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# A Scenario Testing of Canal Irrigation Cooperatives for Multiple Use Services: A Case study of Major Irrigation Project in Gujarat (India)

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**Abstract**

India has cautiously embarked on a process to transfer the management of public irrigation systems to Water Users' Associations/ Irrigation Cooperatives (ICs), with the stated objectives of providing sustainable and adequate financing for operation and maintenance and of facilitating investment in the required rehabilitation of irrigation and drainage systems. It is likely that most of the failed co-operatives are weak in their financial position. There is a need to find out the various critical factors that ensure financial strength of the ICs, and the various steps taken by the co-operatives to increase their revenue for better financial management. The study tries to identify and analyze the scope for charging multiple use of water including domestic, livestock and industrial purpose by making non farming users as members of the irrigation cooperatives, assess the capacity of the farmers/non farmers to pay and elicit the conscious steps taken by the government and farmers for ensuring the financial strength of ICs. The study refers to a multi-disciplinary approach which involves simulations and scenario-testing, acknowledging that there are costs incurred by supplying water and water-related services to farmers and other users. The farmers tap into their monetary resources to pay these water service fees. The outcome of the study suggests that there is a need to include non-farmers as members with a membership fee and charge non-farm uses to make ICs financially sustainable in the long run.

**Keywords**: Financial Viability, Irrigation Cooperative, Livestock, Multiple Use, Sustainability, Water rates.

## Introduction

Over the last two decades, irrigation researchers, policy-makers, and donor agencies have become increasingly disenchanted with state managed large-scale irrigation systems (GoI, 1992; Hussain and Hanjra, 2004; World Bank, 2006) and have shifted their focus to farmer managed irrigation systems (Watson et al., 1998). The shift has occurred parallel to a trend to decentralize water management programs from the state to local users (Parker and Tsur, 1997). Irrigation management transfer or Participatory Irrigation Management has become a widespread strategy in Asia, Africa, and Latin America. It often includes demand management to encourage efficient water allocation and imposes new externalities on irrigation systems in terms of environmental performance (Vermillion, 1997). Increasingly, local management solutions are being sought for global problems of food and other resource (Ostrom 1990).

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The sustainability of the Water Users' Associations/Irrigation Cooperatives (ICs) created as part of these reforms is however now seen depend on their capacity to provide an adequate water delivery service, control and allocate water to provide an improved service to enable gains in agricultural productivity (Svendsen, 1997). This is essential for the capacity of farmers to pay water and for the users associations to be financially viable. Most often, governments pursue management transfer programs to reduce their expenditures on irrigation, improve productivity, and stabilize deteriorating irrigation systems. This process of Irrigation Management Transfer (IMT) includes state withdrawal, promotion of water users' participation, development of local management institutions, transfer of ownership and management (Vermillion, 1997). The interventions by outside agencies that aim to devolve water management to local populations can be problematic (Meinzen-Dick and Zwarteveen, 1998).

Issues such as the appropriateness of technology, forms of social organization including gender considerations have significant implications for conventional top-down approaches. Social scientists have long argued that if interventions aimed at improving the developmental role of indigenous water management systems, planners need to not only reconsider technical, but also socio-cultural and financial factors (Anil Shah, 1997 and Gleick 2000). Despite the claim, many development programs still fail to effectively include these considerations, often because of little research on the topic.

India has cautiously embarked on a process to transfer the management of irrigation systems from government agencies to local management entities like Water Users' Associations/ Irrigation Cooperatives (ICs), with the stated objectives of providing sustainable and adequate financing for operation and maintenance irrigation systems. It is the social processes and the dynamics between the various stakeholders, which ensure a sound initiation of any institution (Viabhav Chaturvedi, 2004).

The other dimension brought out by various studies is the increase in the demand for water for non-agricultural use (Anil Shah, 2004; GoI, 1992). Yet, in most of the places the legal system does not seem to specify the rights for irrigated agriculture and to state how these rights can be protected against increasing demands non agriculture uses. Multiple use of water simply is the use of water for additional purposes than it was intended to (World water Forum-4). While most water systems in the world have been designed for a single purpose, e.g. irrigation or drinking water, in reality the water from these systems is used for multiple purposes. Multiple use water services (MUS) is a participatory, integrated and poverty-reduction focused approach which takes people's multiple water needs as a starting point for providing integrated services, moving beyond the conventional sectoral barriers of the domestic and irrigation sectors (Koppen, et al, 2006).

**Rationale and Background**

The search for ways to better consider multiple needs especially when the sectoral divides in the water sector are very much prevalent is not new. For long, professionals in the irrigation sector, have highlighted the unexpected outcomes and shortcomings of single-use planning and design approaches and have proposed alternative and more integrated approaches that take people's multiple needs as a starting point (Meinzen-Dick 1997; Boelee et al., 1997; Moriarty 2002).

Externally facilitated schemes that were originally planned and designed for a single use, either a domestic or irrigation scheme are invariably transformed into de facto multiple-use schemes by the users immediately after construction is finalized (Koppen et al., 2006). This includes domestic uses, animal watering and fisheries commonly reported as uses of irrigation water. The single-use planned systems for multiple purposes have often caused problems. Users or their livestock damaged the hardware and, within the domestic sector, additional use frequently caused low pressure resulting in the tail-end users not receiving any supply and increasing conflict (Moriarty et al. 2004). The non-planned uses threatened the functioning and the existence of the schemes, water service providers often tried to prevent such uses declaring them as illegal, sometimes leading to fines. However, interventions that were only taken during the use phase usually perpetuated conflict between user groups and seldom resulted in a better functioning service.

