Study on Tail-enders and Other Deprived In Irrigation Commands In Maharashtra

Study by:
Society for Promoting Participative Ecosystem Management (SOPPECOM)

As part of an All-India Study on Tail ender and Other Deprived in Irrigation Commands

Co-ordinated By:
Development Support Centre (DSC), Ahmedabad

Sponsored by:
The Planning Commission, New Delhi
Wageningen University : Environmental Sciences

Society for Promoting Participative Ecosystem Management (SOPPECOM)
16 Kale Park, Someshwarwadi Road,
Pashan, Pune 411 008
Phone: 020-2588 0786 and 2588 6542
E-mail: Soppecom@gmail.com

August 2002

Study on Tail-enders and Other Deprived In Irrigation Commands In Maharashtra

Researchers:
Suhas Paranjape and K.J.Joy

Research Assistance:
Raju Adagale and Ravi Pomane

Office Assistance:
Pratima Medhekar

Advisors:
K.R.Datye, R.K.Patil, S.N.Lele and S.B.Sane

As part of an All-India Study on Tail ender and Other Deprived in Irrigation Commands

Co-ordinated By:
Development Support Centre (DSC), Ahmedabad

Sponsored by:
The Planning Commission, New Delhi
Wageningen University : Environmental Sciences

Society for Promoting Participative Ecosystem Management (SOPPECOM)
16 Kale Park, Someshwarwadi Road,
Pashan, Pune 411 008
Phone: 020-2588 0786 and 2588 6542
E-mail: Soppecom@gmail.com

August 2002

Contents

Acknowledgements

This project "Study of Tail-enders and Other Deprived in Irrigation Commands in Maharashtra" by Society for Promoting Participative Ecosystem Management (SOPPECOM), Pune, is part of an all India project on the issue of deprivation within command areas coordinated by Development Support Centre (DSC), Ahmedabad. The study has been taken up with financial assistance from the Planning Commission, New Delhi and Environmental Sciences, Wageningen University. We would like to express our sincere thanks to DSC, the Planning Commission and Wageningen University for their support to this study. A special word of thanks to Shri Anil Shah of DSC for first mooting the idea of this study and also for approaching SOPPECOM to take up the Maharashtra part of the study. We are also thankful to Dr. Sachin Oza and Dr. Surashree Saha, both from DSC, for all their help during the project period. Similarly we also appreciate the role played by Dr. Peter Mollinga and his inputs during the study, especially during the one-day meeting in Hyderabad in the initial phase of the study, as they have helped in keeping the study focussed.

We also would like to put on record the cooperation given to us by the Irrigation Department and its officers. Firstly we are thankful to Shri S. V. Sodal, Secretary of the Irrigation Department (Government of Maharashtra) for the initiative he took in writing to the officers concerned about this study and also asking them to provide the necessary data for this study. All the officers that we came in contact with during this study -- Shri M. V. Patil, Shri R. E. Mhaske, Shri Karad, all Sub-Divisional officers of the Mula irrigation system, the concerned Sectional Officers of the selected minors and sub-commands of Mula irrigation System, Shri A. R. Kore and Shri S. D. Palshikar (both from CADA Solapur), Shri Shinde and Shri Jagtap of Mangi Project, Shri Deokar and Shri Morankar of Walen project and also all the Canal Inspectors of all the concerned minors/sub-commands -- were very cooperative and helpful especially during the data collection phase of the study. We are also thankful to the office bearers of both the WUAs which were part of our sample and also all the farmers who participated in the walk through surveys and focussed group discussions.

The outcome of the study reflects the collective experience of SOPPECOM and its work over the last 10 years or so in the water sector. We would like to acknowledge the contribution made by our senior colleagues in SOPPECOM -- Shri R. K. Patil, Shri S. N. Lele, Shri K. R. Datye and Shri S. B. Sane -- especially in interfacing with the senior ID officials for this study. The timely suggestions they have given during the various stages of this study and their comments on the draft report have helped us greatly. We also appreciate the sincere efforts put in by both our Research Assistants -- Shri Raju Adagale and Shri Ravi Pomane - and their efforts have greatly enhanced the quality of the data. We also acknowledge the help of Ms. Pratima Medhekar for the data entry and for her assistance throughout the project.

Pune — K. J. Joy
August 2002 — Suhas Paranjape

Chapter 1
Background of the Study

Though Society for Promoting Participative Eco-system Management (SOPPECOM) has been very concerned about the issue of deprivation in the command areas of irrigation projects, it had not addressed this issue systematically till this study. Hence when Shri Anil Shah of Development Support Centre (DSC) approached us with the proposal of taking up this study in Maharashtra as part of an all India effort to understand the issue of deprivation in irrigation commands, we were more than happy to get into the study. As part of this study SOPPECOM took up three projects – one major, one medium and one minor – in Maharashtra. And having got into it we do not regret it as the study did help us to understand the complexities involved and, though depressing at times to see the state of the physical system, has also made us more sensitive to the problems involved in the management of irrigation systems. Our overall feeling after the study could be very well paraphrased by what often K. R. Datye, senior member of SOPPECOM, says -- `what irrigation (especially major projects) could have done, but could not do' – this expresses both the problems and potential of irrigation sector today.

The context

After independence massive investments were made in the irrigation sector with the belief that irrigation would lay the foundation for the development of the country. Dams and irrigation projects were seen as the `temples of development'. Between 1951 and 1997, public sector plan outlays on all forms of irrigation, including flood control, at current prices totaled Rs. 860 billion. The potential created by all sources of irrigation at the end of Eighth Five Year Plan come to around 49 million ha.

Though it is true that irrigation and irrigated agriculture did play a significant role in creating self-reliance in food, especially in terms of production, studies show that the initial euphoria could not be sustained. Even with such massive investments and potential created, many of the problems that we wanted to address through the development of water resources still continue. Drinking water shortages, increasing drought conditions, decreasing productivity, environmental problems like waterlogging and salinisation, uneven development between and within regions, etc., still haunt us. Under-utilisation of potential created, the mismatch between actual and potential productivity of irrigated agriculture, increasing gap in cost recovery, poor quality of services, deterioration of the physical system because of lack of adequate maintenance, lack of control and participation of the users, etc., are generally cited as reasons for the ills that plague our irrigation sector. Added to this is the problem of the tail-enders and other deprived sections within the irrigation service areas -- a problem which is universal in its presence as it cuts across regions and size and type of projects.

Situation in Maharashtra

Though generally it is said that Maharashtra ranks first in terms of number of large projects, the present situation is that only about 17% of the cropped area is irrigated where as the all India average is about 26%. It is estimated that even if Maharashtra develops all its water potential it would be sufficient to irrigate at most about 30% of the total cropped area. On the other hand Maharashtra has large tracts, nearly about one-third of the area, that are chronically drought prone. Coupled with this the uneven development between regions is also very sharp. This can be seen in both in the creation of irrigation potential and its actual utilisation. Thus, certain urgent steps have to be taken to improve irrigation efficiency and coverage of irrigation sector and in this context the issue of the `tail-enders' within the command becomes very important.

Another context related to the issue of tail-enders is the whole issue of treating water as a common property/common pool resource and hence all the people who depend on land and water for their livelihoods should have access to certain minimum quantities of water. In other words, equitable water distribution and access become important concerns in irrigation sector reforms. In fact we should place the issue of tail-enders and other deprived within the overall context of equity. Equity within the command could be our starting point in ensuring water to all.

Absence of focused studies on deprivation in irrigation commands

Though tail-ender deprivation is a very wide-spread phenomenon, there are no systematic, focused studies which look at the problems of the deprived within the irrigation command areas, in terms of the reasons, the factors that contribute towards this deprivation and what are the possible ways out of it (solutions). In fact, though there are many studies that deal with the problems of irrigation in general and problems of irrigated agriculture in particular, in most of these studies the issue of the tail-enders is itself a `tail-end' problem that receives as little attention as the tail-enders!

Hence there is a need to address this issue separately and systematically. It is hoped that the proposed study in Maharashtra as part of an all-India effort would bring the issue of the deprived in the command areas to the forefront of public debate which will have its impact on both local/grassroots level action and at the policy level. With the involvement of eminent institutions like the Planning Commission, Wageningen Agriculture University and Development Support Centre in this study we hope this would not be such a difficult task. For us in SOPPECOM the insights that we have gained through this study would form an integral part of our agenda for water sector reform in India in more sustainable, equitable and participatory lines.

Fig.1.1: Irrigation command or drought prone dryland? Many of the tail portions of irrigation projects are left without water and revert to the typical drought prone dryland landscape.

Organisation of the Report

The report is organised in 8 chapters as given below:

Chapter 1	Background of the Study
Chapter 2	Scope and Methodology
Chapter 3	Profile of the Projects and Selected Sub-commands
Chapter 4	Findings -- Mula Major Irrigation Project
Chapter 5	Findings -- Mangi Medium Irrigation Project
Chapter 6	Findings -- Walen Minor Irrigation Project
Chapter 7	Quantification of Deprivation
Chapter 8	Broad Conclusions and Emerging Issues
Annexure	Mula, Mangi and Walen Projects: Summarised Findings

Chapter 2

Scope and Methodology

The scope and methodology of the study were finalised during the one-day meeting in Hyderabad in the first week of November 2001. This discussion helped the study teams in going beyond the prevalent, conventional notions about `tail-ender' problem and making `deprivation' in the irrigation command areas, a much broader concept, the focus of the study. Of course being physically at the tail end of the irrigation projects and their sub-commands and its implications in getting access to water is also an integral part of this broad understanding of deprivation.

2.1 Central Research Question and Sub-questions

Thus the main focus of this research project is to study water user deprivation, non-access to irrigation water in major, medium and minor surface irrigation systems in the northern, eastern, southern and western regions of India. In this sense, the concept of deprivation here goes beyond the conventional formulation of deprivation as a problem of the `tail-enders'. This central research question, which is common to all the study groups who are part of this project, is to be explored in different regions of the country, under different types of surface irrigation projects like major, medium and minor, under different irrigation practices that are prevalent and also different notions of water entitlement as defined by the existing norms and practices.

The above described central research question has been further broken down to the following set of sub-questions.

1) Identifying the deprived.

2) Identifying degree of deprivation.

3) Identifying the reasons for deprivation.

4) Identifying the impacts of deprivation.

5) Identifying the strategies of deprived persons to overcome deprivation and those of the others to reproduce deprivation.

6) Responses of other actors like system managers, policy makers, local leaders, politicians, etc., to the phenomenon of deprivation.

2.1.1 Identifying the deprived

For the purposes of this study it has been decided to focus on deprivation as defined by current norms of entitlement, that is, on deprivation within the section that is formally entitled to irrigation water according to the norms of the Irrigation Department. It should, however, be noted that this leaves out another kind of deprivation that is caused by the nature of these norms themselves: for example, with reduced water norm, a greater area could be served, or if lifts up to a specified height were allowed a different area could be served than when lifts are not allowed, or if irrigation water is integrated with local watershed development again there could be greater area served, equitable distribution on the basis of households or per capita, etc., could make water available to a much larger sections of rural population, etc. Though this aspect of potential deprivation falls outside the purview of the commonly decided focus of the present study, it should be noted that a study of such deprivation may have significant relevance in macro level approaches to and planning of irrigation systems.

In surface irrigation systems in Maharashtra the area officially designated as the irrigable command area (ICA) by the Irrigation Department (ID) defines who is entitled to irrigation. In Maharashtra the ICA is an unambiguously designated and demarcated entity. However, the entitlement is not fixed and is not formally tied rigidly to season nor is it binding on the irrigator to take any one designated crop, though there is an approved cropping pattern for each project. Formally, at the beginning of the irrigation season (there is a formally announced date for this for each project) each irrigator is supposed to fill up a form indicating the crops and the area of each he/she intends to take on his/her land. This is then scrutinised by the ID on the basis of the availability of water in the reservoir. The water charges then are assessed on the basis of the finally sanctioned crop pattern after measuring the area actually irrigated. Usually the area sanctioned is charged unless the farmer intimates about non-receipt of water within one month. The present practice is to levy full irrigation charges even if only one watering is received. However, it has been reported that this year water charges have been levied in proportion to the rotations received.

In practice, forms are not always filled, and the matching may be far from perfect. In case the irrigator departs from the sanctioned crop pattern in terms of crop or area, the Department is entitled to assess the area actually irrigated and crop taken and levy penalties if the irrigator is found to over irrigate in terms of crop or area. This process is called the *panchanama*.

Besides the canal, the irrigator in the command may have a well(s) in his/her field and is entitled to utilise any amount of water that may appear in the well. Irrigators are not supposed to irrigate the same crop by both canal water and well water as per the present Irrigation Act (breaking of the *pat-mot sambandh*). As per this Act, all area irrigated from wells in the command area situated within a distance of 35 m of government canals could be charged up to 100% of the water charges (the prevalent water charges on the canal) and up to 50% if the wells are situated beyond the distance of 35 m. However, very often this provision is not enforced.

There is also this new emerging government practice in Maharashtra, especially in respect of new irrigation schemes, where the emphasis is simply on developing the source and not building the canal system at all. The practice is to build a dam, and instead of the canal system, construct a series of pick up weirs (basically Kolhapur type of weirs) downstream, release regulated flows into the river and have the users lift the water from the pick up weirs. This simple device greatly simplifies matters for the government and allows it to shed its responsibility for regulating distribution. The result is use of unregulated amounts of water becomes the privilege of those who have the resources to invest in lifting devices (who also tend to become water-lords extracting rent for their ownership over water as they sell this water to others in which the water users give one-fourth of the produce to the owner of the scheme). This system, known as *chouthai* (levy of one fourth), is very common in Kolhapur district and the adjoining areas.

2.1.2 Degree of deprivation

There is also a need to quantify the degree of deprivation. A spectrum can be identified in terms of degree of deprivation: irrigators who do not receive any surface irrigation nor any irrigation from well recharge form one end of the spectrum, and those who get water for every rotation for the full area according to the filled in demand form forming the other end of the spectrum. There are two dimensions of this access -- direct access to surface irrigation and indirect access from well recharge. The reference should be the area and the valid rotations due to the irrigator according to the crops and area sanctioned in the demand form. Another indicator is related to deprivation in relation to the design crop pattern. A full discussion of the method of estimation of the degree of deprivation is taken up in a later chapter on `Quantification of Deprivation', As would be obvious, all indicators must use a defined reference situation and cannot therefore measure biases inherent in that reference situation itself. This remains a limitation of this kind of indicator. For example, in the first and second case, the reference point is the demand form itself, and that itself may reflect deprivation: for example, anticipating that he may not get much water anyway, an irrigator who has had a long history of deprivation may decide to fill in a form for a much smaller area or for a crop that may not be productive enough but requires or tolerates smaller quantities of water or longer rotation intervals. This kind of deprivation will not be covered by the proposed indicator. This in itself is not a disadvantage, so long as the indicator covers a sufficiently broad spectrum adequately, biases are kept in mind and investigated through other means.

Some of this deprivation can be offset by the indirect access to well recharge, and a similar indicator may be derived to assess the degree to which direct access deprivation has or can be offset.

There would also be some exceptional kinds of deprivation that may need to be tackled separately. For example, the problem of waterlogging which is often common in head reaches.

