seven cooperatives were located on roadsides, seven in remote areas. The sample included seven successful cooperatives, three partially successful, and four unsuccessful ones.

Lift irrigation is a small-scale irrigation scheme in which all participants are expected to know the technology. In each lift irrigation cooperative, one pump operator and one water distributor are appointed whose responsibility is to ensure

Table 1. Classification of Lift Irrigation Cooperatives, Gujarat

LI cooperative	District	Supporting agency	Status of success	Village location
Samdhiala	Junagadh	NGO	Successful	Remote
Zadaka	Junagadh	NGO	Unsuccessful	State highway side
Kajali	Junagadh	Self-initiative	Successful	State highway side
Ghanikut	Bharuch	Govt./NGO(joint)	Successful	Remote
Koliwada	Bharuch	NGO	Partially successful	Remote
Anjoli	Bharuch	Government	Unsuccessful	District highway side
Kathipada	Bharuch	Government	Partially successful	District highway side
Amli	Bharuch	NGO	Successful	Remote
Ghodi	Bharuch	NGO	Unsuccessful	Remote
Vakol	Dahod	NGO	Successful	Remote
Kachumber	Dahod	NGO	Partially successful	Remote
Kesarpar	Dahod	Government	Unsuccessful	District highway side
Kesarpar	Dahod	NGO	Successful	District highway side
Degawada	Dahod	NGO	Successful	District highway side

equity in water distribution. In this system, all farmers have an equal opportunity for water. Therefore, per-acre benefits are almost equal for head- and tail-end farmers. We therefore decided not to analyze further the benefits for head- and tail-end farmers. Similarly, the analysis according to land holdings (large, medium, and small farmers) is also not very revealing, since water is distributed according to the rules of the cooperative—per-acre benefit is almost identical for large and small farmers. In the command area of a lift irrigation, almost all farmers have less than 5 acres of land and most hold between 0.25 and 2.5 acres. Irrespective of caste or land-holding size, everybody had to pay for water. Without collection of water charges from all, it was not possible to sustain the scheme. Bharuch and Dahod are tribal areas and cooperatives had highly homogeneous compositions. Therefore, caste and class discrimination did not arise. In Junagadh, Samadhiala, and Kajali, cooperatives were socially heterogeneous; however, lower castes were aware of their rights and as a result were not subjected to discrimination. Social class accordingly was not a significant variable affecting the performance of irrigation management.

A COOPERATIVE MODEL OF IRRIGATION MANAGEMENT: PRINCIPLES OF FUNCTIONING

The cooperatives have been very successful in Gujarat, particularly under the leadership of the National Dairy Development Board (NDDB), Anand. The cooperative model has become a popular institutional innovation in Gujarat and an integral part of its culture. Four fundamental institutional rules were themselves created by the people: governance by rules, pricing of scarce water resources, equitable distribution of water, and rapid capital mobilization.

Principle of Governance by Rules

Governance by rules is the most important hallmark of lift irrigation cooperatives. All had framed rules and regulations for their operations (see Appendix). Cooperatives developed their own systems for remunerating the pump operator, water distributor, and secretary. Adherence to rule-based governance helped eliminate favoritism and partisanship.

Principle of Water Pricing

The second most important principle was that everyone paid for the water, regardless of social position, on the basis of acres of irrigated area or hours of water release. If supplied on the basis of per acre-irrigated area, water charges differed every year, depending on electricity supply as well as water availability. Charges varied from Rs. 40 to Rs. 240 per acre and were some 10 to 20% higher in summer season than in the *kharif* and *rabi* seasons. The appropriate method of charging for water is still evolving. The drawback of the per acre system is that

because of lack of control on time, some farmers over-irrigate their fields, which leaves less water for others. In the case of hourly rate systems, tail-enders may be deprived of their due share of water owing to narrow pipes or inappropriate slopes. Some experts have suggested charging on the basis of volume of water used. This may be an appropriate method to address the equity issue and avoid overuse of water. However, this requires installation of water meters which are very difficult to be repaired quickly in case of breakdown.