The concept of multiple use service is feasible from a water-resources and financial perspective, but is blocked by formal limits on the use of sectoral water like irrigation (Butterworth et al. 2005). There are attempts focusing on the institutional aspects of multiple use services. For example, the South African NGO Association for Water and Rural Development is piloting livelihood-based bottom-up planning for multiple uses, which is fully integrated into the Integrated Development Plans of Local Government (Maluleke et al., 2005). Improved well-being among the poor is not only the yardstick of achieving the development objectives but also an important determinant of the willingness and ability to pay among all users. According to the principle of economic rationality, at the basis of all economic science, humans are willing to pay more for a good or a service than for another if the utility derived from the former is higher than that derived from the latter. Moreover, irrigation schemes that shift to domestic-plus and multiple-use designs also enhance the ability to pay using income from the additional productive activities.

This merit of multiple use service is closely linked to perhaps the thorniest issue in the public irrigation sector, where tariffs and fees in irrigation schemes seldom cover even basic operational costs let alone capital costs (WHO/ UNICEF 2000 and GoI, 1992). The higher willingness and ability to pay for schemes that better meet one's need can be harnessed to attain a better level of or even full cost-recovery and, thus, higher financial and technical scheme sustainability. So this study is based on two main propositions, first, in contrast to the current institutional strategies focusing on a narrow objective of reducing government costs in managing irrigation infrastructure, the study aimed at broader resource management goals through multiple use services. Second, the study also tries to identify a demand-driven bottom-up approach in establishing mechanisms for decentralized management of water resources and resource mobilization for the financial viability and sustainability of irrigation cooperatives.

In Gujarat, a progressive state in Western India known for its successful cooperative model especially in milk sector, the implementation of the National Water Policy guidelines was initiated in 1995 with a policy on Participatory Irrigation Management (PIM). The government as well as voluntary agencies had initiated a number of Water Users' Associations (WUAs) registered as Irrigation Cooperatives (ICs). The success of these farmers' institutions depends on various factors-social, administrative as well as financial. However, as the institutions start functioning, they need money to cover their running cost and the financial working issue gains much importance along with the social dimension. Though most of the ICs are still in their early stages, some can be identified as being financially strong, and some as weak. It is likely that most of the failed co-operatives are weak in their financial position (Anil Shah, 2004 as cited in Viabhav Chaturvedi, 2004). According to him financial viability of an IC implies that it is able to generate enough income to meet its regular and emergency expenses and at the same time invest adequately in the maintenance & repairs of canals. It thus becomes imperative to find out the various critical factors that ensure financial strength of the ICs, and the various steps taken by the co-operatives to increase their revenue for better financial management (Svendsen, 1997). This exercise gains more importance in view of the legislation of the Government of Gujarat, which proposes to form ICs by legal mandate throughout the state of Gujarat. The role of subsidies and grant by the government in ensuring the financial soundness of the IC also has to be analyzed. The Irrigation Cooperatives should be able to generate some surplus for coping with the unforeseen requirements.

Shah (1993), points out that the water prices charged by owners of ‘electric water extracting mechanisms (tube wells) are much higher even in Gujarat’s water abundant areas and other states. This analysis suggests the possibility of lowering tube well water rates as and when the number of waterings from the canal improves, the possibility farmers counted too. The water supply by the tube well companies is considered not only to be reliable but also efficient in terms of revenue. Many studies have shown that output is higher with the use of ground water rather than canal water (Dhawan, 1990 as cited in Parthasarathy, 2000).

International Irrigation Management Institute’s (2001) study on irrigation service fees in five Asian countries including Gujarat concludes that irrigation agencies with a significant degree of financial autonomy have often been able to reduce the amount of direct payment required from farmers through institutional arrangements where the agencies earn secondary income from sources other than charges on water users (Small 1987). On the other hand, the newly created users’ cooperatives were also found to incur managerial expenses. Perhaps based on this evidence, Johnson III (1997) suggests a need for users to establish an investment fund to sustain the transfer. But the question remains how?

A multiple use service approach addresses the challenges mentioned above by recognizing that people’s water needs are integrated and are part and parcel of their multifaceted livelihoods, and that the necessity to better meet peoples’ multiple water needs is a main driver for integration within the water sector itself. The rural poor especially farmers and non famers use water concurrently for domestic purposes, cropping, gardening, livestock, fisheries and aquaculture, tree growing, food processing (beer making, coffee processing, butchery), brick making, market places, weaving, handicrafts and other small businesses and ceremonial and cultural purposes. The observed high potential of multiple-use water services taken together with the already mentioned general global trends towards decentralization and participation implies that broad and systematic up scaling of multiple use service approaches in canal commands areas may well present a real opportunity to implementing integrated water resource management (IWRM). If MUS approaches have proven to have systematic merits across quite a number of projects, their benefits will multiply manifold if applied nationwide. This study seeks to systematically set out the existing evidence for the merits of MUS, followed by presenting a framework within which further testing and validating of MUS approaches can be carried out in preparation for rapid up scaling.

*Objectives:* The broad objective of this study is to use a new approach to help investigating the sustainability of irrigation cooperatives with special reference to small holding and ability and willingness of the farmers/non farmers to pay the water fees determined by Irrigation Cooperatives. The study tries to identify and analyze the scope for charging multiple use of water, assess the capacity of the farmers/non farmers to pay.

