CHAPTER VII
SUMMING-UP

BIRD'S EYE VIEW

All large-scale irrigation projects in India have always been treated as multipurpose dam projects, which cater not only to the agricultural sector but also to the drinking water sector. The reliance of both the sectors on surface water has grown consequent to depletion of groundwater resources. After the Government prioritised allocation to drinking water sector, the allocation to drinking water grew at a phenomenal rate. This pushed the allocation to agricultural sector to second rung and during lean period the agricultural sector is not provided with adequate water. To monitor and if possible bring about equitable water distribution, institutions are formed in both the sectors to manage and distribute water. Institutions like municipalities distribute drinking water in urban towns and Water Users Associations (WUAs) distribute water in the farm sector.

Given the background of uncertain rainfall, depleting groundwater resources and multiple users of water, a macro study from the perspective of the reservoir fails to illuminate completely the status of water use in various sectors, its contribution in each sector and the performance in various sectors. Therefore, this study is carried out at two levels – Macro Level and Micro level. Macro level analysis helps in understanding dimensions of water related conflicts and inequitable water distribution and use. Micro level analysis aids in knowing the extent to which present institutions governing water management in farm and drinking water sector are able to use water efficiently. Study also examines status of water-use in farm and drinking water sectors.

Agriculture is the largest user of water resource from the reservoir. Thus, efforts made to improve water use efficiency in farm sector have the tremendous potential to improve the efficient use of water in the reservoir. As this sector uses water inefficiently, scholars have claimed that appropriate pricing of water could induce water use efficiency. However, if the user is not willing or able to pay for water used then this theory will hold no water. Willingness and ability of farmers to pay for water are dependent upon contribution of water to improve returns from cultivation along with the reliability of water supply. Thus by examining factors affecting returns from cultivation, we could learn whether there is a possibility of improvement in physical productivity.
and whether the impact of recovery of water charges on financial performance of irrigation department is positive.

We study here the productive efficiency of water corresponding to its usage in large, medium and small sized farms. Analysis suggests about the optimum crop selection, cropping pattern, cropping intensity and level of use of all inputs including water, needed to maximise productive efficiency for each category of farmers. Contribution of water is also studied by sources of irrigation (surface water only, ground water only and conjunctive use) is related to productive efficiency of farmers of different sizes.

The Dharoi reservoir project is chosen for this study because inherent in it are all sorts of phenomena associated with the water sector like water scarcity, multiple claims on use of water from irrigation and drinking sector, depleting groundwater level, along with dynamics of water distribution by user based institutions like WUAs and municipalities. Case studies on water use in drinking water sector are used to examine water use from the Dharoi reservoir project. The selected municipalities are: (a) Unjha Municipality (b) Kheralu Nagar Panchayat (c) Siddhpur Municipality (d) Vadnagar Nagar Panchayat (e) Palanpur Municipality. Data was collected with the help of structured questionnaire and discussions with Chief executives of these municipalities. Data on population were collected from published census of Gujarat. For studying the contribution and performance of agricultural sector, three WUAs were selected on the basis of their location in the canal command. A total of 30 households from each of the WUAs were selected for the extensive household study. For the selection of the sample household, stratified random sampling of members of WUAs was considered. Households were divided into three farmsize groups with the operational holding upto 1.0 hectare; 1.01- 2.50 hectare; and, 2.51 and above. It was envisaged that 10 household interviews each would be conducted from each of these categories in each WUA. In order to study contribution of water to farm households, the study examines gross return obtained from crop production by households. In order to probe further, the analysis is based on the cost of cultivation data in *Kharif, Rabi* and *summer* season for the normal agricultural year (2003-2004). The crop wise data for all seasons and farm sizes regarding farm inventory, cropping pattern, labour employment, variable cost, farm product, expenditure on fertilisers, manures and so on were collected. To examine the performance of institutions i.e., WUAs in distributing and managing canal water, a rapid assessment of WUAs formed in Dharoi canal command was undertaken. Selection of WUAs was based on stratified random sampling method. We
took one third of the total 40 WUAs in the canal command for an in-depth survey. WUAs were selected in proportion to the total number of WUAs lying in the head; middle and tail portions of the irrigation systems. Thus, 13 WUAs were selected for the study. Performance of these WUAs was studied by examining indicators that throw light on processes and the impact of IMT.