2.1.3 Reasons for deprivation

Keeping the broader understanding of deprivation and the irrigation scenario as it exists in Maharashtra, we have tried to investigate the probable reasons for deprivation. Some of these probable reasons could be: mismatch between planned water availability and its pattern and actual water availability and its pattern leads to water shortage, and the absence of equitable sharing of shortages; water delivery sequence and scheduling methods favour some (upper reaches, more influential sections, the politically influential, higher castes, etc.); anticipated deprivation, leading to curtailing of demand for water; lack of volumetric bulk deliveries cause difficulties in controlling/limiting higher deliveries in middle and head reaches; nature of sanction procedures; consequences of user response to the situation **--** for example indifference to irrigation due to unreliability or fall in productivity due to variable supplies leading to defaulting on payment of water charges; lack of information, of transparency, of participation or of an adequate mechanism for redressal of grievances; the physical status of the system (lack of maintenance, distribution system, disrepair, etc.) is such that certain portions of the command cannot receive water; etc.

2.1.4 Impact of deprivation

There are two types of impacts that need study: linear impacts and the overall cyclical or systemic impact. The linear impacts are those that are well known: impact on productivity, on income, on subsistence and on livelihoods, on scheduled payments and future creditworthiness. The cyclical or systemic impact is when these impacts cluster together and reinforce each other to reproduce a situation (here deprivation) and render it endemic. Both these kinds of impact need study.

2.1.5 Strategies to overcome deprivation

There are a host of strategies that the deprived may mobilise in order to cope with deprivation. The first set of strategies may be classified as an attempt to adapt to deprivation: these include steps like, opting for a cropping pattern that does not require too much water or tolerates longer rotation intervals, supplementing direct access through access to well recharge, etc. The other set of strategies may be classified as those attempting to modify the situation and reduce or eliminate deprivation: these may range from individual strategies like those of bribery, unilateral voluntary system improvement, seeking redressal through official intervention, seeking redressal through political intervention, and lastly, as has been the case in some areas in Maharashtra, forming Water User Associations. Similarly, especially where inequitable sharing of irrigation and of shortages has led to the deprivation, there may be similar counter strategy by those who see their privileged access under attack by these strategies on the part of the deprived.

2.1.6 Responses of other actors

Irrigation from canal systems is essentially a political good in India, and is not a simple matter between the providers and users (sellers and buyers) of irrigation service. It involves all prominent social forces within the area and its surroundings. Irrigation services are shaped by political leaders, community leaders, caste hierarchies as well. The response of all these actors is crucial in the final outcome. The profile of who has decisive influence and who are deprived has a lot to do with the perpetuation of deprivation, and even in the fact of deprivation itself.

2.2 Sample Size and Choice of Sub-commands

The study is focused on investigating the issue of deprivation in one major, one medium and one minor irrigation project such that they would represent the irrigation situation in Maharashtra. The projects chosen are: Major project – Mula in Ahmednagar district; Medium project – Mangi in Solapur district; and Minor project – Walen in Pune district.

During the Hyderabad meeting it was suggested that each of the study group should cover at least 15 to 20 villages or sub-commands for its field work. We have taken commands and sub-commands (outlets, minors or distributaries depending on the type of project) as the units of data collection. In fact the villages covered are more than 20 as very often the sub-commands cuts across village boundaries and very often cover 2-3 villages.

In Mula major irrigation project we selected 10 sub-commands (minors) for detailed investigation and field work. The whole command area of the project was divided into three zones, namely, head reaches, middle reaches and tail reaches. Then the 10 minors were distributed over the three zones on the basis of 2:4:4. Thus, of these ten minors, two are located in the head reaches of the canal system, four in the middle reaches and four in the tail reaches of the system. Three zones were further subdivided into head reaches and tail reaches and the minors were proportionately distributed over them. For example, of the two minors selected in the head reaches of the project command, one is from the head of the zone and the second one represents the tail portion of the zone and like-wise for the middle reaches and tail reaches of the project command. This helped us to capture the variations with the zones in terms of head and tail reaches. The selections of the minors and their distribution over the command, as described above, was made on the basis of the command maps, secondary data collected both at the project and the different sub-divisional levels and the discussions with the project officials. Care also was taken that each of the sub-division is also represented in the sample. The effort was to capture all the main representative situations in the sample. In our earlier proposal we had suggested that in the middle and the tail reaches of the project, the selected villages will be divided equally between those minors having a WUA and those not having one. However, in the light of the discussions at Hyderabad we decided to take only one WUA managed minor each from middle and tail reaches of the project. So out of ten minors selected we have 8 non-WUA situation and two WUA situation, again representing the general irrigation situation in Maharashtra.

In the case of Mangi medium project we selected 8 sub-commands (direct outlets and distributaries and there are no minors on this project) for detailed investigation. Of these 5 sub-commands are located on Right Bank Canal (RBC) and 3 are on Left Bank Canal (LBC). RBC commands much larger area as compared to the LBC. All the 8 sub-commands are distributed over the head, middle and tail reaches of both RBC and LBC.

Since Walen minor project mostly serves only one village, we have included the entire command in the sample.

2.3 Data Collection

In the light of the discussions at the Hyderabad meeting and the whole project design (both in terms of time and resource available for the study), it was decided not to use individual, questionnaire-based, quantitative data collection tools. The emphasis was on qualitative and participatory methods. The primary data collection was more directed towards exploration of issues and a qualitative understanding of the issues. Most of the quantitative data have come from secondary sources. We conducted a series of participative discussions and appraisals in the form of walk through surveys (WTSs) and focussed group discussions (FGDs) as part of the primary data collection.

2.3.1 Coverage of the secondary data and sources

The secondary data collected for each project cover the following details of the project, including minor-wise data for the selected sub-commands or minors wherever applicable: salient features of the projects, rainfall, inflow and storage data, approved cropping pattern, total number of applications for water, applications sanctioned, applications rejected with reasons, actual crop pattern prevailing for the last 3 to 5 years, water charges collected, *panchanama* done on unauthorised irrigation and the details, season-wise number of rotations for 3-5 years, details of wells in the command area and the area irrigated and the cropping pattern on wells, annual maintenance costs for the last five years, scheduling of water distribution planned as part of project report, actual schedules adopted over the last five years, scheduling pattern in case of shortages, command area maps, and list of irrigators outlet-wise with details of the land records for the selected minors especially ICA and the actual irrigation for the last three years.

The above data was collected at different levels. Some of the data related to the project as a whole was collected from the respective main Irrigation Department offices. For example the data related to Mula project was collected from Ahmednagar. Similarly for Mangi and Walen the project-level data were collected from Solapur and Pune offices. In the case of Mula we had a middle level source, that is the sub-divisional offices. All the data at sub-division level were collected from the respective sub-division offices. The detailed data related to the selected sub-commands were collected from the sectional offices. Apart from getting access to data, the visits to these offices at different levels also helped the study team to meet and interact with officers at different levels and also understand their perceptions of the issues involved.

Right at the beginning of the project, SOPPECOM had a meeting with Shri Sodal, Secretary, Irrigation in Mumbai and discussed with him the purpose of this study and also the type of help we would require from the Department especially in getting access to secondary data. Shri Sodal in turn instructed his officers accordingly and we are happy to record here that all the officers of the department were very cooperative during the course of the study, helped us in getting access to the data and also were quite frank in expressing their views on the issue of deprivation.

2.3.2 Discussion with Irrigation Department officials

As explained above, the study team made a conscious effort to get the cooperation of the ID and the concerned officers. As part of the efforts to get data and information as well getting their view points of specific issues we had discussions with a cross section of officers including the Secretary Irrigation, officers at the level of Superintendent Engineers, Executive Engineers, Deputy Engineers, Section Officer, right up to Canal Inspectors. This helped us to get an understanding of the perceptions of the ID officers placed at different levels in the irrigation hierarchy.

Fig. 2.2: The focused group discussion in progress at Walen.

2.3.3 Walk through surveys

At the selected sub-command level, in each of the outlets, minors and distributaries, a walk through the command similar to a PRA `transect walk' in a watershed context was conducted. This was

basically to understand the physical layout of the associated sub-command and its associated features and problems. The study team would start the WTS from the off-take or head of the minor (or outlet or distributary as the case may be) and walk through the entire distance up to the end of the minor. During the walk through the emphasis was on understanding the condition of the physical system including the condition of the channel, the different types of structures including outlets and their gates, condition of the field channels, present capacity of the channel as against the design capacity, incidence of breaches of the minor, etc. The discussions with the accompanying section officer, canal inspector and the farmers of the minor helped the study team understand the condition of the minor and the structures in a historical perspective, the reasons for the present condition, what the people have done to maintain the system, till what point the water reaches in the sub-command, etc. The focus of WTS was on making an assessment of whether the physical system is capable of giving water to all who come under the designated command of the minor. The study team also used to carry the map of the sub-command and this helped to make a comparative assessment of the present condition with the designed one. As the study team walked through the minor, it also prepared a schematic map of the minor as it exists today noting all the structures, outlets and their condition, the gradient of the canal, general state of repairs and maintenance, instances of users breaching the minor to take water to their fields bypassing the authorised outlets, etc. As a general practice we used to have the WTS first, and then the focussed group discussion so that we could take up some of the issues arising out of the WTS for a discussion with the users belonging to the designated command area of the minor.

2.3.4 Focused group discussions

The focused group discussions were conducted in the villages that come under the selected sub-commands. These discussions were conducted with the help of a discussion guide and checklist prepared for this purpose. Generally the FGDs were conducted either in the morning or in the late evenings. If the sub-command serves more than one village then we tried to cover a minimum of two villages under FGD. Sometimes we had to conduct the FGD in the hamlets as the farmers stay on the farm. Apart from the group discussions we also had individual discussions especially during the WTS. Altogether the study team conducted about 20 FGDs. The attendance at the FGDs ranged from about 20 to 100 depending on the size of the hamlet/village, the number of beneficiaries in the village under the particular sub-command, etc.

As a general rule the FGDs used to be conducted in two parts. In the first part the study team elicited information about the actual status on the ground and the farmers view of the performance of the system in terms of the number of waterings they receive, how many of them receive the full quotas and how many do not, benefit they receive from well in the command, etc. The second part dealt with the issue of deprivation. The second part of the discussion starts with one of the team members explaining the issue of deprivation and its various aspects as perceived by the researchers. The rest of the discussion was conducted on the basis of the discussion guide and checklist. The attempt was to keep the discussion free flowing and spontaneous, but also to ensure that all the points in the checklist are covered.

The discussion guide and checklist for the FGD was finalised only after we collected most of the secondary data and also after we made preliminary visits to the projects and held discussions with the ID officials. This helped us to understand the problems and issues little better and in turn helped us to keep the discussion guide and checklist more focussed and sharp.

Chapter 3

Profile of the Projects and Selected Sub-commands

The study area and selection of projects

As discussed in the previous chapter, the SOPPECOM's study is focused on investigating the issue of deprivation in one major, one medium and one minor irrigation project representing the irrigation situation in Maharashtra. This chapter gives a brief profile of the three projects selected for the study: the Mula major irrigation project, the Mangi medium irrigation project and the Walen minor irrigation project. The projects chosen – Mula, Mangi and Walen – are from the Pune-Ahmednagar-Sholapur region of Maharashtra falling in the Krishna and Godavari basins -- the two major basins in the state -- and are representative of the large drought prone region in Maharashtra. The situation with respect to canal irrigation is fairly similar in the whole tract which embraces a very large part of Maharashtra with the exception of the high-rainfall Konkan region, the Eastern banks of the Sahyadri and the upper reach of the Godavari catchment bordering Madhya Pradesh and Andhra Pradesh. The location of the three projects is shown in the map of Maharashtra at Map 3-1).

Presently projects are classified as major, medium and minor on the basis of the size of the command area they serve. Projects which have a command area of more than 10,000 ha are put in the major project category. Medium projects serve an area between 2,000 ha and 10,000 ha. Minor irrigation projects serve an area up to 2,000 ha. The earlier classification was on the basis of cost. According to this criteria, Mangi was considered as minor project and even now in some of the ID records the project is still listed under the minor projects.

Around 1995-96 the Government of Maharashtra formed basin-wise corporations and all the projects coming under a particular basin were transferred to that corporation. Accordingly all the projects in the Godavari basin were transferred to the Godavari Marathwada Irrigation Development Corporation (GMIDC) and projects in the Krishna basin were transferred to the Maharashtra Krishna Valley Development Corporation (MKVDC). Thus the Mula project comes under the jurisdiction of the GMIDC and Mangi and Walen come under the MKVDC.

Another recent development is the Government of Maharashtra's decision to make formation of WUAs mandatory in order to get access to irrigation water. According to this Government Resolution (GR No. WUA/1001/(442/2201)I.M.(P) dated 23/07/2001), the entire state is to be covered by 2003. People not forming WUAs would not get access to water. As a result of this, there is a concentrated effort by the ID officials to forms WUAs in a targeted manner.

With a view to improve irrigation efficiency and increase the irrigation coverage the Irrigation Department has come up with a Government Resolution (GR No. Sinchan 1101/(760/2001) dated 5/12/2001 which says that in Rabi season 1Mm3 150 ha should be irrigated.

The Major Project: Mula Irrigation Project

The Mula Project is located on the Mula river, a sub-tributary of the Godavari. The dam has a gross storage capacity of 767 Mcum and a live storage of 609 Mcum. The project was completed in 1971-72 and has a planned capacity to irrigate 80,800 ha in 149 drought prone villages in Ahmednagar district. The project serves the command area through two main canals, the MLBC (Mula left bank canal) and the MRBC (Mula right bank canal) and their branch canals serving an

Fig. 3.1: The Mula dam.

area of 10,100 ha and 70,700 ha respectively. The MLBC was constructed to strengthen and stabilise the command of Pravara right bank canal. It has a discharge capacity of 8.5 cumecs, runs for 18 km and then merges into the Pravara canal system. MLBC is generally considered as part of the Mula-Pravara system and not as part of the Mula irrigation project. For the purpose of this study also we have considered only the MRBC. The design discharge capacity of the MRBC is 46.67 cumecs. There are three branch canals taking off from the MRBC.

The minors and direct outlets taking off from the MRBC itself serve an area of 28,075 ha. The first two branch canals taking off from the MRBC serve an area of 33,215 ha. The third branch, known as the Pathardi branch, takes off at the tail end of the MRBC and runs for 53 km with a discharge capacity of 7.28 cumecs serving an area of 11,400 ha, but only for eight months (July to February). The command area of the MRBC is further divided into 5 sub-divisions known as Rahuri, Newasa, Ghodegaon, Kukana and Amarapur sub-divisions. The dam site, the water-spread, the MLBC and MRBC, the five sub-divisions and the command area are shown in the command map of Mula project given at Map 3-2.

The service area of the project was determined on an approved design crop pattern of 5% area under perennials (mostly sugarcane), 20% two-seasonals, 30% Kharif seasonals, 42% Rabi seasonals and 3% Hot Weather (HW) seasonals. This crop pattern has been used as a reference in the comparisons that follow. The rainfall in the command area is scanty, the average rainfall being below 600 mm. It is not uniformly distributed over the monsoon period.