The specific objectives of the study are

1. Identify and analyze the critical factors for financial success/ failure of canal irrigation co-operatives in the context of agro climatic conditions.
2. Elicit the conscious steps taken by the supporting agency and farmers for ensuring the financial strength of these Irrigation Cooperatives.
3. Develop recommendations for enhancing financial viability of the Irrigation Co-operatives while simultaneously taking adequate care of Maintenance & Repair of canals.
4. To identify and analyze the scope for charging multiple use of water including domestic, livestock and industrial purpose by making non farming users as members of the irrigation cooperative in the context of irrigation scheme and agro climatic conditions using scenario testing model.

**Research Framework for Analysis**

Its main features involve apart from the performance of irrigation cooperatives in terms of their costs and income, simulations and scenario-testing on the costs incurred by scheme management, the possible contributions by farmers to cover these costs, the possible charging system to be set up, and finally the impact of certain measures or decisions in terms of charging multiple use services, or certain farmers' strategies on the financial viability of the scheme. The paper discussion mainly involves principles of the need for a sustained and multi-disciplinary partnership during scenario development and discussion, including farmers and transfer operators (NGOs and Irrigation Agency). Such an approach shows huge potential for information and decision-making support towards transfer operators, for training and farmers' participation.

First, focus is on the approach acknowledging that there are costs incurred by supplying water and water-related services to farmers, and that an objective of financial viability is pursued at scheme level (involving partial or total cost recovery). In an IMT context, this means that

- The management entity (IC) provides irrigation water and related services to farmers,
- Such services generate costs (capital, maintenance and operation costs, and personnel-related costs),
- The management entity charges the farmers according to a system to be established
- The farmers tap into their monetary resources (generated by cropping systems, by off-farm income-earning systems) to pay these water service fees in the context of Smallholders' agricultural and resource-management systems facing a quickly changing economic, and social environment.

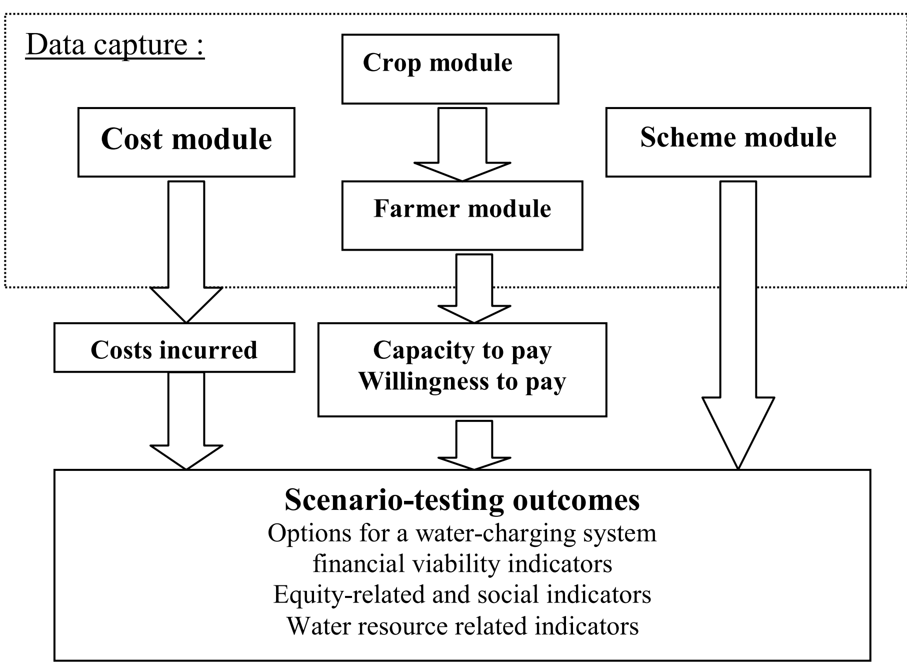
## Implementation features

The approach implies three phases: (1) Information at household and scheme level, on one given scheme, (2) information analysis and information-system development, which requires a typology of farmers, and (3) running the model on a scenario-testing basis, evaluating the impact of certain measures or decisions, or certain farmers' strategies on agricultural and production features, land allocation, costs and cost recovery, and sustainability-related indicators.

### Framework for analysis

The analysis of the case as a whole takes root in the principles mentioned above. The model's conceptual framework (S. R. Perret, 2002) takes into considerations the economic and financial aspects of scheme's management, and addresses some technical indicators in order to check out that scenarios are realistic (e.g. water resource availability). Five input modules form the basis of the information system, as interfaces for data capturing by the user as mentioned in the figure below. The initial inputs (real data) form the base scenario. Additional scenarios may be tested through the capture of non-real / prospective data, especially when the given scheme has not yet been rehabilitated or transferred (e.g. alternative crops and cropping systems, emerging farmers' types, changes in scheme's management patterns, options for a charging system, new infrastructures).

**Figure-1: The research framework for information system for viability of irrigation cooperatives.**




**(Source: Adopted from Perret et al, 2002)**

## Materials and Methods

For identifying the critical factors determining the success of irrigation cooperatives a detailed study dealing with financial aspect of the selected co-operatives was carried out.

## Sampling

In the light of some studies on financial viability of irrigation cooperatives without taking the agro climatic conditions, choice of cropping pattern for the farmers and size of land holding and income generating capacity of the farmers into consideration, it was considered useful to make qualitative study by taking such a sample that will bring out the factors that impact the financial viability of ICs.