Furthermore, to make the best use of scarce water, the cooperatives engaged in planning exercises. Most cooperatives were required to do crop planning before every agricultural season. Farmers had to provide their cropping plans to the executive committee to estimate water needs in advance. This helped the cooperatives to estimate income and costs, and match water demand and supply. The planning improved the distribution of crops by season. For example, maximum irrigation is required in the *rabi* season. About 43% of the gross irrigated area is covered in *rabi* with six to eight waterings (see Table 2). In *kharif,* 39% is covered but with only one or two waterings. In summer, because of lower availability of water, only 18% was irrigated. Accordingly, maximum water charges are contributed in the *rabi* season and minimum in the summer.

Principle of Equitable Water Distribution

The third principle of governance was to promote the equitable distribution of water. Cooperative societies address this goal in several ways:

1. In some cooperatives a lottery is drawn to decide the order for supplying water. A justice committee also can give priority to those who are in urgent need of water.
2. Some cooperatives distribute water on first-come first-serve basis. In this system the farmer who registers his/her name first and deposits the charge first, gets water first.

Table 2. Breakdown of Seasonwise Use of Water, Gujarat

Cropping seasons	Irrigated area	Collection of water charges	Number of watering
Rabi	43%	63%	6 to 7
Kharif	39%	25%	1 to 2
Summer	18%	12%	8 to 9
Total	100%	100%	5 to 6

3. In some cooperatives the turn system was introduced. Under this system, farmers register their names for their turn by paying 50% of water charges in advance.

This guarantees their turn. That is, if a tail-end farmer deposits money first, he/she gets water first regardless of the location of the field. The turn system is flexible. In case some farmer's crop is drying, water can be released out of turn in his/her field with the consensus of all members.

In field visits, more than 90% of tail-end farmers expressed satisfaction with water distribution. Location of fields was not an obstacle. Only in two cooperatives were there problems for tail-end farmers. In the Amali and Kesharpur cooperative societies, water was supplied on an hourly basis. Consequently, some tail-enders complained that the diameter of the pipe was narrow and that therefore in one hour they received less water than did the head farmers. The problem was resolved with an understanding that tail-enders would pay water charges for one hour of supply while water was supplied for one hour and ten minutes. (It is estimated that it takes six hours to irrigate one acre of land.) However, the problem of inequitable distribution persists.

Principle of Rapid Capital Mobilization

The fourth crucial principle was rapid mobilization of capital and other resources. In non-tribal areas, the District Rural Development Agency (DRDA) provided a 45% subsidy for the Samdhyala and Zadaka schemes; the balance came in the form of loans from banks. In tribal areas, 75% of the cost of a scheme was subsidized by the provincial government and 25% contribution by farmers, either from a bank loan or in the form of provided labor [4]. NGOs have also been instrumental in mobilizing capital. For example, often NGOs construct lift schemes using their own sources of funding, such as foreign agencies or foundations. Some Indian donors support NGOs by setting up Indian foundations. NGOs became catalyst in mobilizing capital resources for the people. The NGOs also help villagers to acquire funds from the range of available sources.

Other means of mobilizing capital resources used by the cooperatives included income from collection of water charges, membership fees, penalties, sale of agricultural inputs like seed, fertilizers, and pesticides, interest from fixed deposits of their corpus fund which was generated from the membership fees, and people's contribution in cash. Most of the expenditure was used to pay for electricity, salaries of office bearers, travel, stationery, communication (phone and postal), insurance of pump and maintenance and repair. Payment of electricity bills on time was essential; otherwise the cooperative had to pay an interest rate of 18% on unpaid bills. Most of the cooperatives kept reserve funds for financial safety. Some 35% of the cooperatives achieved less than 50% of the irrigation potential. Another 35% achieved targets between 51 and 80%. Only 30% cooperatives were able to meet the targets of 100% irrigation in their command area. It is

important that cooperatives should achieve maximum potential in order to become financially sustainable. Increase in irrigation potential will lead to more membership and in turn more income from water.

SOCIOECONOMIC IMPACTS OF IRRIGATION MANAGEMENT

The irrigation management transfer affected the social, economic, and physical environment of the region in many ways. Altered cropping mixes the use of high payoff inputs, and reduced migration from villages, improved consumption and wealth levels.