It is seen that (Chapter 2) barring a few exceptions, during most of the years, the water level in the reservoir has not been adequate. Despite this with each passing year, the estimated area that could be irrigated has shown to increase. We assess that potential area irrigated is not realised because the water availability in the reservoir fluctuates widely and water use is not efficient. It is also seen that though water use in drinking water occupies only a small proportion of demand for water from the reservoir in comparison to farm use, it has the potential for competing with agricultural water use, specifically during lean years. During scarcity, drinking water demand actually claims a major share of the total water available in the reservoir. Secondly increasing urbanisation and depleting groundwater table increase the demand for drinking water significantly thereby increasing pressure on available water resource. It was seen that in year 2002, drinking water use constituted nearly 24% of total water use from the Dharoi Reservoir. Analysis of Productive Efficiency (PE) with reference to the agricultural water use was carried out. This analysis shows that the department has the potential to save water and that water is used more efficiently during the peak years than during the lean years. This suggests that water adequacy would provide incentive for water use efficiency. With prioritization of water for the drinking purpose, there is also a need to efficiently use water in drinking water sector. Moreover, as water for drinking water use is prioritised during lean years the only way to meet the demand of farm water is by using water efficiently in agricultural sector. As water use in agricultural use will bring about more than proportionate increase in total water use from the reservoir, any measure to improve efficient water use in farm sector would bring about efficient water use from the reservoir. It was demonstrated that there is a need to increase supply of water to farm sector in order to improve efficiency of the water use from Dharoi reservoir. This calls for the need for large-scale irrigation projects for storing runoffs that have a high probability of occurrence so that during the years of large runoffs major part of the runoffs will not be lost uncaptured.

The study has analysed the performance of municipality in distributing and managing drinking water was analysed with the help of case studies (Chapter 3). Adequacy of
drinking water has no doubt improved but such an improvement is to be viewed in the perspective of under-utilised capacities of newly constructed water networks. Practice of overemphasis on supply management in the past raises concerns about the sustainability of this institution. In the new set up, there is an enhanced emphasis to supply water on basis of BWR. In order to achieve the norms, supply-augmentation schemes are adopted. In such a situation, water providers have little desire of transition to reforms based approach leading to efficient water use for meeting future needs. Moreover, municipalities suffer from problems of low water charges and poor cost recovery. It is seen that with improved supply the recovery of water charges have also improved. At present low recovery adversely affects the outlay on maintenance of existing infrastructure. If recovery has to be improved then appropriate pricing strategy must be devised. The proper analysis of pricing requires well maintained records on quantity of water supplied for residential and commercial uses and the revenue earned from various users. Such records are currently non-existent. In absence of relevant information, municipalities are not in a position to devise strategies to distribute water between uses and/or revise water rates.

Analyses of productivity of water and returns from crops to various size classes showed that enhancing water use efficiency could be one of the solutions for meeting the ever burgeoning demand for water in the agricultural sector (Chapter 4). It is recognised that water is just one of the many inputs used in crop cultivation. Apart from water, a number of other resources are required. These factors are the amount of material inputs like seeds, fertilizer, pesticide etc.; machine inputs like tractor hours and other factors like cropping intensity and yield. All these factors carry a specific cost and the farmers would be willing to pay for water use only if an optimum mix of these factors results in substantial benefits. A household level analysis is undertaken to shed light on the production behaviour. It is seen that the costs incurred by farmers of the WUA located in the middle reach of the command are much lower than that for those located at the tail end. This is due to adequate availability of surface water. A linear regression equation is used to estimate the effects of variations in independent variables on dependent variables. It is seen that most of the small and medium farm households realise a PE of less than or equal to 45%. It is estimated that any intervention to improve cropping intensity, yield and bullock labour hours for small and marginal farmers would enhance gross returns from cultivation and reduce cost of cultivation. We also came to the conclusion that increasing watering to large farm size groups will improve gross returns from cultivation more than that for medium sized
farms. We also felt that improving user participation in WUAs for all farmers and large farmers in particular will help improve water distribution and its use. Apart from involving users in water distribution and management, there is also the need to bring about an improvement in extension services and increase in market access and market-related facilities. Some WUAs like Rangpur are selling fertilisers, pesticides but have failed to have a significant impact on farmers’ efficiency. Empowering farmers in input and output market calls for an improvement in their skill, access to state of art, technology and infrastructure. There is also lot of scope for extending credit, particularly for irrigation facilities, fertilizers and other purchased inputs. Extension services are also required to be oriented towards crop diversification and cultivation of less water intensive crops.