The financial data of various cooperatives available with Development Support Centre, Ahmadabad (Vaibhav Chaturved, 2004) was used for the study. The details on financial performance of ICs are based on consolidated financial results for 4-6 years based on the availability of data. The financially strong and weak co-operatives were identified after discussion with the senior staff of Development Support Centre (DSC), and the Water and Land Management Institute, Gujarat (WALMI). Five irrigation co-operatives were studied.

Apart from the details of performance of selected Irrigation Cooperatives the information on land type, agro climatic conditions of the command, cropping pattern, yield levels of various crops during different seasons, cost of cultivation and gross margin of profit to the farmers were collected based on discussion with Department of Agriculture, officials of Development Support centre and interaction with the farmers of the command area. For identifying the critical factors determining the success of irrigation cooperatives a detailed study dealing with financial aspect of the selected co-operatives was carried out.

## Data Collection

The data collection was on pilot basis. Secondary data was collected through the record of Development Support Centre, Ahmadabad. The Income-Expenditure Account and Balance Sheets of the various ICs were collected from the records of Development Support Centre, annual report of ICs and discussion with presidents of Irrigation cooperatives in Dharoi Irrigation Project. Primary data was collected through survey and focus group discussions (FGDs) with the Executive Committee (EC) of IC, and with the field implementation unit staff of DSC and various policy level actors.

## Free listing

Free listing was conducted to generate a comprehensive list of reasons why canal water is important for villagers (in consultation with IC officials). A stratified sampling strategy, was used selecting informants from five villages using canal water such as men, women (Meinzen-Dick and Zwarteveen, 1998). Non farming People with different occupations was also considered. The total sample for free listing was 50 respondents from 50 households, in 6 villages in the command of the selected irrigation Cooperatives.

Respondents were asked to generate a list of items in response to the question like Why do you think canals are important for the village? The respondents were asked to give as many reasons as they could conceive. Although free-listing is widely used in anthropological research (Bernard, 1995), the households may not place a particular importance on canal irrigation might have given positive answers because of the framing of the question. The information on the relative importance of canal irrigation was not collected in relation to tube well irrigation to weight the bias introduced by our question.

From responses to free listing, the percentage of people who mentioned each reason, the average rank of the order of mention of each reason, were calculated. The informants' explanations were used to classify items according to their main use or function (ecologic, economic, and socio-cultural). Among economic functions between agricultural, non-agricultural, and domestic were differentiated. As one particular item might have more than one use or function the results from this classification were taken with caution.

**Survey**

A survey was conducted to assess household variation in the uses of canal irrigation water. To select informants for the survey, the same sampling strategy that was used to select informants for free listing was followed. The sample for the survey included 50 adults (with minimum 20 percent of non farmers) from different households of 8 villages across the Dharoi Irrigation Project. The household survey included socio-economic questions (i.e., caste, land ownership) and questions related to the use of canal water **(Table 2).** Questions related to the use of canal water were selected from responses to free listings and refer to economic uses. The survey included questions related to agricultural, non-agricultural, and domestic uses of canal.

## *Results and Analysis*

The account books of the various ICs were analyzed for assessing the trend of revenue generated, operation & maintenance costs, and reserves & surpluses. As well as the various steps taken for improving its financial strength were studied. Finally, the factor s affecting the financial viability was elicited through discussion with the members of ICs, supporting agency and policy level actors. The study findings are presented focusing on present status of financial viability as mentioned here under.

**a*) Analysis of Expenditure***

Maintenance & Repairs expenditure

Salary of secretary, operator and other staff

Administrative expenditure

Minimizing expenditure through voluntary lab our

**b)** ***Analysis of Income***

• Government assistance for

-Maintenance

-Management

• Additional water rate collection

• Interest from balance at bank Income from additional services

• Others-such as penalty

**c)** ***Other factors which affect income are***

• Quantum of water available

• Area irrigated

• Recovery

**d)** ***Comparison of water charges***

**e)** ***Scope of diversification***

The schemes display a number of features that are common to other irrigation schemes e.g., a diversity of practices and performance among irrigation farmers, yet generally little productive and subsistence-oriented, a simple conception of infrastructures (a gravity-fed system with dam, canals and furrows), yet deteriorating, a lack of support services, a weak, water allocation and water availability problems, especially in winter.

Ever since, there has been intense sharing of experience and ideas between the NGO groups that have direct experience of working with the farmers and officers of the Water Resources Department both at the field level and at the policy level. This has resulted into developing packages of incentives for the farmers in the canal command like retaining 50% of their water fee collection and carrying rehabilitation work with financial help from government to organize themselves into Irrigation Cooperatives(IC). The command area under study where the Irrigation Cooperatives are being formed (Dharoi Irrigation Project) was of mainly sandy loam and almost all area was being cultivated. The average land holding in the command is 1.1 hectare. The area receives 625 to 825 mm annual rainfall indicating that if rain fall is normal and evenly distributed, the farmer can have a better crop during the season **(Table-1).** In the scheme the farmers receive water from canal from October that too only when the reservoir is having sufficient water. During Kharif the farmers use water from tube well cooperatives. There are number of tube well cooperatives where each cooperative cater to the needs of 10-12 hectares. Each farmer pays about Rs. 60/ hour and needs about 6-7 hours of irrigation for one acre. Each canal branch has about 350 hectares of command indicating cultivable command area under each can be minimum of 350 hectares according to topography of the land. There are number of operatives with command area as less as 16 hectare with a maximum of 890 hectares.