Changes in Cropping Patterns

Before the commencement of lift irrigation schemes, farmers could only grow *kharif* crops. A late monsoon meant that more than 50% of the crop would be destroyed. Irrigation cooperatives changed the picture entirely. The prospects of losing the crop were reduced to almost nil and yield levels more than doubled (see Table 3). The availability of water allowed farmers to grow wheat and vegetables in *rabi* season and groundnut, green gram, black gram, and vegetables in the summer season (see Table 3). The increased level of assurance of irrigation enticed farmers to grow high-value crops such as chilly, French beans, and summer groundnut. Chilly crop is a very high-value crop but stresses the fertility of land; therefore, farmers grow it every second or third year. The French bean (locally known as Papadi) is a 10- to 11-month crop that provides per acre annual income in Rs. 10,000-12,000. When farmers do not grow long-duration crops like cotton and pigeon pea in *kharif,* they grow wheat in *rabi.* Summer groundnut is a high-value crop with timely watering, fetching 20 to 30% higher prices than *kharif* groundnut. If farmers can grow summer crops, their income goes up markedly. Increases in the production of vegetables significantly contributed to increases in income levels. Owing to access to irrigation, crop intensity increased two- to three-fold (see Table 3).

Increased Usage of High Payoff Inputs in Agriculture

As farmers were assured supply of water, they did not hesitate to invest on high-payoff inputs. The introduction of lift irrigation schemes resulted in a five- to ten-fold increase in inputs in agriculture. Farmers switched to certified seeds, chemical fertilizers, and pesticides. For example, expenditures on chemical pesticides increased at an alarming rate (see Table 4). Farmers could spend Rs. 600 to Rs. 20,000 on pesticides, depending on the intensity of pest attacks. Very high doses of pesticides were used for cotton and vegetable crops. Since irrigated land remains wet for a longer period, making for favorable conditions for

Table 3. Changes in Cropping Pattern and Per Acre Yield (in qts)

	Bharuch		Dahod		Junagadh	
Crop	Before	After	Before	After	Before	After
Kharif						
Paddy	**7**	**12**	**10**	**12**	0	0
Jowar (sorghum)	**4**	**8**	0	0	0	0
Cotton	**3**	**6**	0	0	0	0
Pigeon pea	**1**	**3**	**1.5**	**2**	0	0
Urad (black gram)	**3**	0	**1.5**	**2**	0	0
Soyabean	0	**5**	0	0	0	0
French beans	0	**180**	0	0	0	0
Groundnut	0	0	0	0	**6**	**10**
Bajari (pearl millet)	0	0	0	0	**3**	0
Maze	0	0	**13**	**15**	0	0
Rabi						
Wheat	0	**8**	0	**13**	0	**20**
Horse gram	0	**2**	0	**7**	0	**0**
Bajara (pearl millet)	0	**4**	0	**0**	0	**0**
Vegetables	0	**10**		**20**	0	**15**
Maize	0	0	0	**13**	0	0
Summer						
Groundnut	0	**8**	0	**14**	0	**12**
Mung (green gram)	0	**3**	0	**2.5**	0	**6**
Urad (black gram)	0	0	0	0	0	**6**
Vegetables	**0.25**	**5**	0	**20**	0	**50**
Fodder	0	**200**	0	**300**	0	**250**

pests, farmers confirmed that pest attacks became quite frequent. Even for a small-size pest attack, farmers use high doses of pesticides instead of using eco-friendly methods of pest control. Pesticides were used for groundnut, cotton, and vegetable crops.

Increased Level of Asset Base

Lift irrigation schemes brought significant changes in asset ownership. Increased cropping intensity and growth of high-value crops brought in more income, which affected three areas: housing, food, and investment. Farmers formerly lived in thatched huts; these were replaced by cement and concrete houses. People formerly grew only low value coarse grains, their staple diet. With

Table 4. Change in Expenditure on Inputs in Gujarat
(2002 = 100)

	Average per acre expenditure on inputs (in Rs.)					
	Bharuch		Dahod		Junagadh	
Inputs	Before	After	Before	After	Before	After
Seeds	100	1,350	100	800	1,000	2,300
Fertilizer	0	700	0	500	220	930
Pesticide	0	3,000	0	600	1,000	8,000
Water charges	0	1,600	0	1,200	0	1,500
Labor	450	6,000	400	4,000	700	9,000
Plough/tractor	500	1,500	500	1,500	500	1,000
Transportation	200	700	150	1,000	200	1,500
Total	1,250	14,850	1,150	9,600	3,420	22,730

higher income they switched to wheat, vegetables, and dairy products. People also put extra savings into gold and silver jewelry, household utensils, furniture, fans, or refrigerators. In the Junagadh area land values increased from Rs. 25,000 to 30,000 per acre before irrigation to Rs. 200,000 to 300,000 per acre after irrigation. Many small farmers sold their land in the command area and purchased larger pieces of land outside the command area. Many used their extra money to dig wells. Large farmers purchased more land adjacent to their fields to consolidate their holdings.