Aggregate analysis at the household level, however fails to illuminate the relative importance of various sources of irrigation and impact of water deficit on gross returns. The lacuna is overcome by crop level analysis (Chapter 5). The analysis focused on cost and returns structures for different crops for *Kharif* and *Rabi* 2003 with respect to different sources of irrigation. Crops were divided into two heads; irrigated crops and unirrigated crops. The regression analyses of irrigated crops are carried out along with crops irrigated solely by canal and crops which use at-least two watering from alternative sources in addition to canal water. The study examined productivity efficiency by assessing the amount of resource that could be allocated to maximise returns. The deviations from these targets assist in studying reasons behind inefficiency. It was noticed that PE of crops dependent on conjunctive source was marginally better than PE of crops dependent solely on canal source. Use of bullock labour hours and yield of crop seems to improve PE of the crop dependent on canal source along with other source. Elasticity coefficients showed that efforts to improve yield and bullock labour hours per hectare in crops irrigated only by canal source, rather than conjunctive source, would promote increase in gross returns from crops. Similarly, total watering showed positive and significant relationship with total crops irrigated from all sources and conjunctive source. Apparently, there is a need to increase watering in crops by conjunctive source in order to promote increase in gross returns. The estimated mean PE for all irrigated crops was 25 per cent, implying that 75 per cent of the potential was not realised. This difference between the realised output and the frontier output was more due to inefficient use of resources at the disposal of the sample farmers. Though source wise variation is not significant, but such inefficiency was less observed when crops were dependent on conjunctive source. This is because conjunctive use of groundwater and
surface water improves the availability and reliability of water supplies unlike water from canal, allowing water providers to meet growing demands for water despite variable rainfall. It provides a safety net during drought or peak use periods, when groundwater stored during wet periods is extracted at times when precious surface supplies are limited. Estimated PE of major crops of the study area namely sorghum and wheat crops showed that farmers growing wheat were more efficient vis-à-vis sorghum growing farmers. The output elasticity with respect to yield and machine inputs in wheat is higher than sorghum crop. Thus, efforts made to increase in yield and machine inputs in this crop would promote increase in gross returns of cultivation of crops. Hence the cropping pattern needs to be changed in the study area under different sources of irrigation. However in North Gujarat, Sorghum is primarily grown to meet fodder requirement majority of households and its production also has linkages with dairy cooperatives. No efforts from the department could wean away the farmers from producing this crop. However, our analysis shows that gross returns from Sorghum could be improved by directing efforts towards increasing bullock labour hours and watering.

It emerges that improving resource use efficiency of farmers is vital. In order to study the variables affecting efficiency of resource use by farmers, regression analysis was examined against a vector of explanatory variables. It was noted that PE is indirectly related to area under food crops. PE would improve by diversifying to cash crops. Productive efficiency gap is also due to high input use and high ratio of cultivation of food crops to total crops. Clearly farmers are not following the package of practices and input levels as demonstrated by the department or extension personnel. Productive efficiency is positively related and also statistically significant in relation to percentage of area irrigated to total area for all, small and medium farm households. From a policy perspective, measures to increase area under irrigation for small and medium farmers would necessarily bring about an improvement in the PE. Negative and significant relationship of PE with water shortage stresses the point that for efficiency gains not only availability of water is important but reliability is equally crucial. Though one of the aims of forming WUAs was to bring about efficient water distribution, from the data it was clear that aim was not fulfilled. The reform process failed to bring about an improvement in access to water. It is also seen that lack of reliability in water supply was true for crops irrigated by tubewell as for canal sources. In this situation, when only 47 per cent is irrigated by solely canal source and the rest have to depend on groundwater partially or fully, WUAs in canal command has an
uphill task in improving water distribution and management. Performance of WUAs in distributing water, given the constraints is promising.