There were 124 ICs (Table-2) for about 64 villages in Dharoi Irrigation Project as on 31st March 2007. The Development Support Centre Ahmedabad is involved in establishing these ICs as mentioned earlier in collaboration with Water Resources Department and NDDB. Through a collaborative effort of Gujarat Water Resource Department and Development Support Centre Ahmedabad, supported by National Dairy Development Board (NDDB), Irrigation projects covering 56,700 hectare are being developed as models of Participatory Irrigation Management. The NGO Development Support Centre is planning to form a total of 216 ICs in the three schemes of Dharoi (45,000 ha.), Guhai (7200 ha.) and Mazam (4500ha.) covering 56,700 hectares of command area by March 2008.

The cotton is predominant crop (Table-2) covering 40% of the total area followed by castor (20%), bajra (15%), green gram (10%) and fodder (10%) during Kharif. The area under cotton is on increase after Bt cotton was introduced because of higher yields. Even though the cotton is sown during Kharif it is harvested during Feb- March almost covering Rabi season as well. So the farmers have to pay to both tube well cooperatives and canal cooperatives increasing the cost of water. The Rabi is dominated by wheat (40%), followed by mustard

(20%, jeera (20%), hybrid bajra (10%) and fodder and vegetable (10%).Normally the farmers will not get water from canal cooperatives during summer.

Canal irrigation is supplemented with groundwater irrigation. At the time of the research, there were number of tube well cooperatives using diesel engines. In addition to the water fees (Table-4) being paid to canal cooperatives (Rs. 400/acre) the farmers are paying tube well cooperatives for water during Kharif and possibly summer at the rate of Rs. 70/hour for 6-7 hours per acre which works out to be in the range of Rs 2000 to 4000 /acre depending upon crop and rainfall during Kharif. During normal years of monsoon the farmers will get better yields because of relatively fertile soils.

The average net income of the farmers works out to be in the range of Rs. 20,000 to 30,000 per year/ hectare through all seasons (Table-3). As per the official Meteorological records the area has the history of drought thrice in 8 years. As the farmers are paying for water to both tube well cooperatives and canal cooperatives the cost of water is significant (Rs 2000 to 4000 per acre depending on rain and crop). If the farmers are able to generate income in the range of Rs 20,000 to 30,000 per hectare the canal irrigation cooperatives have to be extra careful in fixing the water fees over and above the government rates. There is a need to look for alternative sources of income through diversification as has happened with Thalota IC (Table-7).

**Minimum Canal Command under each Irrigation Cooperative**

In the Dharoi Irrigation Project there are number of cooperatives with command of as less as 16 hectares, 18 hectare with significant number with less than 75 hectares. Based on the fixed cost and average variable cost of the cooperatives the minimum command area (break even area) for each works out to be 100 hectares assuming there is no drought. But with drought every fourth year and need for extra income the command area should be anywhere around 150 hectare. The fixed cost includes the salary to secretary and minimum administrative expenses which has been in the range of 20- more than 50% of total expenses as against the norms of not more than 20% 30 %. (Table-5).

***Factors affecting Financial Viability*:** The factors affecting financial viability (Table-6) fall under different categories technical, institutional/social or managerial. There are different ways to deal with these factors for ensuring better financial viability. Maintenance of canals is a very important responsibility transferred to irrigation cooperatives. They must attend to proper maintenance of the systems transferred to them; otherwise the system would deteriorate, reducing the area irrigated and consequent fall in water charges collection leading to downhill of the working of entire cooperative.

Thus for the regular and proper repair of the canals, the IC has to incur expenditure on regular basis. If the IC ignores this necessary expenditure on maintenance and repairs of the canal, it can lead to inefficient and inequitable water supply, conflicts, loss of income to farmers as a result of decrease in yield, opposition to the Water Users' Association (WUA), and increasing and continuous loss of income to the WUA. Better service thereby better recovery and better financial health of the institution will lead to improved maintenance &

repairs as well as higher incomes for the member farmers, leading to an increase in the standard of living of the farmers and labor community living in the rural areas and dependent on agriculture for their livelihoods.

The experts of supporting centre are of the view that better management of irrigation system should be ensured to increase the command area irrigated. Some portion of yearly surplus of the IC should be deposited as fixed deposit to earn a fixed stream of money. As of now, of the rebate of 30% on the timely payment of water charge is for O & M [which includes Operators' salary as well as M & R grant for the canals]. From this rebate of 30% of water charges offered by the government, some proportion should be reserved exclusively for maintenance & repairs. Norms should be evolved for ensuring adequate investment in M & R. Even if a good irrigation cooperative attends to routine and major (annual) repairs, it may suddenly need funds for meeting emergency needs. Like any other well managed organization, irrigation cooperatives should regularly save funds that they can access in emergency.

The report of an exploratory study by SC on Financial Viability says that rule conformance should be ensured for avoiding grave problem of non-recovery, and diversification should be undertaken only after long-term planning. Apart from the diversification activities, those benefits of I C can be increased by increased utilization of irrigation potential (which is very important for the success of participatory irrigation management). The irrigation potential created can be optimally utilized if the O & M activities are adequately financed. The costs incurred by ICs can be classified into two types' capital costs and O & M costs.