Salient features of the Mula project are given in Table 3.1 below and the details of the distribution network of MRBC is given in Table 3.2 below:

***Table 3.1*: Salient features of the Mula irrigation Project**

No.	Item	Detail
1	Name of the project	MULA IRRIGATION PROJECT
2	Location of the Dam	a) Dam at Baregaon Nandur across Mula River Taluka Rahuri, Dist. Ahmednagar
		b) Longitude - 74^{o} 34' 30" Latitude - 19^{o} 1' 30"
3	a) Catchment area b) Yield of Catchment at 70% dependability	2274 sq. km (878 sq. miles) 767.47 mcum (27,100 mcft)
4	Annual Rainfall	5,080 mm in Ghat area & 508 mm in other part of catchment
5	Gross Capacity of Reservoir	736.62 mcum (26,000 mcft)
6.	Live Storage	608.88 mcum (21,500 mcft)
7	Dead Storage	127.44 mcum (4,500 mcft)
8	Carry over	28.32 mcum (1,000 mcft)
9	Lake losses	56.64 mcum (2,000 mcft)
10	Type of Dam	Earthen dam with gated masonry spillway.
11	Length	2,856 m (9,370 ft)
12	Maximum width at the base of earth dam	262.74 m (862 ft)
13	Top width	6.10 m (20 ft)
14	Quantity of earth work	7.4198 mcum (262 mcft)
15	Average river flow in monsoon	(Base flow) 56.64 cumecs (2000 cusecs)
16	F.S.L.	552.30 m (1,812 ft)
17	M.W.L.	553.21 m (1,815 ft)
18	M.D.D.L.	534.00 m (1,752 ft)
19	Utilisation Gross	637.20 mcum (22,500 mcft)
20	Utilisation Net	608.88 mcum (21,500 mcft)
		Table 3.1 contd.
21	Maximum height of dam over deepest foundation.	46.63 m (153 ft)

No.	Item	Detail
22	L.W.L.	532.79 m (1,748 ft)
23	Crest of waste weir	544.68 m (1,787 ft)
24	Top of Dams	555.65 m (1,823 ft)
25	Waste Weir	Gated spillway in left saddle.
	a) Maximum flood (as per Inglis formula)	5,947.20 cusecs (2,10,000 Cusecs) (outflow with allowance for flood moderation of 3 ft between F.R.L. and M.W.L.).
	b) Length of masonry spillway	298.70 m (980 ft)
	c) Flood height	7.62 m (25 ft)
	d) Clear over flow length	173.73 m (570 ft)
	e) Radial gates Tainter type	12.19 x 7.62 m -- 11 Nos. (40 x 25 ft)
	f) Quantity of Masonry	0.1416 mcum (5 Cft)
26	OUTLET DETAILS	
	1. R.B. Outlet Ch. 1350	
	a. Size of Gates	2.74 x 1.83 m 2 Nos. (9'x 6')
	b. Designed Discharge	38.23 cumecs (1350 cusecs).
	c. Sill level	530.15 m (R.L. 1739.34 ft)
	2. L.B. Outlet Ch. 17881	
	a. Size of Gate	1.22 x 1.83 m 1 No. (4'x6')
	b. Designed Discharge	8.296 cumecs (300 cusecs).
	c. Sill level	531.42 m (1743.50 ft)

***Table 3.2*: Details of the MRBC distribution network**

Canal or branch	Length of canal (km)	Design discharge (cumecs)	Command area (ha)	Distributaries		Minors and sub-minors		
				No.	Length (km)	No.	Length (km)	Outlet Nos.
MRBC	58	46.07	26,075	7	109	53	184	528
Branch I	35	9.20	15,295	5	69	--	123	338
Branch II	35	12.00	17,920	5	45	49	163	491
Pathardi Branch	53	7.28	11,400	--	--	--	--	--
Total	181	--	70,690	17	223	49	470	1357

The formation of WUAs has proceeded to a relatively much larger degree within the Mula system than elsewhere in Maharashtra and it was here that the first pioneering efforts at the formation of WUAs in Maharashtra were made. SOPPECOM has been instrumental in setting up the first pioneering WUA on Mula Minor 7 and based on that experience has later helped set up fifteen WUAs on Distibutary 4 on the MRBC with a view to an eventual federation. However, the ID did not allow the federation. On the Mula system, 61 WUAs have been registered so far and about 56 have started functioning. About 14 WUAs are in the process of getting their registration.

Medium Project: Mangi Irrigation Project

The Mangi medium irrigation project is located at Mangi village in Karmala Taluka of Solapur district. It is constructed on Kanoli river which drains into the Sina river and forms part of the Bhima sub-basin of Krishna basin. The construction work started on the site in 1897 as a scarcity relief work but was subsequently abandoned. It was again taken up and in the drought year of 1926 and later abandoned. Another drought year 1952 saw the construction being restarted, and this time the work was continued and construction of the tank was completed by 1955. The Left Bank and Right Bank canal systems were completed in 1966. The total ICA is 3,117 ha. The main cropping season is Rabi and accounts for about 2,500 ha of the total ICA. The length of RBC and LBC is 29 km and 9 km and the ICA under them 2,307 ha and 809 ha ICA respectively. Lifting of about 20% is allowed from the dam storage – 6% under the regular quota and 14% under the drip scheme. The dam site, water storage, RBC, LBC and the command area are shown in the map given at the end of the chapter as Map 3-3.

Fig. 3.2: A view of the Mangi RBC, LBC and emergency outlets. The Mangi dam was started as part of famine relief work as early as in 1897. The work was subsequently abandoned, taken up again in the drought year of 1926, again abandoned, taken up again in 1952 and this time completed in 1955.

Proposals for the renovation of the distribution system as well as a proposal to raise the height of the dam have been prepared by the officials. In the proposal for the renovation of the distribution system it is mentioned that though the ICA is 3,117 ha, the area that can be actually irrigated is only 1,212 ha which comes to about 39% of the ICA which is a very low irrigation intensity. The proposal for increase in the height is also pending because the data given in the height increase proposal shows that inflow into the tank has decreased because of the development in the catchment. About 13 percolation tanks (PTs) and one MI tank have already come up in the catchment of the Mangi project. Many check dams and various other soil conservation measures have also been taken up in the upstream. Hence it is proposed that one TMC of water be supplied from the Kukadi project using Mangi as a feeding tank/pond. The proposals have not yet been sanctioned.

The salient features of the Mangi project are given in Table 3.3 below.

So far no WUAs have come up on the Mangi project. However efforts are on to form the WUAs and at least 2 WUAs are under different stages of formation.

***<u>Table 3.3</u>*: Salient features of the Mangi Irrigation Project**

No.	Item	Detail
1.	Catchment area	304.97 sq km
2.	Average Annual Rainfall	500 mm
3	Type and Length of Dam	Earthen 1475 m
4	Maximum Height of Dam	22.60 m
5	Storage	
	Gross	33.77 mcum
	Dead	1.07 mcum
	Silted Contents	2.01 mcum
	Live	30.69 mcum
10	Length of waste weir	240 m
11	Maximum discharge over waste weir	2,243.68 cumecs
12	Canal length and capacity	
	LBC	10 km and 0.85 cumecs
	RBC	27 km and 3.12 cumecs
13	Area under command	
	GCA	4,646 ha
	CCA	4,048 ha
	ICA	3,117 ha

Fig. 3.3: The Walen dam.

Minor irrigation project : Walen

Walen Minor Irrigation Tank is located in Mulshi taluka of Pune district. The project consists of an earthen dam across Walki river which is a tributary of the Mula river in the Krishna basin. Originally planned to irrigate 270 ha, the tank is now designed to store 5.11 mcum and irrigating 918 ha. It has a mixed cropping pattern of Kharif and Rabi. The single canal on the left bank is 3.10 km long, has 11 outlets and a discharge capacity of 10.47 cusecs. The command area mostly falls in Walen village. The dam site, water storage, canal and command area are shown in the map given at the end of the chapter as Map 3-4.

The salient features of the project are given in Table 3.4 below.

Table 3.4*: *Salient features of the Walen Irrigation Project

No.	Item	Details	
		Original plan	**Revised and approved plan**
1	Location	Walen	Walen
2	Longitude	18^{o} 35'	18^{o} 35'
3	Latitude	73^{o} 73'	73^{o} 73'
			Table 3.4 contd.
4	Name of Stream	Walki	Walki

No.	Item	Details	
		Original plan	Revised and approved plan
5	Nearest Village	Walen	Walen
6	Catchment Area	1.75 sq miles	1.75 sq miles
7	Nature of catchment	Good	Good
8	Average Monsoon Rainfall	56.23" (Poud Station)	85.23" Kolwan Station)
9	Yield Per sq. Miles as Per Storage's Table	72.83 mcft/sq mile	72.83 mcft/sq mile
10	Total Yield at Site	171.48 mcft	287.59 mcft
11	Net Capacity	65.30 mcft	180.75 mcft
12	Maximum Flood Discharge as Per Inglis Formula	90 cumec	90 Cumec
13	Length of Earthen Dam	330 m	510 m
14	Maximum Height of Dam	20.75 m	27.76 m
15	Top Width of Weir	3 m	3 m
16	Full Supply Level	108.00 m	115.30 m
17	Maximum Water Level	110.00 m	117.30 m
18	Length of Canal	3.00 km	3.5 km
19	Discharge Capacity of Head	10.47 cusec	10.47 cusec
20	Gross Command Area (GCA)	423.43 ha	1177.50 ha
21	Culturable Command Area (CCA)	338.75 ha	942 ha
22	Irrigated Area and Proposed Crop Rabi - 80%, Kharif - 20% (ICA)	271 ha	918 ha
23	Cost Of the Project (Rs.)	1,68,74,056/-	5,47,69,841/-
24	Cost/ha of Area Irrigated (Rs.)	62,266/-	72,639/-
			Table 3.4 contd.
25	Cost/mcft of Gross Storage (Rs.)	2,60,977/-	4,71,788/-
26	Benefit Cost Ratio	1.5	1.60
27	Area Submerged	30.10 ha	57.00 ha

The water users have already decided to form a WUA to take over the management of the system. They have constituted the promoters body and are in the process of completing the necessary procedures and documentation required for registration.

The Selected Sub-commands

Mula Project

Ten sub-commands were selected from the command of the Mula Project. The Mula command was the most complex and also the most clearly divided into head, middle and tail reach. The list of the sub-commands is given in Table 3.5 below and the location of the sub-commands is shown in the map given as Map 3-5.

***Table 3.5*: Details of sub-commands selected in the Mula Project**

No.	Location	Abbreviation	Reach
1	Minor-1 on Distributary-1 on Branch Canal 1	Dy1M1	Head Reach
2	Tail portion of Distributary-2 on Branch Canal 1	Dy2Tail	
3	Minor 3L on Sonai Distributary on Branch Canal 1	SDyM3L	Middle Reach
4	Minor 9 on Distributary-1 on Branch Canal 1	Dy1M9	
5	Minor 1 on Distributary-4 on Branch Canal 1	Dy4M1-WUA	
6	Minor 1/1 on Distributary-5 on Branch Canal 1	Dy5M1/1	
7	Minor 3 on Distributary-1 on Branch Canal 2	Dy1M3	Tail Reach
8	Minor 5 on Distributary-3 on Branch Canal 2	Dy3M5	
9	Minor 4 on Tail distributary	TdyM4	
10	Direct Minor 10 on Pathardi Branch Canal	PBCDM10	

Of the 10 selected sub-commands, the first two are in the head reach, the next four are in middle reach and the last four are in tail reach of the project. While selecting the sub-commands, they were selected so that within the reach too the selected sub-commands were well distributed and captured the different situations within the reach and the project. Thus, in respect of distribution over the sub-divisions, the first two (Dy1M1 and Dy2Tail) fall in the Rahuri sub-division, the third one (SDyM3L) falls in the Ghodegaon sub-division, the next three (Dy3M5, Dy4M1-WUA, Dy5M1/1) in the Newasa sub-division, the next two (Dy1M3 and Dy3M5) in the Kukana sub-division and the last two (TdyM4 and PBCDM10) in the Amarapur sub-division. Within the reach,care was taken to cover the range from head to tail portion within the reach. Two sub-commands with Water User Associations were included. These are the Minor 1 on Distributary-4 (Dy4M1-WUA -- Renuka Mata WUA) and Minor 5 on Distributary-3 (Dy3M5 -- Shiv Shakti WUA).

Mangi Project

Eight sub-commands were selected from the Mangi Project. The list of the selected sub-commands on Mangi Project is given in Table 3.6 below.

***Table 3.6*: Sub-commands selected from the Mangi Project**

No.	Location	Abbreviation	Location
1	Direct Outlet 3	DO3	RBC
2	Distributary 2	Dy2	
3	Direct Outlet 20	DO20	
4	Distributary 7	Dy7	
5	Direct Outlet 50	DO50	
6	Direct Outlet 5	DO5	LBC
7	Distributary 2	Dy2	
8	Direct outlet 20	DO20	

Out of these eight commands the first five are on the longer RBC and the other three are on the shorter LBC. Here too care has been taken to see that the sub-commands are well distributed within the head to tail portions of the command. The locations of the selected sub-commands are shown in the command map given as Map 3-6.

Walen Project

Walen project being a minor project serves only a single village and the entire command has been included in the study.

The villages in which Focused Group Discussions were held

Focused Group discussions were held in one to three locations and covered one or more villages or *bastis* (hamlets) at each location. The list of the villages covered is given in Table 3.7 below.

***Table 3.7*: Villages covered through FGDs**

Project	Sub-command	Villages
Mula Project	Dy1M1	Pimpri Avghad Kondhwad Shilegaon
	Dy2Tail	Kendale Budruk Kendale Khurd Chandakpur
	SDyM3L	Sonai
	Dy1M9	Khupti
	Dy5M1	Babhulkheda
	Dy4M1	Khadke
	Dy1M3	Jeur Haibati
	Dy3M5-D	Mathachi Wadi (Sultanpur)
	Dy3M5-WUA	Bhavi Nimgaon
	TDyM4	Dhor Jalgaon
	PBCDM10	Chitli Burhanpur
Mangi Project	RBC -- DO3, Dy2, DO20, Dy7, DO50, and LBC -- DO5, Dy2, DO20	Pothre Mirgavhan Khambewadi Arjunnagar Nilaj
Walen Project	The entire command	Walen

Chapter 4

Findings – The Mula Project

4.1 The Project as a whole

4.1.1 Inflows at the dam site

One of the possible reasons contributing to deprivation within canal commands are shrinking inflows at dam sites resulting in reduced storages and consequent reduced availability of water. One of the possible reasons for this is the watershed development work that has gone on in the catchment. Watershed development work tends to reduce run off -- in fact, reduction of run off in downstream reservoirs is one of the indicators of its success. It also results in greater local utilisation of water. All this has a possibly small but distinct effect of the regime of large catchments that contain the watersheds.