Reduction in the Out-Migration from Villages

The main effect of lift irrigation was to curb out-migration. Prior to the scheme, rainfed agriculture permitted growing the one single *kharif* crop. When *kharif* season ended, villagers were forced to leave. The change permitted farmers to cultivate two or three crops in a year with the help of irrigation. The continuous work and income stream made most out-migration unnecessary. Prior to the irrigation schemes, people used to migrate for 120 to 150 days in a year; with the scheme, the migration reduced to 30 to 40 days in a year for the few that do still migrate. In this way, migration has become a matter of choice, not one of compulsion.

Occupational Changes

Another social effect of this experiment was the changing pattern of occupation among villagers. Some landless villagers started farming. The increased crop intensity that irrigation made possible made the work of large landowners difficult, particularly when holdings were fragmented. As a result they started leasing out land to the landless for share cropping. This has also pushed up wages and made food cheaper.

Increased Level of Income and Living Standard

The most tangible impact of lift irrigation was dramatically increased agricultural income (see Table 5). Average income before the irrigation was Rs. 5,000 to Rs. 6,000 per acre, and Rs. 20,000 to Rs. 25,000 per acre afterward [5]. This gave rise to qualitative and quantitative changes in food consumption. Earlier, marginal and small farmers hardly used to manage two meals a day, particularly in summer and rainy seasons. In the post-irrigation period, all farmers had ample and nutritious food (wheat, pulses, and vegetables). Their intake of sweets also increased. Many farmers started producing small quantities of vegetables, purely for home consumption. Thus, their diets now include a much greater quantity of green vegetables. Vegetables have become available almost year-round in most villages, and at lower prices.

Drought-Proofing

The failure of the monsoon from 1999 though 2001 caused acute drought conditions in Gujarat. This worsened the economic condition of farmers. Most *kharif* crops failed and a very scant area was covered with *rabi* crops. Agriculture income decreased by 70 to 80% [6]. During the drought, while non-beneficiaries had to migrate or look for other sources of income, lift irrigation beneficiaries

Table 5. Change in Net Income from Agriculture in Gujarat
(2002 = 100)

	Net income (in Rs.)					
	Bharuch		Dahod		Junagadh	
Items	Before	After	Before	After	Before	After
Output	6,400	36,000	7,800	32,000	9,240	47,400
Input	500	14,850	1,150	11,400	3,420	22,730
Net benefit	5,900	**21,150**	6,650	**20,600**	5,820	**24,670**

could sustain themselves. Marginal and small farmers in the command area also migrated—but for fewer days than non-beneficiaries. Though most cooperatives either could irrigate very small areas or could not function at all, lift irrigation beneficiaries by and large were able to face the drought substantially more easily. Some had food grains saved from the previous years while others used savings to buy food grains, or bought on credit because of higher credit-worthiness as owners of irrigated land.

INSTITUTIONAL CONSTRAINTS ON IRRIGATION MANAGEMENT TRANSFER PROGRAM

Irrigation management in Gujarat is not a completely smooth affair. Problems had to be overcome by persistent collective efforts. Legal and economic hurdles had to be faced and overcome by cooperatives. These institutional constraints are discussed below.

Acquiring Permission for Water Lifting

As per Indian law, water cannot be lifted from a designated or "notified" river without permission from the Irrigation Department. Authorization has to be given by the superintending engineers in different parts of the state. These authorizations are seasonal and must be renewed every year [4]. This creates transaction costs for villagers (time and money). It is a tedious task calling for persistent efforts to produce successful results. For example, in good rainfall years water lifting permission can be acquired in two to three visits; but in low rainfall years, more visits are required for persuasion and to push the bureaucracy. Permission is not granted during drought years. The reluctance of the Irrigation Department to grant permission is also related to the lower price that farmers pay for water. For example, the rate for lifting water for a lift irrigation scheme is only one-third of that charged for canal irrigation. For many years, permission to lift water from the reservoir was not granted. But the long struggle (15 years) waged by the Sadguru Foundation bore fruit for the underprivileged, ousted people living near the reservoir. Sadguru fought for the rights of people living around the reservoir of the Macchan river medium irrigation project. In 1977, the Sadguru sought permission to build five lift irrigation projects on the banks of the reservoir for people who were affected by the irrigation project. Permission was not granted. In 1993, Sadguru obtained permission for five lift irrigation projects. Many more lift irrigation schemes were built subsequently on other reservoirs ([7], for 2002).