**Why Canals are locally considered important?**

Respondents listed 20 different reasons why canals are important (Table 9). On an average, informants listed 7 different reasons. The shortest list included only two reasons and the longest included 15. Only one of the 20 reasons recorded was of high Saliency: crop production. Crop production was listed by 91 percent of people in the sample and the reason appeared in the first position on the list. The next to crop production include twelve economic, five ecological and two social reasons. Among the economic reasons, two reasons were found related to agriculture (irrigation and increase in production), two reasons not directly related to agriculture (water for cattle and wash for cattle), and five domestic uses (fresh water, bathing, wash clothes, festival and firewood production). From the five ecological reasons, three relate to water for agriculture (well recharge and water storage) and two to other natural resources (favor presence of grass and trees).

## Conclusion

There are number of cooperatives which are functioning well with enough income generated and are going to be self-sufficient. In case of the cooperatives which are struggling to become viable there is a need to spend substantial amount on maintenance and repair cutting down the other expenses. Looking into the capacity of the farmers to generate more income, it has more to do with higher income generated by Bt. cotton cultivation in recent past. With the present water rates being collected by ICs and income level of the farmers there is a need to look into this whole exercise of water rates. As there is lot of variation on the proportion of expenses on maintenance and repair (M&R), the government must fix some portion specifically for M & R of canals (excluding operators' salary) and the ICs should ensure that this is strictly followed.

Especially during the years of drought there is a need to institutionalize voluntary labor. Either member farmers should contribute physically or pay equivalent labor wage at the time of annual M & R of the canal and channels. Margin on water charge should be higher for high value crops like cotton than that of low value crops. The charging of water fees over and above government rates should take the income generating capacity of the farmers into consideration based on their cropping pattern.

Diversification should be undertaken only after long-term planning. There is a lot of scope for the Irrigation Cooperatives to diversify into the activities like vermi compost production and input supply. In spite of being members of tube well cooperatives, farmers want to be part of cooperative. But it is up to cooperatives to make farmers realize the importance of raising commercial crops and diversification. It is easier said than done as it depends more on agro climatic and physical conditions. Here the diversification plays important role to make farmers sustainable and hence irrigation cooperatives.

Regarding the discussion around multiple use services, two findings emerge from the results. First, without denying the importance of the canal for agriculture, villagers also acknowledge the multi-functionality of canal irrigation. Second, the data also suggest that villagers use canal water resources in more diverse ways than other sectors of the population. The finding that deserves discussion is the local perception of canal as multifunctional. In contrast to previous research (Palanisami and Meinzen-Dick 2001), it was found that most, but not all, informants mentioned crop production and irrigation as the most relevant uses of canals. Nine percent of respondents did not mention crop production or irrigation (23 percent) as important reasons for the existence of canals which can be interpreted as an indicator that villagers perceive canals to be important beyond agricultural uses.

Results from the free listing data complement this previous research (Mosse 1997; Singh 2006; Wade 1987) that people give more importance to the economic uses of canal irrigation. The finding can be attributed to the methodological issues. When asked about the importance of canals people might have understood the question as referring mostly to the material importance of canals. Therefore, the method adopted might not have fully captured the socio-cultural importance of canal command. Although domestic uses of canals might be economically less relevant than agricultural uses, these uses might have high value in terms of household consumption, and health especially for the poorer.

The findings suggest that local population seems to benefit from the multiplicity of uses and functions of canals, irrespective of whether they use canals for irrigation. These findings pose at least three issues that need to be addressed by policies on canal irrigation management. First, which of the uses and services generated by canal are exclusive? What are the potential trades-offs between different uses and services? Second, if there are trades-offs between uses and services, which ones should be maintained? Third, should beneficiaries of relatively less salient uses and services participate in canal irrigation management? If not, how can users other than farmers have a voice to ensure than non-irrigation uses and services are maintained? It is strongly suggested that in addressing these complex policy issues, organizations working on capacity building like Development Support Centre can achieve a more equitable and socially sustainable management of water resources if they recognize that canal irrigation benefit people other than farmers and in ways other than providing water for irrigation.

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**Table-1**: Cropping Pattern in the Dharoi Irrigation Project

| **Kharif Crops** | **Rabi crop after Kharif[1]** | **Hot weather crop after Rabi[2]** | **Hot weather crop[3] after kharif crop.** |
|---|---|---|---|
| Hy.Bajra<br>Hy.Castor<br>Cotton<br>Jowar<br>Pulses/Fennel | Wheat/Mustard<br>Cumin<br>Isabgol/Cumin<br>Wheat, Lucerne | Cowpea, Mug<br>Jowar, Bajra.<br>-<br>Cowpea | Bajra<br>Bajra/Pulses<br>Hy.Bajra<br>Pulses |

**Source :DoA, GoG**
[1]**Kharif:** Cotton (40%), Green gram (10%), Castor (20%) Hybrid Bajra (20%), Fodder (10%)
[2]**Rabi:** Wheat (40%), Mustard/isabagol/jeera (40%), fodder (10%)
[3]**Summer:** Bajra (40%), fodder /vegetables (10-15%)

**Table-2:** Progress of Irrigation Cooperatives Registered in Dharoi Irrigation Project (as on 31-03-2007)

| **Cultivable Command Area** | **No. of ICs** |
|---|---|
| Less than 50 hectare | 17 |
| 50- 150 hectare | 39 |
| More than 150 hectare | 68 |
| Total | 124 |
| **Area** | **25141 hectare** |