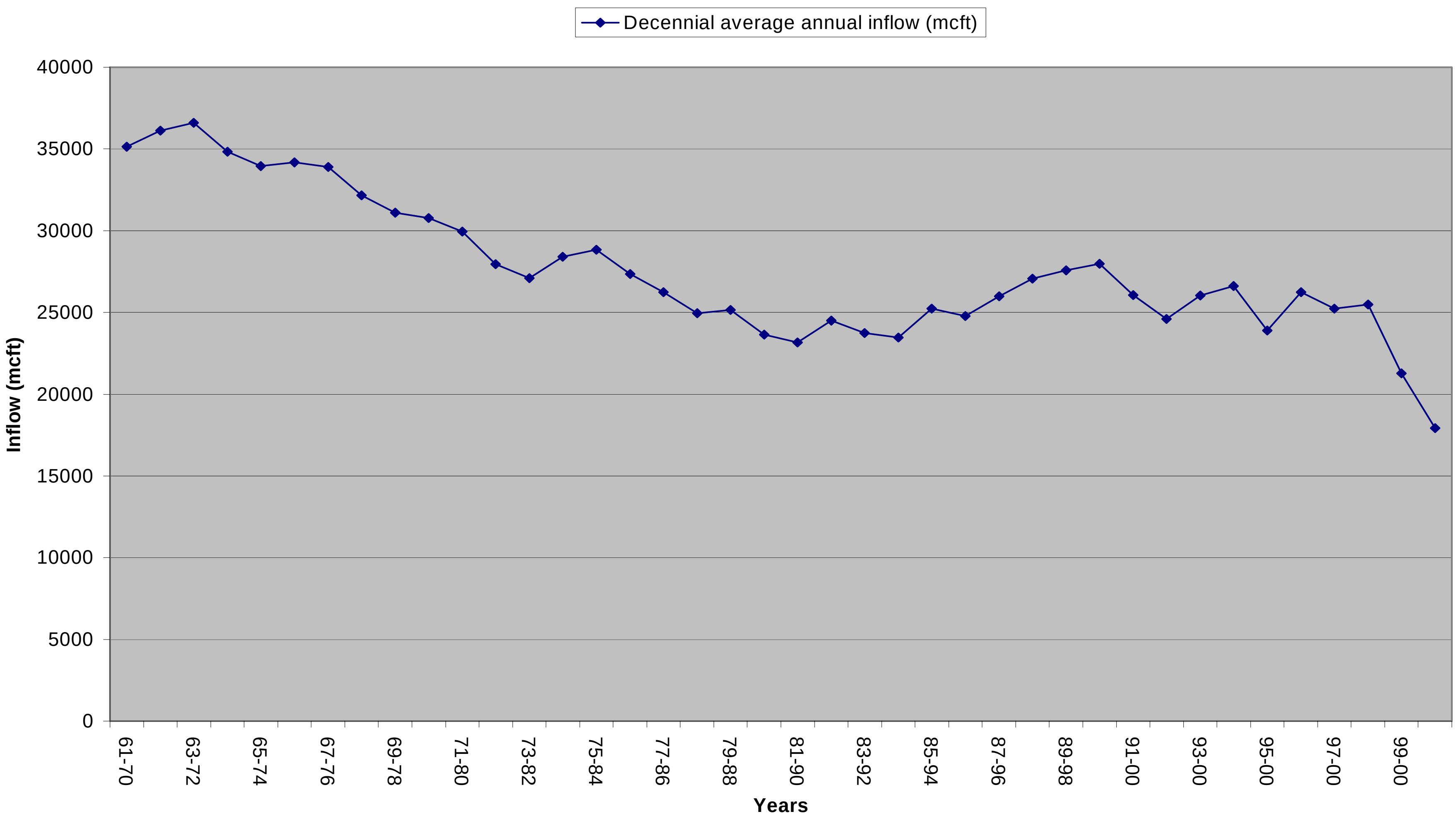
This phenomenon has not as yet been conclusively proved in the absence of systematic observations and critical analysis. Some experts hold the view that catchment treatment or watershed devlopment may initially reduce the monsoon inflows, but this is likely to be made up by substantial regeneration flows during the post monsoon period.

This should not to be construed as an argument against watershed development, which is a first step towards the development of water resources in a manner that can provide minimum water assurance for all in the rural areas. The important thing is to realise that watershed development, or more accurately, micro-watershed development, may seem a micro-phenomenon but it has definite macro effects that need to be taken into account during the planning and management of larger projects.

What can we say in this respect about Mula project inflows? Inflows are available for years 1961 through 2000 for 40 years. (See Table 4.1) However, the annual variation tells us very little about a trend. Ten-year moving averages were therefore computed for this period (tapering off into the remaining year's averages for the last ten years) and are presented in Table 4.2 and Chart 4.1 below. We may see a distinct trend towards reduced inflows, though the trend is somewhat heightened by the last few bad rainfall years. In short, there is reason to believe that there is a trend towards reduction of inflow at the dam site.

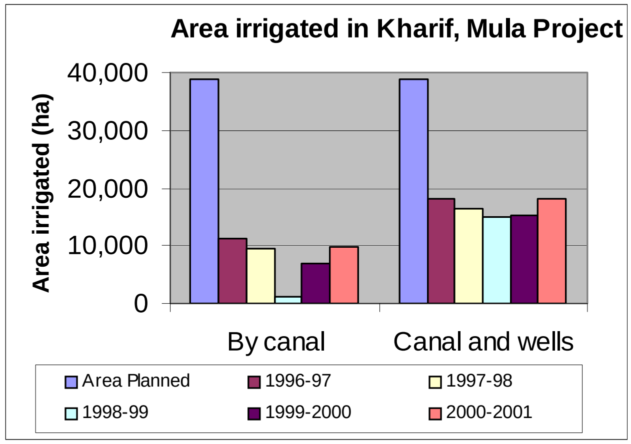
How far does this trend affect the Mula system? The Mula system has been planned for a gross utilisation of 22,500 mcft. In respect of that, it may be seen that despite the trend towards reduction in only eleven of the forty years for which data have been presented does the inflow fall below this value. However, even within these years, over the last twenty years, the inflow has fallen below this value in nine years as compared to only two consecutive years in the earlier twenty year period. That implies that for 45% of the latter twenty years the system has been receiving inflows less than the planned gross utilisation.

Chart 4.1 : Decennial average annual inflow at Mula dam site

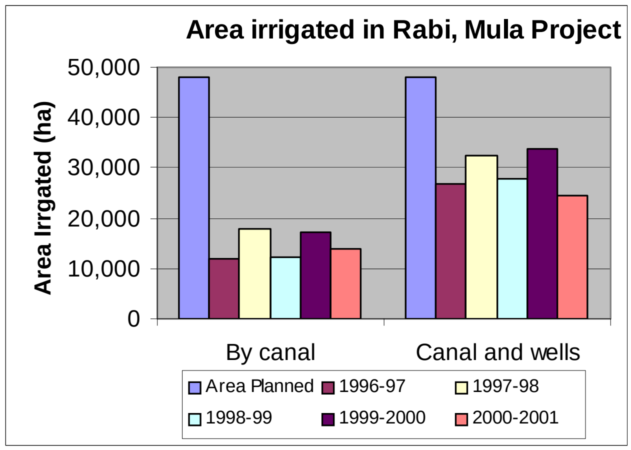


4.1.2 Area irrigated by canal and wells

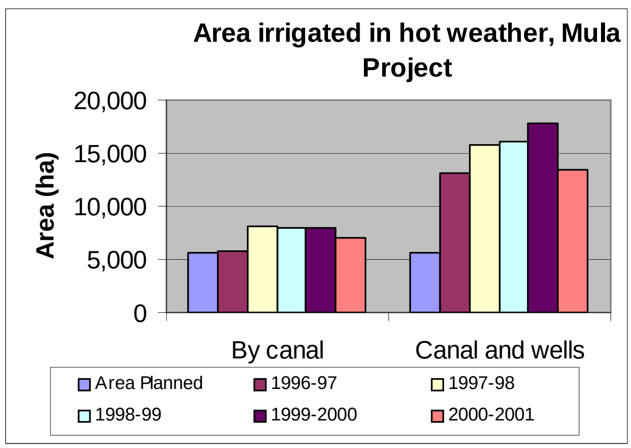
How much of the area is irrigated by canal? How does it compare with the area that had been planned to be irrigated by the project? These are questions important in determining how severe a constraint present use level and pattern places on the degree of deprivation within the command. These data are presented for the project as a whole in Table 4.3.



The data show that the kharif area irrigated by canal fluctuates around 25% of the planned kharif irrigation; similarly the rabi area irrigated by canal varies between about 25 and 35% of the planned rabi irrigation. In contrast, the hot weather area irrigated by canal varies from 45 to as much as 145% of the planned hot weather irrigation. In short, the data show a marked difference between the seasons, so far as proportion of planned irrigation is considered. It indicates that around 75% of the area planned in kharif and between 65 and 75% in rabi does not receive canal water.



However, availability of water in the reservoir and rainfall in the command also need to be taken into consideration while comparing actual irrigation with planned irrigation. Kharif utilisation is planned mainly from the run of the river. If there are goo rains, there is no demand for kharif irrigation; in case of failure of rains there is.



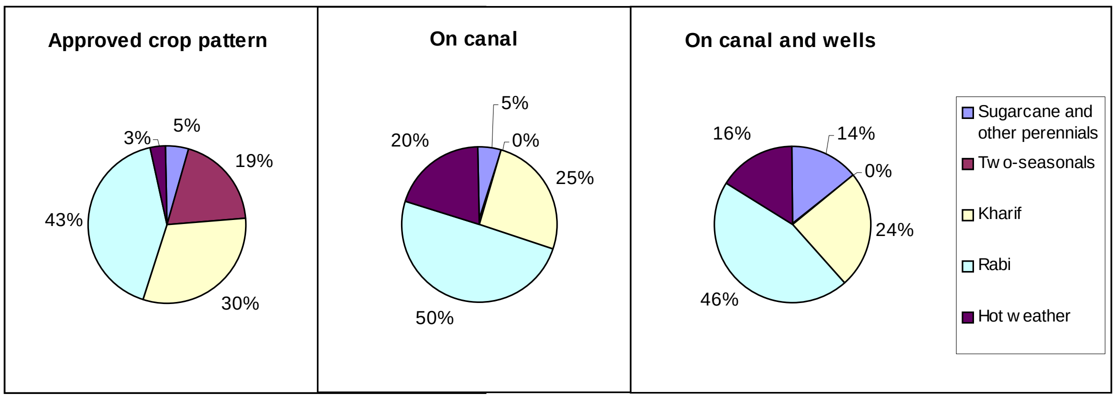
Also, these figures need to be modified in the light of the well irrigation data. It is well known that wells in the command are dependent in the large part on groundwater recharge by canal, hence some of the portion not served directly by canal may receive canal water indirectly through the wells in the command area. The simplest way to assess this effect is to add the area irrigated by wells to the area irrigated directly by canal.

If we take well irrigation into account in this manner, we may see that the area irrigated in kharif now comprises between 40 and 75% of the planned kharif irrigation; that for rabi comprises between 65 and 75% of planned rabi irrigation. In the meanwhile, the hot weather irrigated area rises steeply and comprises between 225 and 325% of the planned hot weather irrigation. This is a trend that we shall see corroborated at the micro level within the project as well.

4.1.3 Crop pattern

A glance at the crop pattern bears out the trends identified above. It may be seen that while the proportion of sugarcane and other perennials in the crop pattern has been kept at a figure close to the approved crop pattern, the proportion of perennials in the well irrigated area is substantially high. In terms of the demand for water created witjhin the command, it of course has serious implications, and it would create severe stress on a system not designed to handle this kind of demand. (See Table 4.4.).

Note: Readers may notice that in the tables that follow, project level figures show no two season crops



taken on canal water, but the data for the minors and distributaries do show a small percentage of area under these crops. The data at the project level have only a categorywise break up and do not have a cropwise break-up while the minor and distributary level data have been given cropwise rather than categorywise. The small deviation is probably due to differences in classification of crops.

4.2 The Head Reach

The Rahuri Sub-division may be taken to comprise the head reach of the project. We selected two sub-commands located on two minors in the head reach. The first one was the Minor 1 on Distributary 1 (Dy1M1). Distributary 1 is the first distributary on the RBC in the Mula command. Minor 1 takes off from the Distributary 1 within its head reach. Dy1M1 has an irrigable command of 345.58 ha that is spread over the three villages of Pimpri Avgadh, Kondvad and Shilegaon in order of head to tail on the minor. The second one was the tail portion (beyond Outlet 09L) on the Distributary 2 (Dy2Tail). Distributary 2 ia a fairly long distributary situated in the middle reach of the sub-division . The total irrigable command on Dy2Tail portion is 444.92 ha spread over the three villages of Kendal Budruk, Kendal Khurd and Chandkapur in the head to tail order. The Dy1M1 and Dy2Tail portions were chosen to represent the head and tail reach within the head reach of the system.

4.2.1 No. of farmers drawing water from the canal

Since we were in the head reach and water being relatively plentiful we expected that many more farmers would be receiving water. However, data provided by the department officials show that the proportion of farmers who have been drawing water from the canal is quite low.
On Dy1M1, in the last three years, about 15 % irrigators drew water from the canal in the kharif season in two out of three years (in 98-99 there was no water released in kharif). In the rabi season, only around 25 % of the irrigators drew water from the and about 15% drew water in the hot weather season (see Table 4.5a). On DY2Tail, the corresponding figures were: about 17 % irrigators in kharif in the two years, 18 to 33 % in the rabi and 11 to 24 % in the hot weather season drew water from the system (see Table 4.6a).

4.2.2 Portion of command drawing water from the canal

The area that has been irrigated directly from the canal has been compared with the ICA as planned on the basis of the approved cropping pattern for the project. This comparison shows that on Dy1M1, the area being irrigated from the canal in the kharif season was 18 to 21 % of the planned area, and between 25 and 30 % in the rabi season. However, the most significant figure was the one for the hot weather season, when the area actually irrigated by the canal was between 70 to 160 % of the planned area. Corresponding figures for Dy2Tail are: just under 6 % of planned area in the kharif season, 5 to 8 % in the rabi and between 25 and 50 % in the hot weather.

4.2.3 Taking wells into account

The figures given above relate only to the reported area irrigated directly from the canal. As discussed, we should take into account the effect of wells in the command. If we add the area within the command served by wells, the picture is substantially modified. It shows that on Dy1M1, the combined area being irrigated from the canal and by wells, in the kharif season was between 70 and 85 % of the planned area, and between 85 and 96 % in the rabi season. Moreover, in the hot weather season, the area actually irrigated rises to between 450 and 500 % of the planned area! Corresponding figures for Dy2Tail then become between 35 and 40 % of planned area in the kharif season, about 45 % in the rabi and between 250 and 300 % in the hot weather.

4.2.4 Water in the wells has become saline

Discussions with the ID officials at Rahuri Sub-division and the interaction with the farmers during the WTS and FGD shows that almost all the wells in the command within this sub-division has gone saline. People report that before the Mula project came the wells had good quality water. However within 5-6 years of Mula Project, the wells started going saline and by about 1980 most of the wells became saline.
As a result of this:

1) the cropping choices have shrunk as only very few crops like wheat, fodder, etc., can tolerate salinity; and
2) the productivity of sugarcane has come down drastically to about 10 to 15 T/acre.

The general productivity of sugarcane in normal conditions is about 40 to 50 T/acre. When asked why farmers take sugarcane in spite of such low productivity, the answer was that sugarcane gives them easy access to crop loan. In fact, the farmers get only two rotations in rabi from the canal and for the rest they have to manage with the water from the wells. This is another type of deprivation encountered in the head reach of the project throughout the Rahuri sub-division. The exact reason for this is not very clear, but this probably has something to do with characteristics of the deep black cotton soil prevalent in the command area of this sub-division and excessive use of canal water in the initial stages of the project.

4.2.5 Some general findings

The main finding here is that as soon as we take into the effect of wells in the command, the apparent degree of deprivation is modified substantially. Similarly, there is a disproportionate shift in the utilisation in favour of hot weather utilisation, which rises to a level many *times* that originally planned for the project.

4.2.6 Cropping pattern for the canal water

The actual cropping pattern for the land receiving water from the canal is fairly close to the approved pattern, whether by manipulation or by design. However, the pattern of crops irrigated by wells is disproportionately weighed towards hot weather crops, the water guzzling sugarcane accounting for about 15 % instead of 5 % as planned in Dy1M1, though it is close to its planned proportion in Dy2Tail. (See Tables 4.5b and 4.6b.) This causes severe deprivation in other parts of the command.

4.2.7 Physical state of the system

The system, expectedly, has fallen into disrepair and by all reports the degree of disrepair is rapidly increasing. There have virtually been no allocations for repair and maintenance since the formation of the Godavari Marathwada Irrigation Development Corporation (GMIDC).

On Dy1M1, of about 4.5 km of channel length, just under 4 km is functional, more than half a km of the tail portion is completely non-functional. The off-take structure from Dy1 at the minor head is standing, and the gate is functioning, though the SWF is not. Of the 11 outlets in the functioning stretch of the channel, five have functioning gates. However, even here, except for the gate portion, all other portion of the construction is crumbled down. Four of the outlets on the right are not functioning at all. Farmers have constructed roads across the channel in at least four places in this stretch. The canal has been breached at least 13 places. The CI informed us that this has been done `with permission' since the field channels were not functioning. At one point, where we are about to enter Shilegaon, farmers complained about stormwater flowing into the canal and heavy siltation of the channel. On the CI's own admission the canal has lost a lot of its earlier capacity.