The analysis of WUAs shows that proper functioning of WUA would have positive impact on the yield of small farmers (Chapter 6). This is because most of the small farmers of the Dharoi Reservoir Project were dependent on canal water. Farmers who had insufficient access to water were lured to join the WUAs with the promise of assured availability of water. Some other factors, which enticed the farmers to join the WUAs, were the assurance of cheap water supply, faster resolution of conflicts and promise of timely operation and maintenance of canal network. It was found that WUAs faced problems in mobilizing resource and they had to depend on aid from NGOs and activities like sale of pesticides to remain economically sustainable. In the situation when both surface and groundwater co-exists in the basin, lessons needs to be learnt on methods and ways tubewell companies manage and distribute groundwater.

To sum up, the study brings out the point that current practices of water allocation are not used efficiently. Conflicts in farm and drinking water use are also noted. Regrettably there are no formal rules for determining who have the rights to use how much water and for allocating water mainly during scarce years. Conflicts are likely to inflate with increasing population and urbanisation. With increasing pressure on water resource, present practice of water transfer from water abundant to water scarce basin would involve high transaction cost. It is evident that existing institutions in water may not work well unless water rights are be established and strictly enforced. To establish exclusive water rights, amount of water available and allocated to various uses should be agreed upon and restricted. All this requires strong support of irrigation community and other users. From the above discussion, though there are numerous institutions like GWSSB, Municipalities managing water distribution in drinking water sector and WUAs managing water distribution in farm sector, not one institution or a set of well-linked institutions is able to carry out water management programme efficiently. Each set of institutions has strengths and weaknesses. A need to provide a platform for stakeholders is felt which would distribute and manage water.

**IN NUTSHELL**

Analysis of physical and financial performance of water using sectors suggests the types of intervention that would mitigate constraints and enable use of opportunities for
greater benefits from water. In drinking water sector, towns have performed well in terms of revenue collected from water tax as they have relied on supply management to improve water availability. Even in this situation, recovery of water charges is rather low. Full recovery of water charges had the potential to meet 63 per cent of total water costs in supplying water. This means that even in case of full recovery of water charges, municipality would have to incur deficit. There is a need to increase water charges along with the efforts to improve recovery of water charges.

Thus, drinking water sector like farm sector is fraught with the problem of inefficient water use, low water charges and low recovery rates, which hinder local bodies to meet operation and maintenance expenditure. In farm sector also hike in canal water charges alone will fail to bring about efficient use of water. Water is only one of the inputs used by farmers in cultivating crops. Efficient use of resources depends on several factors like availability of inputs, reliability in the supply of inputs, mix of other inputs and so on. Reform in the combined influence of water and other inputs is possible through targeting development of infrastructure, water resource, credit and markets. Such an analysis allows a systematic comparison and the identification of factors that impinge upon stated policies, laws and in implementation. As such water management in farm and non farm sectors suffers from fragmentation of responsibilities among different institutions. Although the Ministry of Water Resources is responsible for water resources planning and management, coordination with other stakeholders like GWSSB, groundwater department are not strong enough to eliminate conflicts. Some of these stakeholders affect water quantity available for various sectors, while others are more involved in water quality issues. Moreover, due to vastly different types and scales of use, communicating between water professionals and non-water professionals is quite difficult. Policy decisions are often taken without a clear understanding of consequences on all water users. Nonetheless, various measures like federation of WUAs should be explored. Efforts should be geared towards increase in public participation in municipalities. Any insight in to these factors possibly will lead to an improvement in and refinement of the continuing experiments in water management. In situation of diverse interest of users and irrigation department, no single measure of reform is believed to work. The analysis empirically demonstrates three key issues having immense value not only for institutional design but also for its sequential implementation. These issues are: the relative importance of institutional aspects, the performance impact of their linkages and the synergy possible from factors exogenous to water sector.
The results suggest that an ideal water institution needs to have a water law that treats all water sources within an integrated framework, imbibes effective conflict resolution provisions, reveals higher degree of internal consistency, and also provides scope for private sector participation. While these features set the priorities for institutional reform in a generic context, this does not mean that other institutional aspects are unimportant; their effects. Clearly there is the need to move to more interdisciplinary research efforts which incorporate economic and engineering knowledge to develop integrated decision making frameworks resulting in ecologically sound and economically efficient solutions. This requires comprehensive institutional and legal reforms, which must empower water users to make their own decisions regarding resource use, while at the same time providing a structure that reveals the real value of water.