**Source: DSC, Ahmadabad.**

**Table-3:** Yield levels of Different Crops in Dharoi Irrigation Command

| Crop | Average Yield (Qtl/ha | Cost of Cultivation (Rs/ha) | Gr. income @market prices(Rs.) | Net Income (Rs) | Weightage (%) | Income to farmer/ha |
|---|---|---|---|---|---|---|
| Cotton | 25 | 25,000 | 50,000 | 25,000 | 40 | 10,000 |
| Castor | 20 | 15,000 | 30,000 | 15,000 | 20 | 3,000 |
| Wheat | 50 | 15,000 | 35,000 | 20,000 | 40 | 8,000 |
| Bajra | 50 | 15,000 | 30,000 | 15,000 | 20 | 3,000 |
| Green gram | 10/2* | 10,000 | 20,000 | 10,000/4000 | 10 | 1,000 |
| Tobacco | 10 | 15,000 | 30,000 | 15,000 | 10 | 1,500 |
| Mustard | 10 | 10,000 | 15,000 | 10,000 | 20 | 2,000 |
| Jeera/Isabgol | 10 | 20,000 | 30,000 | 10,000 | 20 | 2,000 |
| Fodder/ Veg | ** | 5,000/ | - | - | - | - |
| **Total** | | | | | | **30,500** |

* *__Kharif__-3q/acre and __Rabi Summer__-1 q/acre*
** *Varies according to the crop and varieties*

**Table-4:** Water Fees Charged by Government and ICs in Dharoi Irrigation Project

| Crop | Water Rate(Rs/ha) (Govt. Rates) | Rates Charged by some of ICs* |
|---|---|---|
| Cotton | 1000 | 1200 |
| Castor | 750 | 1000 |
| Wheat | 556 | 900 |
| Bajra | 499 | 900 |
| Green gram | 499 | 900 |
| Groundnut | 499 | 900 |
| Tobacco | 750 | 1000 |
| Mustard | 556 | 900 |
| Jeera/Isabgol | 1000 | 1200 |
| Fodder/Veg | 499 | 1200 |

**Source: DSC, Ahmedabad**
* ***The water fees vary from IC to IC and now the water charges have been changed on per hectare basis under new guidelines wef 2008***

**Table-5**: Cost (**to ICs**) component of Irrigation Cooperatives

| Component | Extent of expenditure by ICs (% of Total expenses) |
|---|---|
| Secretary's Salary | 10- 22% (Rs 500 to 2000/month) |
| Operator's Salary | Highest component with 20-40 % ( Rs. 500 to 1500/month)<br>(1 to 3 and more operators depending on the command area.) |
| Administrative expenditure | 5-45% (Rs 9 to Rs 116/ha) |
| Maintenance and Repair of the canal | Less than 50% |

**Source: Interview with farmers**

**Table- 6**: Profile of the studied Irrigation Cooperatives

| Sl no | Name of I C | Type of Scheme* | CCA (Ha) of IC | Year of Start | No. of Share holders | Supportin g Agency |
|---|---|---|---|---|---|---|
| 1. | Kakdiamba | Minor | 891 | 1995 | 550 | AKRSP |
| 2. | Chopadvav | Minor | 1460 | 1993 | 444 | AKRSP |
| 3. | Rangpur | Major | 617 | 1997 | 248 | DSC |
| 4. | Thalota | Major | 251 | 1994 | 212 | DSC |

**Source: DSC, Ahmedabad**

***As per Government of India Classification-***

- *Minor Irrigation Scheme-< 2000 Ha of Gross Command Area*
- *Medium Irrigation Scheme-2000-10000 Ha of Gross Command Area*
- *Major Irrigation Scheme-> 10000 Ha of Gross Command Area*

**Table-6**: Factors Affecting Financial viability of ICs

| Factor | Component Type | Comments |
|---|---|---|
| Command area per unit length of canal | Technical Component | Cannot be altered |
| Canal section & structure | Technical Component | Cannot be altered |
| Lined and unlined canals | Technical Component | Lining the unlined canals is the obvious option as it will greatly reduce the running costs as well as huge seepage losses and other environmental costs. |
| Water availability | Technical Component | Not in ICs control |
| Interest from cash at bank | Financial Component | The ICs can deposit some portion of money (e.g.) share capital as fixed deposit to ensure a higher interest |
| Subsidy for Maintenance and Repairs | Financial Component | As the water rates levied by the government will increase, the subsidy will automatically increase. But a major portion of the subsidy is spent on operators' salary and the issue of proper and adequate maintenance & repairs is neglected. Hence norms should be evolved for ensuring adequate investment specifically for M & R of canals. |
| Avg. Additional Water Charges gained/Ha | Financial Component | Margin should be higher for high value crops and lower for low value crops. For ensuring that farmers using higher quantity of water pay higher, charges should be on per watering basis. |
| Number of Shareholders | Social Component | Cannot be altered |
| Voluntary Labour | Institutional / Social Component | Should be institutionalized. Either member farmers should contribute physically or pay equivalent labour wage at the time of annual M & R of the canal and channels. Its value should be entered in the books of accounts. |
| Recovery Problems | Institutional/ Social Component | This problem can only be addressed by making the institution strong and strictly ensuring rule conformance. |

| | | |
|---|---|---|
| Efficient water distribution | Managerial Component | Better management of irrigation water to ensure effective and efficient service delivery and hence increasing the command area irrigated. |
| Diversification Activity | Managerial Component | If the diversification activity undertaken is technical or the risk involved is high, then either the activity should be promoted by federation if it is capable of hiring technical expert, or it should not be taken up at all. |