On Dy2Tail, of the three villages supposed to be served by the tail portion, one, Chandkapur, is completely un-served. The last 2 km of the channel are not functioning. Encroachments have narrowed the channel and the channel is overgrown with weeds and the ubiquitous prosopis juliflora. Outlet 9L where the portion begins stands in disrepair. The other 4 outlets downstream are also in the same condition. One of them is completely blocked and a breach by its side functions as the outlet. There are at least five `with permission' breach on the canal. At one point, a farmer who is supposed to be served by Minor 3, draws water from a breach since he cannot do so from that minor because the

Fig. 4.1: Can you identify the outlet gate in this photograph on DM10 of Pathardi Brach Canal? What looks like a rubble heap in the centre is what was once a proper outlet gate. This not an uncommon sight within the Mula command.

field channels do not function, of course, `with permission' as the CI assured us.

4.2.8 Focused group discussions

There were four group discussions conducted. The first one was held at Pipri Avghad on Dy1M1 and attended by about 35 farmers. The other discussion was taken in Kondhwad and was attended by about 45 farmers from Kondhwad and Shilegaon on Dy1M1. On Dy2Tail, the one at Kendale Budruk (head reach) was attended by more than 40 farmers, including the Dy. Sarpanch and Panchayat members and village elders. The other one at Kendale Khurd was attended by about 40 farmers from the village as well as another 10 from the deprived Chandkapur village, both on Dy2Tail.

The following points were reported by farmers during the discussion

Pimpri Avghad (Dy1M1)

- Half or more of the farmers in the command do not bother to apply for water. The reasons given are
    - They get far less than the number of waterings they require. On top of that they have to pay the full charges for the season.
    - Many of them have adequate water from the wells, so they do not need the canal water.
    - There is need for water in the tail portion, but water cannot reach them because the capacity of the minor is insufficient.
    - There are about 10% farmers who do not get water in spite of applying for it because field channels have not been maintained.
    - About 30 % do not apply because they are defaulters.
    - Maintaining field channels is the farmers' responsibility but they cannot afford it and the farmers in the higher reach do not co-operate.
    - Many times one can receive water without applying. It is possible to apply for one crop and receive water for a more intensive crop. The bribes cost much less than the assessment. So many prefer not to apply.
- No one ha s bothered to complain because all have wells. On this minor at least, everyone has access to water: those who do not have access to canal water have access to wells or to other lifts from the river.
- The number of rotations have decreased since the formation of the GVDC.
- They thought that a Water Users' Co-operative was a good idea but the Chairman needs to be someone from the tail, only then will the tail-enders receive water.
- Only sugarcane, cotton, wheat and *ghaas* are taken because other crops do not grow well because of salinity.

Kondhwad and Shilegaon (Dy1M1)

- About 10% of the farmers do not get water for more than 5 years. Mainly because they are defaulters.
- About 25% have not bothered to apply this year. They are at the tail and do not get water because the field channels have not been maintained.

- The number of rotations is far too inadequate. About 50 farmers in the command area do not have access to water, i.e., do not get water from the canal and also do not have access to any other source of water. The rest have access to wells.
- No use complaining to the leaders or the representatives because they are the ones who have land in the head reach. They take plenty of water for their crops.
- Some attempt was made to form a Water User Society. More help needed from the government. Formation of a society may not solve the problem, instead may strengthen the hands of the political leaders.
- Only sugarcane, cotton, wheat and ghaas are taken because other crops do not grow well because of salinity.

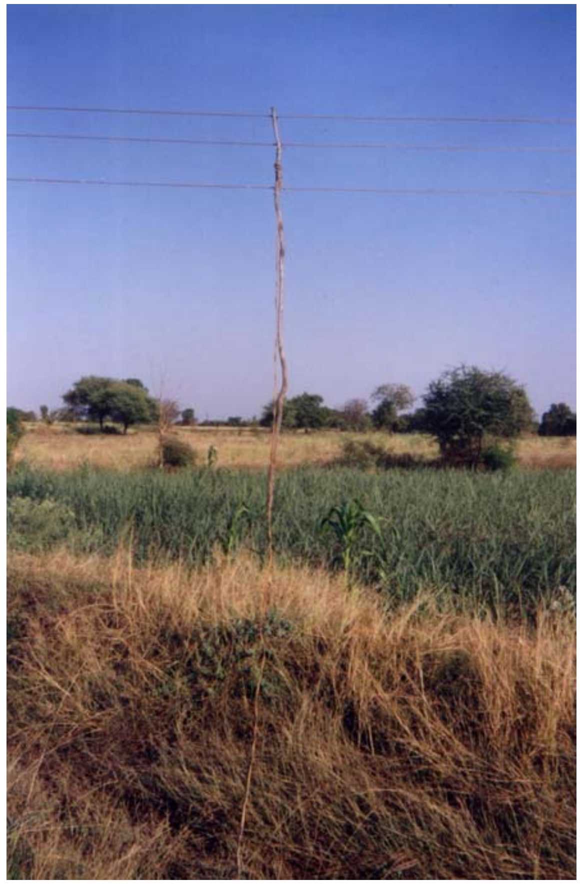


Fig. 4.2: The `aakdi', the system of throwing three hooks on to the live line to draw electricity, is not an uncommon

Kendale Budruk

- Farmers do not apply for all of the area in the command to save on water charges.
- About 50% do not bother to apply.
  Since almost 80% have access to well irrigation or to lifts from the river. Also they can take water from other farmers.
- The number of rotations is far below the number required by the crop. Nevertheless full charges have to be paid for the entire season.
- Farmers have encroached on the field channels, so the tail-enders do not get water. So they do not bother to apply.
- Many well owners apply because well water has turned saline after the project came into existence and they need freshwater supplements for their crops, especially sugarcane.
- Only sugarcane, cotton, wheat and *ghaas* are taken because other crops do not grow well because of salinity.
- If rotations are on time and in sufficient number other crops can also be taken.
- Some people tried to complain, but CIs were not responsive and after a time they just stopped bothering.
- Water has become saline and the yields, especially of sugarcane have declined.
- Earlier there used to be at least five rotations per season. Now it is very difficult to have even five rotations in the whole year.
- Almost 50% of the area is out of service because field channels have not been maintained.

Kendale Khurd and Chandkapur

- At most 20% apply. The rest do not because of the following reasons:
- For the last five years the tail portion has not received water. The distributary itself has lost capacity and the field channels are also not maintained.
- Most of the farmers in the tail portion have stopped even expecting water to reach them. They no longer bother to apply. Because there is no demand water is not released and maintenance not carried out. And this goes on.
- Most people now rely on wells. Other farmers seek a share from the wells rather than from the canal.
- Farmers who fall into arrears stop applying after a while and drop out. Because the rule now is that the entire outstanding and the current season's charges have to be paid in advance before water can be released. Many defaulters prefer not to pay.
- About 15% take water illegally. They apply for one crop but use it for a higher water demanding crop.
- For example, you would apply for wheat area but use it for sugarcane. Some bribe has to be paid to the CI.
- Earlier we used to complain if we applied for water but did not receive it. Since we found that the complaints were not heard, we stopped bothering.
- The department should repair all field channels.
- They should concentrate on releasing water from tail to head.

4.3 The Middle Reach

The Ghodegaon and Nevasa Sub-divisions may be taken to comprise the middle reach of the project, in that order. We selected four command portions in this middle reach. The first one was Minor 3L on the Sonai Distributary (SdyM3L) that takes off from the canal almost as soon as it enters the Ghodegaon sub-division; it serves mainly the village Sonai after which the distributary is named. It may be taken to represent the situation close to the head reach within the middle reach. The second portion selected is that served by Minor 9 on Distributary 1 in the Nevasa sub-division (Dy1M9) and lies in the Khupti and Nevasa villages. The third selected portion is that served by Minor 1 on Distributary 4 and is turned over to a water users society, The Shivshakti Water Users' Society (Dy4M1-WUA) lying in village Khadke-Jalke. The fourth selected portion is that served by SubMinor 1/1 on Distributary 5 (Dy5M1/1) and lying mainly in village Babhulkheda. The latter three portions are fairly closer to the tail portions within the middle reach.

4.3.1 No. of farmers drawing water from the canal

On SDyM3L, the number of farmers receiving water varied from 20 to 30% for kharif, from 30 to 40% for rabi and 11 to 30% for hot weather season. On Dy5M1, the corresponding proportions were 3 to 13%, 6 to 16% and 4 to 9% for the three seasons. On Dy1M9 practically no one received water; only 2.5 to 3% received water for two years. Interestingly, on Dy4M1 with a functioning WUA, the farmers receiving water comprised 1 to 17% for kharif, 17 to 78% for rabi and 38 to 50% for hot weather. In spite of being in the middle if not the tail portion, the access is better than that on SdyM3L in the head portion. (See.4.7a through 4.10a.)

4.3.2 Portion of command drawing water from the canal

On SDyM3L, in comparison with the planned ICA on the basis of approved crop pattern, the area receiving water varied from 1 to 35% for kharif, from 20 to 35% for rabi and 55 to 125% for hot

Fig. 4.3: A farmer on the Sonai Distributary installed, not just a pump, but a submersible pump within the minor.

weather season. On Dy5M1, the corresponding proportions were 5 to 20%, 10 to 20 % and 25 to 80% for the three seasons. On Dy1M9, as noted earlier practically no one received water; only 11.5% planned area received water in rabi for two years. On Dy4M1 with a functioning WUA, the corresponding proportions were 5 to 10% for kharif, around 35% for rabi and 150 to 250% for hot weather. Here again we see Dy4M1 comparing very well with SdyM3L. (See Tables 4.7a through 4.10a.)

4.3.3 Taking wells into account

Taking wells into account, the figures for proportion of planned area receiving water expectedly improve: on SdyM3L -- 60 to 175% for kharif, 45 to 60% for rabi, and 230 to 300 % for hot weather; on Dy5M1 – 20 to 40% for kharif, 20 to 30% for rabi and 95 to 140% for hot weather; on Dy1M9 too there is a marginal increase – 8 to 20% for kharif and 40 to 55% for rabi in two out of the three years; and on Dy4M1 – 20 to 25% for kharif, 45 to 55% for rabi and 250 to 315% for hot weather, again showing a performance on par, if not better, than SdyM3L in the head portions.

4.3.4 Some general findings

Here too we see that taking into account the effect of wells in the command, the apparent degree of deprivation is modified substantially and there is a disproportionate shift in the utilisation in favour of hot weather utilisation, which rises to a level many *times* that originally planned for the project, though the rise is not as pronounced as in the head reach.

Also, the performance of Dy4M1, with a WUA, compares well with that of SdyM3L which is situated within the head portion the canal as compared to Dy4. This is especially apparent in respect of access in terms of number of farmers receiving water.

4.3.5 Cropping pattern for the canal water

The shift to hot weather demand is also apparent here and the trend seems to be related to better access: better access leading to a larger shift. (See Tables 4.7b through 4.10b.)

4.3.6 Physical state of the system

On the SdyM3L, The SWF and the gauge off take from the distributary is fully silted and is not functioning. The structures have broken down and shrubs and weeds have taken over much of the off-take portion. All outlets are makeshift and regular structures are all broken. Besides the makeshift official outlets, there are at least 9 places where the channel has been breached `with permission'. The department has stopped all repair and maintenance work since the formation of the GVDC. However, it should also be noted that the farmers took up a contribution, hired an excavator and cleared and repaired almost 75% of the minor length last year. Right at the beginning one of the farmers has installed a submersible pump and draws water for his wheat crop in the un-command area. About mid-way, another farmer pumps water directly from the minor for his wheat and sugarcane crop.
On Dy1M9, the minor resembles a patch of wasteland: the channel has silted up and the minor and its sidelengths are taken over by profuse vegetation – bushes, shrubs and grasses and towards the end sturdy babhul trees. For the last two years, the minor has not received any water. Dy1M9 forms the tail portion of Dy1.
Dy4M1 has a functioning WUA. The minor is much better maintained. The gates and gauges are – both --functioning. The gates on the outlets are in place, though as usual, many are missing rods and peripherals. The falls seem to be well maintained too. At one point where a road has been built by the farmers across the minor, care has been taken to install a pipe for the minor.
On Dy5M1, the subminor has its first three gates intact and functioning. However, from there onwards, the condition rapidly deteriorates. Though the gates are still intact, the channel is in the process of being colonised by the ubiquitous shrubs, prosopis and babhul. Water rarely flows past the third gate, so except for two or three places there are no breach, with or without `permission'.

4.3.7 Focused group discussions

There were four group discussions conducted, one in each of the selected command portions. The one held at Sonai on SDy1M3L was attended by about 10 farmers. The one at Khupti on Dy1M9 was attended by about 25 farmers. On Dy5M1 the meeting at Babhulkheda was attended by 70 farmers. On Dy4M1, at Khadka, the meeting was attended by about 15 farmers from the WUA, the Shivshakti Water Users Association.

Sonai (SdyM3L)

- This year everyone got water, and does get it every year.
- Almost 25% of the farmers do not apply since they can get water by other means (literally as reported `they can steal water').
- There are a number of defaulters. The exact number is difficult to assess.
- The soils are black and heavy and this has created its own problems. Almost 90% of the land has turned saline. And about 40% of the land remains waterlogged for almost a month.
- Every farmer in the command has access to either a dug well or a borewell.
- For the last five years farmers have been collecting contributions and repairing the Minor every year.
- The water should be delivered by pipeline to avoid all these problems.
- If a society is to be formed, the water charges should be deposited with the department, so the society will not go into deficit. The society should only take over the actual operation of the system.

Khupti (Dy1M9)

- For the last three years no one in the command has received any water from the Minor.
- Almost 40% of the farmers have stopped applying since their applications for irrigation for sugarcane were rejected and even when water was delivered the supply was erratic.
- Almost 40% of the area held by about 25% of the farmers in the command is now irrigated from a check dam downstream. They also need water since the water from the check dam is not sufficient and they are ready to pay for it.
- Almost 60% of the rest of the 75% farmer is rainfed since it is dependent totally on the canal for irrigation and the canal does not deliver any water.
- The earlier MLA was more rooted in the village and more concerned. In his times we used to get regular and plentiful deliveries. After the new MLA has been elected things have gone down and now we do not think about canal water at all; it has gone out of our purview. *This was the general consensus in the meeting*.
- About 20% of the people felt that the CIs were earlier more interested to see that the Minor functioned. They used to get the forms filled by us for some crop of the other, and they used to give us water for sugarcane also.
- Two farmers thought that the situation was worse than theft because depending on the canal water and not getting it got you into much more trouble.
- If the Minor functions and water reach the tail, then 90% farmers would again apply for canal water but 60% said they will need assurance and dependability of supply. Last time crop needed water, and the crops failed because water was delivered late.
- When they complained to the department, the department told them that they should settle their arrears, pay the water charges and the department would repair the Minor and deliver water, but they did not believe that the department would be able to do so. So they think it is better not to apply at all.
- A few big landowners had cleared the Minor at their own cost, but again it has been overgrown with babhul shrubs.
- They did not think they should form a society. There was a society on Minor 8, but if there is no water what use was it forming a society?
- They were of the unanimous opinion that the minor should be repaired and water delivered. That would solve the problems. Farmers would once again apply. Even the field channels, which have been neglected now, would be cleared by the farmers themselves.

Babhulkheda (Dy5M1)

- About 35% of the farmers beyond the outlet 3L have not been getting water for the last ten years now.
- About 25% of the farmers in the head portion outlets and about 20% in the tail portion do not apply because they are in arrears.
- Everyone in the head portion of the command of Dy5M1 has access to well irrigation, while about 50% have so in the tail portion.
- For the last two years wheat and sugarcane crops have been fully dependent on well irrigation: only those who have wells can take these crops.