Acquiring Electricity Connections

Lift irrigation depends on electrical power. It typically took two to three years to obtain electricity connections after papers were filed at the Electricity Department, irrespective of the fact that irrigation cooperatives were willing to pay the entire

installation charges in advance. For example, the Kuyala cooperative completed work on its lift irrigation scheme in June 1990. By the time it had completed the application process for electricity connection, it was April 1991. The connection was finally given in June 1993 [8]. Such delays hold up the entire irrigation process, and postpone the extra income from *rabi* and *summer* crops. That, in turn, affects repayment of bank loans on time, and so interest accumulates. For example, one of the reasons for the failure of the Zadaka cooperative was the delay in getting electricity.

Ensuring Timeliness of Electricity Supply

Securing an electricity connection does not ensure the supply of electricity. Due to power shortages, rural areas did not receive regular supply of three phase electric power. Rural areas in Gujarat received electricity for only eight out of 24 hours.

As a result, during the peak-cropping season it was very difficult to raise sufficient water in eight hours to meet the requirements of all farmers. The sad part was that even this eight-hour electric supply was not assured; on some days only three hours of electricity was supplied. Even during the eight-hour supply, there were frequent power cuts. For example, Parekh [8] noted that electricity power was not available for 63 days during the *rabi* season of 1991-92 in the Ghodi scheme. Surprisingly, the situation has deteriorated since then in some parts of the state. Furthermore, the timing of electricity supply varied. Many a time electricity was supplied between 12 midnight and 4 A.M. Uncertain supply of electricity was one of the major reasons for failures of some schemes. In the Kabaripathar scheme of Bharuch district, owing to non-supply of electricity for 10 days straight, farmers could not give the final watering to their summer crop of groundnut and mung (green gram) in 2001. This resulted in the total failure of the summer crop. Farmers could not recover even the operational costs.

Low Priority to Rural Electricity Supply

Rural electricity supply gets low priority from the Electricity Department. One reason is that the urban industrial power lines are shorter length yet consume much more electricity. And that consumption is constant throughout the year. The Gujarat Electricity Board earns more when it supplies power to industry than to agriculture; therefore, the industrial sector gets more attention. According to the deputy engineer of Gujarat Electricity Board (GEB) in Dahod, a feeder to the urban industrial area is only 6 kilometers long and uses 300,000 kwh a year (at Rs. 4 per kwh). On the other hand, a rural feeder is 125 kilometers long and delivers electricity to 45 villages—but uses only 20,000 to 30,000 kwh per year (billed at Rs. 0.50 per kwh—a highly subsidized price for agriculture). Another feature of electricity consumption in agriculture is that the demand for power is not constant; it varies according to the agricultural season. Maximum consumption

of electricity in agriculture occurs in the *rabi* season. It is very difficult for the electricity board to distribute the load during different seasons.

Power leakage is another problem. Since rural feeder lines are long, it is very difficult to identify and repair faults promptly. Since the line man has to travel long distances, he avoids going at night or in bad weather. On the other hand, faults in urban industrial lines are repaired in a timely fashion.

POLICY LESSONS FROM THE IMT EXPERIMENT IN GUJARAT

Several factors contributed to the success of lift irrigation cooperatives, while other factors interfered with their operation. Some important lessons to be gleaned from this experienced are discussed on the following pages.

Lesson 1: Developing a Systematic Method of Collection of Water Charges

Absence of a proper system for collection of water charges and account-keeping leads to malfunctions. In one case, the secretary did not give receipts to members at the time of payment of water charges. Therefore the secretary could not be held accountable for money collected from members, and made many mistakes in keeping track of how much money each farmer owed. In successful cooperatives, receipts were issued immediately, which increased confidence and efficiency among users.