*Source: DSC, Ahmadabad*

**Table-7:** Financial Performance of Irrigation Cooperatives

| IC (Com. Area) | Rangpur 617 | Thalota 251 | Kakdimba 891 | Chopdavev 1460 |
|---|---|---|---|---|
| Irrigated area (ha)<br>Share holders | 230<br>248 | 152<br>212 | 290<br>550 | 340<br>444 |
| Water Charge Income (Rs/ha) | 203.5 | 164.6 | 238.71 | 259.22 |
| Subsidy for Adm<br>M&R<br>Addl. water charges | 43.72<br>65.52<br>94.42 | 35.76<br>52.51<br>117.23 | 21.43<br>34.91<br>200.61 | 34.01<br>51.02<br>227.33 |
| Bank Interest<br>Voluntary Labor<br>Diversification<br>Total Income | 24.24<br>57.02<br>-<br>284.68 | 28.81<br>-<br>58.10<br>292.41 | 7.1<br>6.41<br>-<br>252.23 | 4.02<br>5.85<br>-<br>275.6 |
| Expend- Adm.<br>Salary<br>M&R<br>Operator Salary<br>Total Exp | 8.83<br>12.50<br>136.63<br>69.77<br>157.96 | 36.52<br>36.09<br>40.09<br>55.67<br>168.37 | 143.85<br>37.03<br>92.32<br>72.06<br>236.1 | 36.36<br>35.60<br>69.34<br>32.51<br>141.29 |
| Surplus | 126.75 | 124.03 | 16.13 | 134.31 |

***Note: The figures in bracket are per hectare of area irrigated*** ***(Source DSC)***

**Table 8:** Survey questions on the use of canal water in Dharoi Irrigation Command (n=300)

| Category of Use | Question | % age Positive answers |
|---|---|---|
| Agricultural | Do you use water from the canal for irrigation? | 87.9 |
| | Are you willing to pay the fees prescribed by the ICs? | 100.0 |
| Forestry | Do you use trees from the canal command? | 36.4 |
| Livestock | Do you use water from the canal for livestock | 78.7 |
| | Do your cattle drink from the canal | 56.4 |
| Domestic | Does the raw material used for shed come from the canal command? | 62.0 |
| | Does the wood for your roof/shed come from the canal command? | 41.0 |
| | Do you use water from the canal for domestic use? | 78.7 |
| | Do you wash clothes in the canal? | 49.3 |

**Table 9:** Results from free-listing about the importance of Canal Water in Five Irrigation Cooperatives (n=300)

| Sl. No | Reasons listed | Category | Percentage respondents | Average rank |
|---|---|---|---|---|
| 1. | Crop production | Econ-Agri | 91 | 1.87 |
| 2. | Irrigation | Econ-Agri | 77 | 2.56 |
| 3. | Drinking water for cattle | Econ- Non Agri | 54 | 3.5 |
| 4. | Drinking water | Econ-Domestic | 47 | 3.1 |
| 5. | Well recharge | Ecol | 35 | 4.1 |
| 6. | Water storage | Ecol | 32 | 4.5 |
| 7. | Wash clothes | Econ-Domestic | 38 | 6.21 |
| 8. | Favor presence of trees | Ecol | 49 | 6.00 |
| 9. | Favor presence of grass | Ecol | 41 | 5.50 |
| 10. | Firewood production | Econ-Domestic | 22 | 6.43 |
| 11. | Bathing | Econ-Domestic | 32 | 6.00 |
| 12. | Grass for cattle | Econ- Non Agri | 19 | 6.50 |
| 13. | Increase of production | Econ-Agri | 7 | 4.25 |
| 14. | Washing cattle | Econ-Non Agri | 7 | 6.75 |
| 15. | Provides livelihood | Econ- Non Agri | 7 | 6.80 |
| 16. | Saves pumping electricity | Econ- Non Agri | 2 | 5.50 |
| 17. | Recharge fresh water pond | Ecol | 2 | 5.00 |
| 18. | Fruit production | Econ-Domestic | 4 | 6.60 |
| 19. | Ornamental function | Socio | 2 | 6.00 |
| 20. | Festival | Socio | 2 | 7.00 |

**Note:** ***Econ****-economic uses,* ***Ecol****=Ecologic uses,* ***Socio****= socio- cultural uses.*

***Agri****=agricultural uses,* ***Non-Agri****= non-agricultural uses,* **Domestic** *=Domestic uses.*

***Appendix- :*** *Agro climatic Features of Dharoi Irrigation Project*

| | |
|---|---|
| Rainfall (mm) | 625-875 |
| Type of soil | Sandy loam to sandy soils. |
| Soil Characteristics & Land use classification | Most of the area is cultivated. |
| Surface color | Dark brown, dark, yellowish, brown to Yellowish brown. |
| Depth of the soil | Deep to very deep more than 90 cm. |

| | |
|---|---|
| Predominant Texture | Sandy loam to loam. |
| Soil Slope | 1 to 3 %. |
| General fertility | Nitrogen-poor, Phosphorus medium, Potash medium. |
| Cat Ion Exchange Capacity | Less than 20 me / 100 gms of soil. |
| Electrical conductivity | Less than 1 mmhos/cm. |
| Exchangeable Sodium % | Traces. |
| Order | Inceptisols, Entisols, Aridisols. |
| Crops | Paddy, Bajra, Pulse, Cotton, Groundnut. Tobacco, Wheat, Jowar, Minor Millet, Vegetables. Spices and condiments, Oil Seeds, Cotton |