- Three years ago they had complained to the department officials. They found the sub-division, the division officials as well as the officials and the ministers sitting in the Mantralaya were all apathetic.
- They have not tried to improve the system on their own.
- The department must repair the Minor and commence deliveries.
- They knew about the Chanda WUA and other WUAs. They have bitter experiences of the co-operative societies. They think they cannot function because of politics, corruption and the dominance of the rich. The Society should get timely information about the society's quota and the Division's schedule. This will allow them to plan their crops.
- The farmers in the tail are in favour of society because they want water while the farmers in the head reach are opposed. If everyone is assured access they are sure everyone will be in favour of forming a society.

Khadke (Dy4M1)

- Everyone applies and everyone gets water. Every farmer in the ICA is registered with the society.
- There are defaulters: reportedly varying from 90% in the head outlet to 35% in the last tail outlet. But these are current arrears. The society is also in arrears with the department this year. Nevertheless everyone is given water. Then farmers also pay off some of their loans each season.
- Sugarcane area is about 10%. Only those who have access to other sources of water like wells go in for sugarcane.
- Ten per cent of the farmers are dependent on well water.
- It was suggested that water charges should be collected from all wells and borewells too.
- Before the society was formed farmers did not get water even after applying and so everyone got into the habit of not applying at all. Also everyone from the department officials, the rich in the village and the leaders in the area all were opposed to the formation of the society. Leaders and officials were in the forefront in spreading rumours about SOPPECOM who were helping them. Now the Society gets everyone to apply. Defaulters are allowed to settle their arrears in a phased manner. So the farmers now have come to trust the Society and are firmly committed to it.

4.4 The Tail Reach

The Kukana and Amrapur Sub-divisions may be taken to comprise the tail reach of the project. After the portion serving the Nevasa sub-division, the RBC passes a short stretch of uncommand and divides into three branches, the left one serving the Kukana sub-division, the right Pathardi Branch extension and the middle Tail distributary serving the Amrapur sub-division. We selected four command portions in these tail reach, two in the Kukana and two in the Amrapur sub-division. Of the two in the Kukana sub-division the first is the command of Minor 3 on Distributary 1 (Dy1M3) serving mainly the village Jeur-Haibati. The other one is the command of Minor 5 on Distributary 3, which is further subdivided into the area turned over to the Bhavi-Nimgaon water user society (Renuka Mata Water Users Association), and the other still with the department serving mainly the village Mathachi Wadi (Sultanpur) (Dy3M5-D). Of the two in the Amrapur sub-division, the first one is Minor 4 on the Tail distributary serving mainly the village of Dhor-Jalgaon (TdyM4). The other one, the farthest command portion chosen is the command of Direct Minor 10 (PBCDM10) on the Pathardi Branch Canal serving the villages of Pathli, Chitli and Burhanpur.

4.4.1 No. of farmers drawing water from the canal

Dy1M3 received water only in the rabi season and the proportion of farmers receiving water varied from 1 to 10%. Information on the proportion of farmers was not available for Dy3M5-D. On Dy3M5-WUA, the proportion of farmers receiving water was around 15% for kharif, around 25% for rabi and around 15% for the hot weather. On TdyM4 the proportion of farmers receiving water was about 3% for the one year in which water was released into the minor for the kharif season; it was 10 to 15% for rabi and 15 to 30% for hot weather. On the PBCDM10, it was around 15% for kharif, around 25% for rabi and about 15% again for the hot weather. (See Tables 4.11a through 4.15a.)

4.4.2 Portion of command drawing water from the canal

On Dy1M3, the water was received only in rabi and the area receiving water varied from 1 to 9% in comparison with the planned ICA on the basis of approved crop pattern. On Dy3M5-D, the area for kharif was a little less than 20% during the single year when it received water in kharif, varied from 12 to 20% for rabi and 70 to 80% for the hot weather season. On the same Minor in the WUA area (Dy3M5-WUA), the corresponding proportions were about 8%, 5 to 15 % and 35 to 90% for the three seasons. On TdyM4, about 6% of the planned area received water during the single year that saw kharif watering on the minor; and varied between 25 and 30% in rabi and 225 and 250% in the hot weather season. On the PBCDM10, the area receiving kharif watering varied from 1 to 5 % of the planned ICA, from 1 to 15% for rabi and 10 to 75% for the hot weather season.

4.4.3 Taking wells into account

Taking wells into account, the figures expectedly improve: on Dy1M3 -- 60 to 70% for kharif, 110 to 150% for rabi, and 110 to 140 % for hot weather; on Dy3M5-D – almost 40% for the single kharif watering, 25 to 40% for rabi and 150 to 225% for hot weather; on Dy3M5-WUA – almost 15% for the single kharif watering, 10 to 20% for rabi and 50 to 100% for hot weather; on TdyM4, the proportions rise to 30 to 35% for kharif and 50 to 60% for rabi and to 360 to 450% for the hot weather season; and on PBCDM10 – 3 to 10% for kharif, 4 to 20% for rabi and 50 to 105% for hot weather.

4.4.4 Some general findings

Here too we see that taking into account the effect of wells in the command, the apparent degree of deprivation is modified substantially and there is a disproportionate shift in the utilisation in favour of hot weather utilisation. However, both these effects are smaller generally than they are in the head and middle reach of the project. Also higher values of area percentages are not correlated with high values of farmer proportions, indicating that a smaller stratum of farmers is getting a disproportionately larger benefit.

Interestingly, the performance of Dy3M5-D, without a WUA, compares well with that of Dy3M5-WUA, which is the reverse of what would be expected. However, the finding is vitiated by the non-availability of the proportion of farmers receiving water and there is still the possibility that though the WUA has not appreciable increased performance it may have improved the distribution of access. This needs greater study.

4.4.5 Cropping pattern for the command portion

The shift to hot weather demand is also apparent here and the trend seems to be related to better access leading to a larger shift. (See Tables 4.11b through 4.15b.)

4.4.6 Physical state of the system

The condition of all the Minors in the tail portions is extremely bad. On Dy1M3, proper outlets have been virtually abandoned. At least at 6 points on the Minor irrigators have breached the channel and draw water without proper application. At another at least 6 points, water is `stolen’, this generally means that non irrigators draw water from the Minor, obviously without permission. Private pipelines and the channel have merged at a few points. About 7 farmers near the first left outlet have not received water for the last 6 years (their lands are a little higher in the command and loss of capacity has resulted in their being excluded) and no longer bother with applying etc. Another 7 farmers who are tribals near the tail portion have not received any water and they also do not have access to wells or other sources the way others have.

On the Dy3M5-D, the portion of Minor 5 not turned over to the users the state of maintenance is no different. Gates, falls, rods all may be broken or missing. There are at least 16 points at which the Minor has been breached. At one point, an electric pump has been installed in the minor. At another point, the water has been taken into a well and since the farmer did not want the pump in his well to be submerged water is pumped back into the canal! Halfway to the tail, we enter the area turned over to the water users association. The maintenance is a shade better, but not too much better. The members say that the channel was not repaired at the time of handover. There are still patches in which grass and weeds are growing within the channel. There is a profusion of outlets of the rudimentary type (there are 14 of them before the tail portion); but not breach since they have a regular pipe installed for delivery into the fields. Only one of these is in disrepair, the rest are in good order. There still are three or four breach, those `without permission'. The general inference to be drawn is that the present outlets are regularised and improved former breach. This may make sense in the short run, but its value in the long run is dubious.

Fig. 4.4: In some places, farmers have virtually dug shallow intake wells within the canal and installed pumps. Here is one such example we saw at Mathachi Wadi (Sultanpur). Incidentally, just beyond the tree some way downstream that can be seen in the photograph is the area in which a WUA has been formed and such practices are much less.

The Minor 4 on the Tail Distributary (TdyM4) is not very well maintained, shows signs of neglect, but has not fallen into as much disrepair as some of the others. The gauge is not functioning, the banks have breached. There is greater bank damage at many points. There are many points at which the farmers have formed temporary roads across the Minor.

The PBCDM10 deserves to be an exhibit in itself. There are many *nallah* crossings and seepage and leakage into the *nallah*s is reported to be causing heavy losses. Since 1994, the area beyond O3R has not received water. Before O3R, at least 12 electric pumps could be seen installed in the channel. In addition there are two other points at which pipes have been installed and the water is carried by pipeline underground directly into the farmers' wells.

4.4.7 Focused group discussions

There were five group discussions conducted, one in each of the selected command portions. The one held at Jeur-Haibati on Dy1M3 was attended by about 35 farmers. The one at Mathachi wadi (Sultanpur) on Dy3M5-D was attended by about 25 farmers. On Dy3M5 in the WUA portion the meeting was held at Bhavi Nimgaon and was attended by 20 farmers. On TdyM4, at Dhor Jalgaon, the meeting was attended by about 35 farmers. At Chitli, on PBCDM10, the meeting was attended by 22 farmers.

Jeur Haibati (Dy1M3)

- The farmers on the outlet O1L face special problems. They complained that since their lands were somewhat higher, it was getting progressively more and more difficult for them to draw water. For the last two or three years farmers on this outlet have not been receiving water and so no one applies.
- About 20 farmers towards the tail portion do not have access to any other source of water. Most of the others have access to other sources. The proportion of those applying for water is reported to be very low (only 2 from O1R out of 12 and 2 out of 70 on the tail outlet had bothered to apply). Since there are so few applications, there are no defaulters.
- The problem is that anyone who wants water has to practically work down from the Minor head and that involves large cost. Some have done so at the cost of 8900 to 1200 Rs. But the poorer farmers can hardly afford such expenditure; they have to rely on rainfed farming.
- There is prima facie evidence that it is enough if only a few apply because even if a few apply, the Minor will run, and since the soils are light the percolation and groundwater recharge is high, the wells are filled. Only those with no access to wells are hard hit by this.

Mathachi wadi (Sultanpur) (Dy3M5-D)

- About 10% of the farmers have not received water for more than 7 years now.
- Last year no one got water in the hot weather season because the main canal had breached in Ghodegaon sub-division.
- About 10% farmers do not apply because the field channels are not maintained.
- The prospective chairman of the prospective society in this portion said that most of the formalities had been completed, but since there was a society downstream, the minor had to run up to that point and so everyone who applied was getting water anyway. There has been no turnover. There were problems with the AR who refused to register the society because of the lack of a NOC. Later one of the two leaders who were taking the initiative died. Meanwhile the Renukamata society had been formed downstream and everyone is now getting water regularly, so the society process has taken a back seat.
- Almost 90% of the area is served by well irrigation.

Fig. 4.5: This farmer from Mathachi Wadi (Sultanpur) has been as daring as to place a permanent siphon inside the canal with a steel flange and all!

Bhavi Nimgaon (Dy3M5-WUA)

- The last 40% area in the tail portion is still unserved in spite of the formation of the society because the Minor has not been repaired and maintained. The Minor was not repaired before hand over.

- Before the society was formed some farmers received water and some did not and there were disputes. Now everyone (except the tail) gets water on time. No defaulters now. There are still arrears relating to the period before the society was formed and they feel that those have been falsely assessed.
- The society has to clear and desilt the channels and the minor during every rotation. Gates are not functioning well.
- After the formation of the society the society has been getting the rotations as specified in the MoU.
- Complaints have been made to the officials but no one has looked into the matter.
- Only 20% of the farmers in the command are dependent on the canal water. For the rest, some have access to well water and the rest, especially those in the tail portion, have access to the Jayakwadi backwaters.
- The society does not levy charges on wells.
- After the formation of the GMIDC it has been getting more and more difficult to get their due allocations for the society.

Dhor Jalgaon (TdyM4)

- All the farmers present were unanimous in saying that since the Minor had silted up and was not cleared and repaired they do not get water and so do not bother to apply.
- No one beyond O3L can get water because the farmers in the head have not maintained field channels at all.
- About 35% of the farmers on each outlet in the tail portion of each were estimated to be deprived of water from the canal.
- Whenever the Sub-Minor 2R is in operation no one beyond it receives any water.
- About 20% apply for a lighter crop but actually take water for more intensive crops and also irrigate more area than they have applied for. This is done either through force or through bribing the CI. Almost 60% of farmers steal water, i.e., do not even apply but take water nevertheless.
- About 25% were assessed to have been defaulters, hence not receiving water and hence remaining defaulters and so on.
- Last year 90% of the farmers who had applied for sugarcane did not receive water because the 10% took all the water by force. Four farmers' sugarcane was `burnt'.
- About 20% of the farmers are fully dependent on canal water and they can irrigate their fields if the Minor is repaired.
- About 80% of the farmers have wells, of which only a few are perennial; the rest are all dependent on canal recharge.
- Initially complaints were made when water was not received even after applying for it. Later more and more people stopped applying and more and more began to rely on bribing the CI and on `stealing' water.
- Everyone was unanimous in their opinion that the Minor should be repaired and desilted right up to the tail portion.

- Almost 40% of the farmers were in favour of forming a society but the rest were doubtful because they thought that they may be deprived even of the occasional watering that they receive now.

Chitli and Burhanpur (PBCDM10)

- Most of the farmers do not get water since no one beyond O3R gets water. The Minor has silted up and the water does not have sufficient head to cross the O3R portion.
- Water does not go beyond O3R because there are 12 electric pumps installed within the channel and two places at which the water is drawn directly into the farmers' wells.
- Society has been formed, but no turnover since farmers insist on the channel being repaired before turnover.
- One of the Chitli farmers also complained of not having received compensation for the land acquired for the Minor.
- The other village supposed to be served by the Minor is Burhanpur. They received water only during the first year the Minor was run. After that they have not received water. Three years ago, the villagers collected a contribution of Rs. 30,000, engaged an excavator and repaired the channel. They received water during that rotation, but again, from the next rotation onwards, they did not receive any water. Also, the farmers paid their arrears of 70,000 Rs when they applied for this water, but after seeing that they did not receive water even after all this, they have now stopped bothering with applications.

***Table 4.1*: Mula Project Inflows at dam site**

Sr. No.	Year	Inflow at dam site (mcft)
1.	1961	36,125
2.	1962	24,338
3.	1963	29,050
4.	1964	30,110
5.	1965	29,040
6.	1966	32,250
7.	1967	43,850
8.	1968	37,190
9.	1969	39,280
10.	1970	50,190
11.	1971	45,870
12.	1972	29,028
13.	1973	**11,607**
14.	1974	**21,178**
15.	1975	31,389
16.	1976	29,443
17.	1977	26,415
18.	1978	26,724
19.	1979	35,885
20.	1980	41,853

Sr. No.	Year	Inflow at dam site (mcft)
21.	1981	25,930
22.	1982	**20,456**
23.	1983	24,662
24.	1984	25,598
25.	1985	**16,574**
26.	1986	**18,196**
27.	1987	**13,633**
28.	1988	28,781
29.	1989	**20,635**
30.	1990	37,100
31.	1991	39,250
32.	1992	**13,029**
33.	1993	**21,922**
34.	1994	43,078
35.	1995	**12,102**
36.	1996	30,246
37.	1997	24,491
38.	1998	33,913
39.	1999	24,630
40.	2000	**17,930**

Note: The gross annual utilisation planned is 22,500 mcft. Inflows less than 22,500 mcft are shown in bold.