Lesson 2: Developing a System of Repair and Maintenance

Proper repair and maintenance of lift irrigation pumps is vital to the sustainability of any lift irrigation scheme [6]. In the absence of proper maintenance, repair costs increased to levels many cooperatives could not afford. There has to be regular greasing of the pump and immediate repair of minor faults. Stabilizers have to be installed to cover the risk of fluctuation in electricity voltage.

Lesson 3: Developing a Documentation System

Records are critical for monitoring the progress of the cooperative and correcting problems. Good record keeping with regular updating, ensures transparency in the working of the cooperative, and so develops trust among members and committees. Proper documentation also helps to acquire further funds from government agencies.

Owing to low literacy levels and lack of familiarity with record keeping systems, some village-level cooperatives failed to keep records in the prescribed usable format. Training programs can help achieve the required level of

competency. With growing awareness of the development of village institutions, many NGOs and academic institutions have developed training modules for village level workers, keeping their particular circumstances in mind. It is very important to develop formats in very simple language and to make them easy to understand. Collecting complicated and large loads of information discourages village workers as this becomes time-consuming. While successful cooperatives often developed good record keeping systems on their own, there is great scope for improvement through frequent training programs.

Lesson 4: Developing Responsible Democratic Governance

Strong leadership and social cohesion are very important factors contributing to the success of any cooperative. A capable leader always gives proper guidance to the cooperative [9]. In the case of the Samdhiala Kajali, Ghanikut, Degawada, and Vakol cooperatives, strong democratic leadership was the major reason for success. Their leaders made extra efforts to solve administrative problems and social conflicts. In the case of Ghodi, Koliwada Kachumber, Kathipada, and Anjoli cooperatives, weak leadership and non-democratic management led to lower rates of success. But leadership qualities can also be developed. Weak leadership should not deprive villagers from participating in development activities. Many NGOs provide leadership-training programs which enable good leaders to run grassroots organizations. Regular and high attendance at meetings is a must. Meetings provide a platform where all water-related issues could be settled. In the less successful cooperatives, members did not give importance to meetings, and the generally low attendance led to mismanagement [10].

When members are aware of their rights and of the importance of participation, they ensure that the system functions well and on time. In successful cooperatives, members are aware of all rules and regulations. There were occasions when they demanded fair services from office bearers, some of whom paid penalties when they were found to have broken the rules. Members of less successful cooperatives were not very well aware of the working rules of cooperatives. As a result, head farmers in Kachumber could steal water meant for tail-end farmers.

Lesson 5: Developing a Culture of Learning Skills by the Local People

The effectiveness of office-holders reflects the success or failure of any cooperative. In Samdhiala, the pump operator and water distributor was very efficient in his work. His updated technical knowledge helped promptly locate and repair technical faults. Similarly, the secretary of the Ghanikut cooperative was an efficient record keeper. It is important to train office holders. Sadguru regularly organizes training programs and refresher courses for office holders [11]. Investing in people builds successful cooperatives.

Lesson 6: Ensuring a Regular Supply of Electricity

Regular and timely electricity supply plays a crucial role. Members of all the sampled cooperatives expressed dissatisfaction regarding timeliness and adequacy of electric supply. It is very important to pursue this matter seriously and bring changes in the policy and practices. Supply of electricity to rural areas during peak agricultural season is as important as supply of electricity to industry. Some mechanism has to be developed to ensure regular supply of electricity during periods of irrigation.

Lesson 7: Developing a Culture of Institutional Endurance

Despite all the constraints and bottlenecks, the irrigation cooperatives overall showed great resilience in accomplishing their tasks with a remarkable degree of persuasiveness and endurance in the face of many odds. The democratic leadership and participatory approach was the key.

CONCLUSIONS

The successful transfer of irrigation management in Gujarat pivoted on the formation of credible irrigation cooperatives by farmers. Farmers understood the importance of collective action and subscribed to the idea of a cooperative framework. Farmers found that a cooperative irrigation system was much cheaper than the individual private irrigation system. For example, the per-acre cost of private irrigation was three to four times that of cooperative irrigation. Farmers were freed from hassles of repair and maintenance, securing permission for water lifting, and so on. These activities were handled by people who were adept in public relations and knew how to deal with government bureaucracy. This lowered transaction costs of doing business for individuals.