***Table 4.2*: Mula Project Inflows at dam site -- Ten year averages**

Years	Average Inflow at dam site (mcft)
1961-1970	35,142
1962-1971	36,117
1963-1972	36,586
1964-1973	34,842
1965-1974	33,948
1966-1975	34,183
1967-1976	33,903
1968-1977	32,159
1969-1978	31,112
1970-1979	30,773
1971-1980	29,939
1972-1981	27,945
1973-1982	27,088
1974-1983	28,394
1975-1984	28,836
1976-1985	27,354
1977-1986	26,229
1978-1987	24,951
1979-1988	25,157
1980-1989	23,632

Years	Average Inflow at dam site (mcft)
1981-1990	23,157
1982-1991	24,489
1983-1992	23,746
1984-1993	23,472
1985-1994	25,220
1986-1995	24,773
1987-1996	25,978
1988-1997	27,063
1989-1998	27,577
1990-1999	27,976
1991-2000	26,059
1992-2000	24,593
1993-2000	26,039
1994-2000	26,627
1995-2000	23,885
1996-2000	26,242
1997-2000	25,241
1998-2000	25,491
1999-2000	21,280
2000	17,930

***Table 4.3*: Mula Project: Area Irrigated by canal and wells by year and season**

Year	Inflow (mcft)	Season	Area Irrigated (ha)			
			Planned seasonal irrigation	Irrigated by canal	Irrigated by wells	Irrigated by canal and wells
(1)	(2)	(3)	(4)	(5)	(6)	(5) + (6)
1995-96	12,102 (53.79 %)	Kharif	38,879	8,842 (23 %)	20,164 (52 %)	29,006 (75 %)
		Rabi	48,069	12,139 (25 %)	18,545 (39 %)	30,684 (64 %)
		Hot weather	5,655	2,551 (45 %)	10,283 (182 %)	12,834 (227 %)
1996-97	30,246 (134.42 %)	Kharif	38,879	11,296 (29 %)	6,813 (18 %)	18,109 (47 %)
		Rabi	48,069	11,962 (25 %)	14,768 (31 %)	26,730 (56 %)
		Hot weather	5,655	5,751 (102 %)	7,392 (131 %)	13,143 (232 %)
1997-98	24,491 (108.85%)	Kharif	38,879	9,607 (25 %)	6,812 (18 %)	16,419 (42 %)
		Rabi	48,069	17,737 (37 %)	14,607 (30 %)	32,344 (67 %)
		Hot weather	5,655	8,188 (145 %)	7,590 (134 %)	15,778 (279 %)
1998-99	33,913 (150.72)	Kharif	38,879	1,025 (3 %)	13,935 (36 %)	14,960 (38 %)
		Rabi	48,069	12,201 (25 %)	15,535 (32 %)	27,736 (58 %)
		Hot weather	5,655	8,030 (142 %)	8,125 (144 %)	16,155 (286 %)
1999-2000	24,630 (109.46 %)	Kharif	38,879	6,767 (17 %)	8,609 (22 %)	15,376 (40 %)
		Rabi	48,069	17,142 (36 %)	16,710 (35 %)	33,852 (70 %)
		Hot weather	5,655	7,962 (141 %)	9,829 (174 %)	17,791 (315 %)
2000-2001	17,930 (79.69 %)	Kharif	38,879	9,871 (25 %)	8,190 (21 %)	18,061 (46 %)
		Rabi	48,069	14,058 (29 %)	10,581 (22 %)	24,639 (51 %)
		Hot weather	5,655	7,015 (124 %)	6,492 (115 %)	13,507 (239 %)
Average for the six years	23,385 (106.16 %)	Kharif	38,879	7,901 (20 %)	10,754 (28 %)	18,655 (48 %)
		Rabi	48,069	14,207 (30 %)	15,124 (31 %)	29,331 (61 %)
		Hot weather	5,655	6,583 (116 %)	8,285 (147 %)	14,868 (263 %)

Note: Planned seasonal irrigation is based on approved crop pattern in project plan.
Figures in parentheses are percentages of gross annual utilisation planned in column 2 and percentages of planned seasonal irrigation in the others.

***Table 4.4*: Mula Project: Crop pattern in area irrigated by canal and wells by year and season**

Year	Source of irrigation	Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1995-96	Canal	2,423 (13 %)	0 (0 %)	6,419 (34 %)	9,716 (52 %)	128 (1 %)
	Well	9,070 (29 %)	0 (0 %)	11,094 (36 %)	9,475 (31 %)	1,213 (4 %)
	Total	11,493 (23 %)	0 (0 %)	17,513 (35 %)	19,191 (39 %)	1,341 (3 %)
1996-97	Canal	497 (2 %)	0 (0 %)	10,799 (39 %)	11,465 (41 %)	5,254 (19 %)
	Well	5,415 (30 %)	0 (0 %)	1,398 (8 %)	9,353 (52 %)	1,977 (11 %)
	Total	5,912 (13 %)	0 (0 %)	12,197 (26 %)	20,818 (45 %)	7,231 (16 %)
1997-98	Canal	987 (3 %)	0 (0 %)	8,620 (26 %)	16,750 (50 %)	7,201 (21 %)
	Well	4,970 (26 %)	0 (0 %)	1,842 (10 %)	9,637 (51 %)	2,620 (14 %)
	Total	5,957 (11 %)	0 (0 %)	10,462 (20 %)	26,387 (50 %)	9,821 (19 %)
1998-99	Canal	1,025 (5 %)	0 (0 %)	0 (0 %)	11,176 (58 %)	7,005 (36 %)
	Well	5,125 (19 %)	0 (0 %)	8,810 (32 %)	10,410 (38 %)	3,000 (11 %)
	Total	6,150 (13 %)	0 (0 %)	8,810 (19 %)	21,586 (46 %)	10,005 (21 %)
1999-2000	Canal	1,015 (3 %)	0 (0 %)	5,752 (19 %)	16,127 (54 %)	6,947 (23 %)
	Well	5,301 (22 %)	0 (0 %)	3,308 (13 %)	11,409 (46 %)	4,528 (18 %)
	Total	6,316 (12 %)	0 (0 %)	9,060 (17 %)	27,536 (51 %)	11,475 (21 %)
2000-2001	Canal	1,710 (6 %)	0 (0 %)	8,161 (30 %)	12,348 (45 %)	5,305 (19 %)
	Well	4,650 (29 %)	0 (0 %)	3,540 (22 %)	5,931 (37 %)	1,842 (12 %)
	Total	6,360 (15 %)	0 (0 %)	11,701 (27 %)	18,279 (42 %)	7,147 (16 %)
Average for the six years	Canal	7,657 (5 %)	0 (0 %)	39,751 (26 %)	77,582 (50 %)	31,840 (21 %)
	Well	34,531 (26 %)	0 (0 %)	29,992 (23 %)	56,215 (42 %)	15,180 (11 %)
	Total	42,188 (15 %)	0 (0 %)	69,743 (24 %)	133,797 (47 %)	47,020 (16 %)

Figures in parentheses are percentages of the season's area irrigated by that source.

Table 4.5a: Mula project -- Head reach -- Dy1M1: Seasonwise area irrigated by canal and wells

No. of farmers: 372. CCA: 437 ha. ICA: 346 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	205	-- (--)	148 (72 %)	148 (72 %)	0
	Rabi	86 (23 %)	253	64 (25 %)	227 (90 %)	291 (115 %)	3
	Hot weather	55 (15 %)	30	42 (141 %)	131 (440 %)	173 (582 %)	3
1999-2000	Kharif	53 (14 %)	205	37 (18 %)	139 (68 %)	176 (86 %)	1
	Rabi	90 (24 %)	253	74 (29 %)	243 (96 %)	317 (125 %)	3
	Hot weather	77 (21 %)	30	48 (162 %)	148 (497 %)	196 (659 %)	2
2000-2001	Kharif	63 (17 %)	205	45 (22 %)	125 (61 %)	170 (83 %)	1
	Rabi	89 (24 %)	253	84 (33 %)	243 (96 %)	327 (129 %)	2
	Hot weather	53 (14 %)	30	21 (72 %)	134 (450 %)	155 (522 %)	2

Table 4.5b: Mula project -- Head reach -- Dy1M1: Seasonwise crop pattern of area irrigated by canal and wells

No. of farmers: 372. CCA: 437 ha. ICA: 346 ha. All areas in ha
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	3 (3 %)	6 (6 %)	-- (-- %)	61 (60 %)	32 (31 %)
	Well	67 (21 %)	45 (14 %)	51 (16 %)	125 (38 %)	39 (12 %)
	Total	71 (16 %)	51 (12 %)	51 (12 %)	186 (43 %)	71 (17 %)
1999-2000	Canal	3 (2 %)	-- (-- %)	28 (19 %)	72 (49 %)	43 (29 %)
	Well	73 (21 %)	46 (14 %)	42 (12 %)	129 (38 %)	49 (14 %)
	Total	76 (16 %)	46 (9 %)	70 (14 %)	201 (42 %)	92 (19 %)
2000-2001	Canal	10 (7 %)	14 (11 %)	41 (31 %)	55 (42 %)	12 (9 %)
	Well	66 (20 %)	38 (11 %)	44 (13 %)	148 (45 %)	36 (11 %)
	Total	76 (16 %)	52 (11 %)	85 (18 %)	203 (44 %)	48 (10 %)

<u>Table 4.6a</u>: Mula project -- Head reach -- Dy2Tail: Seasonwise area irrigated by canal and wells

No. of farmers: 371. ICA: 445 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	245	-- (--)	96 (39 %)	96 (39 %)	0
	Rabi	28 (8 %)	303	25 (8 %)	106 (35 %)	131 (43 %)	3
	Hot weather	24 (6 %)	36	19 (52 %)	88 (248 %)	107 (300 %)	3
1999-2000	Kharif	17 (5 %)	245	14 (6 %)	86 (35 %)	100 (41 %)	1
	Rabi	33 (9 %)	303	25 (8 %)	115 (38 %)	140 (46 %)	3
	Hot weather	16 (4 %)	36	9 (25 %)	91 (255 %)	100 (280 %)	2
2000-2001	Kharif	18 (5 %)	245	15 (6 %)	103 (42 %)	117 (48 %)	1
	Rabi	18 (5 %)	303	16 (5 %)	138 (45 %)	154 (51 %)	2
	Hot weather	11 (3 %)	36	9 (25 %)	86 (241 %)	95 (266 %)	2

<u>Table 4.6b</u>: Mula project -- Head reach -- Dy2Tail: Seasonwise crop pattern of area irrigated by canal and wells

No. of farmers: 371. ICA: 445 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	4.4 (10 %)	5.4 (12 %)	-- (-- %)	20.05 (58 %)	8.7 (20 %)
	Well	8.9 (4 %)	41.5 (18 %)	44.50 (20 %)	97.5 (43 %)	34.40 (15 %)
	Total	13.30 (5 %)	46.90 (17 %)	44.50 (16 %)	122.55 (45 %)	43.10 (16 %)
1999-2000	Canal	4.08 (9 %)	5.80 (13 %)	8.1 (19 %)	21.5 (49 %)	4.2 (10 %)
	Well	12.7 (5 %)	34 (15 %)	37.20 (16 %)	102.4 (44 %)	46.20 (20 %)
	Total	16.78 (6 %)	39.80 (14 %)	45.30 (16 %)	123.90 (45 %)	50.40 (18 %)
2000-2001	Canal	2 (6 %)	1.3 (4 %)	8 (26 %)	12.55 (40 %)	7.50 (24 %)
	Well	15.87 (7 %)	30.35 (13 %)	31 (13 %)	121.20 (51 %)	41 (17 %)
	Total	17.87 (7 %)	31.65 (12 %)	39 (14 %)	133.75 (49 %)	48.50 (18 %)

***Table 4.7a**: Mula project -- Middle reach -- SDyM3L: Seasonwise area irrigated by canal and wells*

No. of farmers: 85. ICA: 141 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	1 (1 %)	77	1 (1 %)	133 (172 %)	134 (174 %)	0
	Rabi	27 (32 %)	96	23 (24 %)	24 (25 %)	47 (49 %)	0
	Hot weather	24 (28 %)	11	14 (124 %)	20 (178 %)	34 (302 %)	0
1999-2000	Kharif	17 (20 %)	77	15 (19 %)	33 (43 %)	48 (62 %)	0
	Rabi	35 (41 %)	96	33 (34 %)	24 (25 %)	57 (60 %)	0
	Hot weather	20 (24 %)	11	7 (62 %)	20 (178 %)	27 (240 %)	0
2000-2001	Kharif	27 (32 %)	77	27 (35 %)	19 (25 %)	47 (60 %)	0
	Rabi	26 (31 %)	96	18 (19 %)	24 (25 %)	42 (44 %)	0
	Hot weather	10 (12 %)	11	6 (57 %)	20 (178 %)	26 (235 %)	0

***Table 4.7b**: Mula project -- SDyM3L: Seasonwise crop pattern of area irrigated by canal and wells*

No. of farmers: 85. ICA: 141 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	0 (1 %)	-- (-- %)	1 (3 %)	23 (59 %)	14 (37 %)
	Well	17 (46 %)	-- (-- %)	6 (16 %)	9 (24 %)	5 (13 %)
	Total	18 (24 %)	-- (-- %)	7 (9 %)	32 (42 %)	19 (25 %)
1999-2000	Canal	-- (-- %)	-- (-- %)	15 (27 %)	33 (60 %)	7 (13 %)
	Well	21 (52 %)	-- (-- %)	6 (14 %)	10 (23 %)	5 (11 %)
	Total	21 (22 %)	-- (-- %)	21 (22 %)	42 (44 %)	12 (12 %)
2000-2001	Canal	-- (-- %)	-- (-- %)	27 (52 %)	18 (35 %)	6 (12 %)
	Well	19 (50 %)	-- (-- %)	3 (9 %)	11 (30 %)	4 (11 %)
	Total	19 (21 %)	-- (-- %)	31 (34 %)	30 (33 %)	11 (12 %)

***Table 4.8a*: Mula project -- Middle reach -- Dy5M1: Seasonwise area irrigated by canal and wells**

No. of farmers: 200. ICA: 150 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	10 (5 %)	83	5 (6 %)	12 (15 %)	17 (21 %)	0
	Rabi	13 (7 %)	102	12 (11 %)	12 (12 %)	24 (23 %)	3
	Hot weather	18 (9 %)	12	10 (80 %)	7 (58 %)	17 (138 %)	3
1999-2000	Kharif	6 (3 %)	83	4 (5 %)	17 (20 %)	21 (25 %)	1
	Rabi	23 (12 %)	102	17 (17 %)	17 (16 %)	34 (33 %)	3
	Hot weather	16 (8 %)	12	8 (63 %)	9 (73 %)	16 (136 %)	2
2000-2001	Kharif	26 (13 %)	83	17 (20 %)	14 (17 %)	31 (37 %)	1
	Rabi	32 (16 %)	102	18 (17 %)	14 (14 %)	32 (31 %)	2
	Hot weather	9 (5 %)	12	3 (28 %)	8 (70 %)	12 (98 %)	2

***Table 4.8b*: Mula project -- Middle reach -- Dy5M1: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 200. ICA: 150 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parantheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	5 (21 %)	-- (-- %)	5 (19 %)	12 (44 %)	4 (16 %)
	Well	9 (77 %)	-- (-- %)	1 (8 %)	1 (8 %)	1 (6 %)
	Total	15 (38 %)	-- (-- %)	6 (16 %)	13 (33 %)	5 (13 %)
1999-2000	Canal	5 (18 %)	-- (-- %)	4 (15 %)	17 (59 %)	3 (9 %)
	Well	12 (68 %)	-- (-- %)	3 (14 %)	3 (16 %)	0 (2 %)
	Total	17 (37 %)	-- (-- %)	7 (14 %)	20 (42 %)	3 (6 %)
2000-2001	Canal	3 (7 %)	-- (-- %)	17 (44 %)	18 (47 %)	1 (2 %)
	Well	11 (74 %)	-- (-- %)	1 (9 %)	1 (9 %)	1 (8 %)
	Total	14 (26 %)	-- (-- %)	18 (34 %)	19 (36 %)	2 (3 %)