From the standpoint of water scarcity, it is desirable that the maximum number of farmers benefit from the available quantity of water. This is possible only when farmers are sensitized and learn to make judicious use of water. The rich experience of NGOs in developing organizational capabilities in people was used to achieve wide-scale implementation of irrigation management technology. Proper attention was given with the help of NGOs to the process of institutional development with popular participation. Rules and regulations formed with the consent of members produced increased compliance with those rules. The major obstacles to the successful implementation of IMT in Gujarat was weak linkages of the Irrigation Department with other connected departments such as electricity, agriculture, cooperative, and land development. Increased interdepartmental coordination is necessary to bring all the relevant departments onto the same working platform.

Some clear lessons emerge from this experiment as to why the IMT experience was successful in Gujarat. These lessons are useful elsewhere. This is an experiment with people working for people with a relatively low level of human capital and finance and under various institutional constraints. The most important lesson was that this was done in a democratic manner and where all beneficiaries were part of the decision-making process. The cooperatives developed a trustworthy operating system by developing a system of documentation, repair and maintenance, and collection of water charges. In addition, the culture of social-capital building and the culture of learning strengthened the functioning of cooperatives and added economically as well. The most difficult physical constraint of electricity supply was also surmounted with great public relation skills in dealing with bureaucracy.

APPENDIX: A Set of Rules Used by the Lift Irrigation Cooperatives, Gujarat

Rules for Members

1. In case any committee member does not attend monthly meetings and if any member fails to attend the annual general body meeting, he/she has to pay a fine of about Rs. 20.
2. If any member fails to contribute labor in the voluntary work of the cooperative, he/she has to pay a fine equaling the labor charges.
3. All members must cooperate in digging water courses adjoining their fields. If they damage the water courses, they will be punished.
4. At least 15 days before the onset of the monsoon, all members must complete the weeding operation in their water courses, otherwise water supply will be withheld.
5. If committee members make mistakes, they have to pay double the fine paid by ordinary members.
6. Fine is levied. If water goes outside the sanctioned area or is released in another farmer's field without his/her turn. When this happens for the first time, the fine is nominal. If the mistake is repeated, the fine is doubled. Every time the mistake is repeated, the amount of fine would keep on doubling.
7. Any member operating the valve and taking water out of the gate without permission of the water distributor, is fined about Rs. 25 the first time. If the mistake is repeated, the fine would be doubled. The third time his/her water supply would be stopped.
8. If any member tries to take water out of turn his/her turn will be shifted to the last for the next watering.

9. If any member misbehaves with any office bearer, he/she has to pay a fine in cash decided by the committee. If the misbehavior is repeated, the fine is doubled. Thereafter, the cooperative can file a police complaint.
10. A drunken person is not allowed to come to the office or at the pump house. In case the rule is broken, the person has to apologize in public and pay fine to be decided by the committee. Anybody failing to pay the fine would be given further punishment with the consent of committee members.
11. Water charges should be paid in advance and get noted in the card. Every member is to show his/her card indicating his/her turn for water, to the water distributor. Without the card water would not be supplied. Demand for water will have to be notified to the cooperative office 24 hours in advance.

Rules for Secretary

1. He/she should attend all monthly meetings.
2. He/she has to read accounts in every monthly meeting.
3. He/she should work according to the resolutions passed by the cooperative.
4. In case of any conflict or problem, he/she should call the committee meeting immediately.
5. In the monthly committee members he/she has to get approval for next months expenditure.

Rules for Pump Operator

1. He/she should take proper care of the pump and motor.
2. He/she should regularly record electricity meter reading.
3. He/she should not start the pump without the permission of the water distributor.
4. If there is any fault in electricity supply, he/she should get it repaired.

Rules for Water Distributor

1. He/she should follow the sequence on the notice board, for releasing water.
2. Soon after starting the pump, he/she should be available at the main chamber for distribution of water.
3. Without producing receipt, he/she should not release water to any member.
4. If there is a fault in the pipeline, he/she should immediately inform the chairperson.
5. If there is any problem in distribution of water, he/she should immediately inform the chairperson.

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Direct reprint requests to:

Professor D. D. Tewari
School of Economics and Finance
University of Kwa-Zulu Natal (UKZN)
Durban 4001, South Africa
e-mail: devitewari@telkomsa.net