***Table 4.9a*: Mula project -- Middle reach -- Dy1M9: Seasonwise area irrigated by canal and wells**

No. of farmers: 100 approx. ICA: 134 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	74	-- (--)	16 (22 %)	16 (22 %)	1
	Rabi	6 (3 %)	91	11 (12 %)	28 (31 %)	39 (42 %)	2
	Hot weather	-- (--)	11	-- (--)	-- (--)	-- (--)	0
1999-2000	Kharif	-- (--)	74	-- (--)	6 (8 %)	6 (8 %)	1
	Rabi	5 (3 %)	91	11 (12 %)	39 (43 %)	49 (54 %)	2
	Hot weather	-- (--)	11	-- (--)	-- (--)	-- (--)	0
2000-2001	Kharif	-- (--)	74	-- (--)	-- (--)	-- (--)	0
	Rabi	-- (--)	91	-- (--)	-- (--)	-- (--)	0
	Hot weather	-- (--)	11	-- (--)	-- (--)	-- (--)	0

***Table 4.9b*: Mula project -- Middle reach -- Dy1M9: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 100 approx. ICA: 134 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		5 %	20 %	31 %	43 %	3 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	10 (100 %)	-- (--)
	Well	-- (--)	7 (16 %)	9 (20 %)	28 (64 %)	-- (--)
	Total	-- (--)	7 (13 %)	9 (17 %)	38 (70 %)	-- (--)
1999-2000	Canal	-- (--)	-- (--)	-- (--)	11 (100 %)	-- (--)
	Well	-- (--)	5 (11 %)	1 (2 %)	39 (87 %)	-- (--)
	Total	-- (--)	5 (9 %)	1 (2 %)	49 (89 %)	-- (--)
2000-2001	Canal	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
	Well	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
	Total	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

***Table 4.10a*: Mula project -- Middle reach -- Dy4M1: Seasonwise area irrigated by canal and wells**

No. of farmers: 256. ICA: 644 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	45 (18 %)	354	37 (10 %)	58 (16 %)	95 (27 %)	1
	Rabi	45 (18 %)	438	148 (34 %)	80 (18 %)	228 (52 %)	3
	Hot weather	157 (61 %)	52	111 (216 %)	50 (97 %)	161 (313 %)	2
1999-2000	Kharif	40 (16 %)	354	29 (8 %)	66 (19 %)	95 (27 %)	1
	Rabi	228 (89 %)	438	174 (40 %)	69 (16 %)	243 (56 %)	3
	Hot weather	98 (38 %)	52	82 (160 %)	48 (93 %)	130 (252 %)	2
2000-2001	Kharif	3 (1 %)	354	15 (4 %)	54 (15 %)	69 (19 %)	2
	Rabi	202 (79 %)	438	158 (36 %)	51 (12 %)	209 (48 %)	2
	Hot weather	129 (50 %)	52	123 (239 %)	35 (67 %)	158 (306 %)	2

***Table 4.10b*: Mula project -- Middle reach -- Dy4M1: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 256. ICA: 644 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	-- (--)	8 (3 %)	29 (10 %)	148 (50 %)	111 (38 %)
	Well	22 (15 %)	5 (3 %)	29 (20 %)	61 (42 %)	28 (19 %)
	Total	22 (5 %)	13 (3 %)	58 (13 %)	209 (47 %)	139 (32 %)
1999-2000	Canal	3 (1 %)	7 (2 %)	22 (8 %)	171 (60 %)	80 (28 %)
	Well	23 (16 %)	3 (2 %)	45 (31 %)	49 (34 %)	24 (17 %)
	Total	26 (6 %)	10 (2 %)	67 (16 %)	220 (52 %)	104 (24 %)
2000-2001	Canal	3 (1 %)	-- (--)	11 (4 %)	155 (53 %)	122 (42 %)
	Well	14 (12 %)	7 (6 %)	40 (34 %)	34 (29 %)	23 (19 %)
	Total	16 (4 %)	7 (2 %)	51 (12 %)	190 (46 %)	145 (35 %)

***Table 4.11a*: Mula project -- Middle reach -- Dy1M3: Seasonwise area irrigated by canal and wells**

No. of farmers: 197. ICA: 139 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	76	-- (--)	52 (68 %)	52 (68 %)	0
	Rabi	3 (2 %)	95	1 (1 %)	107 (113 %)	108 (115 %)	3
	Hot weather	-- (--)	11	-- (--)	15 (138 %)	15 (138 %)	3
1999-2000	Kharif	-- (--)	76	-- (--)	46 (60 %)	46 (60 %)	1
	Rabi	11 (6 %)	95	8 (9 %)	123 (130 %)	131 (138 %)	3
	Hot weather	-- (--)	11	-- (--)	13 (117 %)	13 (117 %)	2
2000-2001	Kharif	-- (--)	76	-- (--)	53 (69 %)	53 (69 %)	1
	Rabi	19 (10 %)	95	8 (8 %)	132 (140 %)	140 (148 %)	2
	Hot weather	-- (--)	11	-- (--)	15 (138 %)	15 (138 %)	2

***Table 4.11b*: Mula project -- Middle reach -- Dy1M3: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 197. ICA: 139 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	-- (--)	-- (--)	-- (--)	1 (100 %)	-- (--)
	Well	11 (7 %)	-- (--)	42 (27 %)	95 (62 %)	5 (4 %)
	Total	11 (7 %)	-- (--)	42 (27 %)	96 (62 %)	5 (3 %)
1999-2000	Canal	-- (--)	-- (--)	-- (--)	8 (100 %)	-- (--)
	Well	12 (8 %)	-- (--)	34 (22 %)	104 (68 %)	4 (3 %)
	Total	12 (7 %)	-- (--)	34 (21 %)	112 (69 %)	4 (2 %)
2000-2001	Canal	-- (--)	-- (--)	-- (--)	8 (100 %)	-- (--)
	Well	11 (6 %)	-- (--)	45 (25 %)	118 (66 %)	4 (2 %)

	Total	11 (6 %)	-- (--)	45 (24 %)	126 (68 %)	4 (2 %)

***Table 4.12a*: Mula project -- Tail reach -- Dy3M5-WUA: Seasonwise area irrigated by canal and wells**

No. of farmers: 176. ICA: 315 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	173	-- (--)	-- (--)	-- (--)	0
	Rabi	86 (23 %)	214	15 (7 %)	10 (5 %)	25 (12 %)	3
	Hot weather	55 (15 %)	25	22 (87 %)	2 (8 %)	24 (95 %)	3
1999-2000	Kharif	53 (14 %)	173	-- (--)	-- (--)	-- (--)	0
	Rabi	90 (24 %)	214	22 (10 %)	10 (5 %)	32 (15 %)	3
	Hot weather	77 (21 %)	25	12 (46 %)	2 (8 %)	14 (54 %)	2
2000-2001	Kharif	63 (17 %)	173	14 (8 %)	-- (--)	14 (8 %)	1
	Rabi	89 (24 %)	214	25 (12 %)	15 (7 %)	40 (19 %)	3
	Hot weather	53 (14 %)	25	9 (34 %)	6 (24 %)	15 (58 %)	1

***Table 4.12b*: Mula project -- Tail reach -- Dy3M5-WUA: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 176. ICA: 315 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	7 (21 %)	-- (--)	-- (--)	10 (33 %)	14 (45 %)
	Well	3 (26 %)	-- (--)	-- (--)	7 (74 %)	-- (--)
	Total	9 (22 %)	-- (--)	-- (--)	17 (43 %)	14 (35 %)
1999-2000	Canal	7 (24 %)	-- (--)	-- (--)	14 (51 %)	7 (25 %)
	Well	3 (33 %)	-- (--)	-- (--)	6 (67 %)	-- (--)
	Total	10 (26 %)	-- (--)	-- (--)	20 (55 %)	7 (19 %)
2000-2001	Canal	3 (7 %)	-- (--)	11 (26 %)	22 (53 %)	6 (14 %)

	Well	4 (23 %)	-- (--)	-- (--)	10 (59 %)	3 (18 %)
	Total	7 (12 %)	-- (--)	11 (19 %)	32 (55 %)	9 (15 %)

***Table 4.13a*: Mula project -- Tail reach -- Dy3M5-D: Seasonwise area irrigated by canal and wells**

No. of farmers: 509. ICA: 605 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	Not Available	333	-- (--)	-- (--)	-- (--)	0
	Rabi	Not Available	411	49 (12 %)	56 (14 %)	105 (26 %)	3
	Hot weather	Not Available	48	39 (80 %)	36 (74 %)	74 (154 %)	3
1999-2000	Kharif	Not Available	333	-- (--)	-- (--)	-- (--)	0
	Rabi	Not Available	411	71 (17 %)	85 (21 %)	156 (38 %)	3
	Hot weather	Not Available	48	37 (76 %)	49 (102 %)	86 (178 %)	2
2000-2001	Kharif	Not Available	333	63 (19 %)	78 (24 %)	141 (42 %)	1
	Rabi	Not Available	411	63 (15 %)	66 (16 %)	130 (31 %)	3
	Hot weather	Not Available	48	35 (71 %)	75 (156 %)	110 (227 %)	1

***Table 4.13b*: Mula project -- Tail reach -- Dy3M5-D: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 509. ICA: 605 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		5 %	20 %	31 %	43 %	3 %
1998-99	Canal	11 (15 %)	-- (--)	-- (--)	44 (58 %)	21 (27 %)
	Well	17 (23 %)	-- (--)	-- (--)	40 (54 %)	17 (23 %)
	Total	28 (19 %)	-- (--)	-- (--)	85 (56 %)	38 (25 %)
1999-2000	Canal	20 (17 %)	-- (--)	-- (--)	58 (50 %)	37 (32 %)
	Well	24 (22 %)	-- (--)	-- (--)	68 (62 %)	18 (16 %)
	Total	44 (20 %)	-- (--)	-- (--)	126 (56 %)	55 (24 %)
2000-2001	Canal	16 (12 %)	3 (2 %)	58 (44 %)	52 (40 %)	2 (1 %)

	Well	36 (20 %)	-- (--)	66 (36 %)	52 (28 %)	31 (17 %)
	Total	52 (16 %)	3 (1 %)	124 (39 %)	104 (33 %)	32 (10 %)

***Table 4.14a*: Mula project -- Tail reach -- TDyM4: Seasonwise area irrigated by canal and wells**

No. of farmers: 250 approx. ICA: 144 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	79	-- (--)	24 (30 %)	24 (30 %)	0
	Rabi	24 (10 %)	98	27 (27 %)	29 (30 %)	56 (57 %)	3
	Hot weather	36 (14 %)	12	26 (225 %)	16 (138 %)	42 (362 %)	3
1999-2000	Kharif	7 (3 %)	79	5 (6 %)	19 (24 %)	24 (31 %)	1
	Rabi	33 (13 %)	98	26 (27 %)	23 (23 %)	49 (50 %)	3
	Hot weather	55 (22 %)	12	26 (224 %)	19 (168 %)	45 (392 %)	2
2000-2001	Kharif	-- (--)	79	-- (--)	27 (34 %)	27 (34 %)	1
	Rabi	29 (12 %)	98	29 (30 %)	31 (32 %)	60 (61 %)	2
	Hot weather	68 (27 %)	12	30 (259 %)	23 (196 %)	53 (455 %)	2

***Table 4.14b*: Mula project -- Tail reach -- TDyM4: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 250 approx. ICA: 144 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	1 (2 %)	-- (--)	-- (--)	26 (51 %)	24 (47 %)
	Well	9 (16 %)	0 (1 %)	13 (25 %)	22 (41 %)	8 (16 %)
	Total	10 (9 %)	0 (0 %)	13 (13 %)	48 (46 %)	33 (31 %)
1999-2000	Canal	7 (13 %)	-- (--)	5 (9 %)	26 (47 %)	18 (32 %)
	Well	5 (7 %)	5 (9 %)	21 (35 %)	18 (30 %)	12 (19 %)
	Total	12 (10 %)	5 (4 %)	26 (22 %)	45 (38 %)	30 (25 %)
2000-2001	Canal	10 (20 %)	-- (--)	-- (--)	29 (58 %)	11 (22 %)

	Well	6 (8 %)	10 (15 %)	15 (22 %)	23 (33 %)	15 (22 %)
	Total	15 (13 %)	10 (9 %)	15 (13 %)	52 (43 %)	26 (22 %)

***Table 4.15a*: Mula project -- Tail reach -- PBCDM10: Seasonwise area irrigated by canal and wells**

No. of farmers: 167. ICA: 229 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	126	7 (5 %)	6 (5 %)	13 (10 %)	0
	Rabi	86 (23 %)	156	2 (1 %)	5 (3 %)	7 (4 %)	3
	Hot weather	55 (15 %)	18	2 (13 %)	6 (35 %)	9 (48 %)	3
1999-2000	Kharif	53 (14 %)	126	2 (1 %)	3 (2 %)	4 (3 %)	1
	Rabi	90 (24 %)	156	22 (14 %)	4 (3 %)	27 (17 %)	3
	Hot weather	77 (21 %)	18	14 (75 %)	5 (27 %)	19 (103 %)	2
2000-2001	Kharif	63 (17 %)	126	4 (3 %)	7 (5 %)	11 (8 %)	1
	Rabi	89 (24 %)	156	8 (5 %)	5 (3 %)	13 (8 %)	2
	Hot weather	53 (14 %)	18	6 (32 %)	6 (35 %)	12 (67 %)	1

***Table 4.15b*: Mula project -- Tail reach -- PBCDM10: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 167. ICA: 229 ha. All areas in ha.
Areas for each category are worked out as averages of seasonwise figures reported.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		**5 %**	**20 %**	**31 %**	**43 %**	**3 %**
1998-99	Canal	-- (--)	-- (--)	7 (60 %)	2 (18 %)	2 (22 %)
	Well	5 (58 %)	-- (--)	2 (20 %)	-- (--)	2 (23 %)
	Total	5 (24 %)	-- (--)	8 (43 %)	2 (11 %)	4 (22 %)
1999-2000	Canal	-- (--)	-- (--)	2 (4 %)	22 (59 %)	14 (37 %)
	Well	3 (38 %)	-- (--)	-- (--)	2 (26 %)	2 (35 %)
	Total	3 (6 %)	-- (--)	2 (4 %)	24 (54 %)	16 (36 %)
2000-2001	Canal	-- (--)	-- (--)	4 (23 %)	8 (44 %)	6 (34 %)

	Well	4 (47 %)	-- (--)	2 (23 %)	1 (9 %)	2 (21 %)
	Total	4 (16 %)	-- (--)	6 (23 %)	8 (31 %)	8 (29 %)

Chapter 5

Findings: The Mangi Project

5.1 The Project as a whole

5.1.1 Storage at the dam site

Sample storage data for the Mangi dam for the years 1991 to 2001 is presented in Table 5.1. As may be seen, the annual maximum storage is extremely variable. This indicates that the Mangi project has not been able to impart a sufficiently dependable and uniform storage. This is expected to have an impact on deprivation since a fixed and expected schedule cannot be followed, even for a sizeable component of the storage.

There has also been a lot of development in the catchment areas of the Mangi dam and it would be of interest to see how this might have changed the profile of annual inflows and achievable storage at the dam site in good and bad years. The annual maximum storage at dam for the years 1964-65 to 2000-2001is presented in Table 5.2. The annual rainfall figures are presented in Table 5.3. To compare two disparate variables, statistically one good way is to compare normalised values which express the value of the variable as a fraction of the mean value.

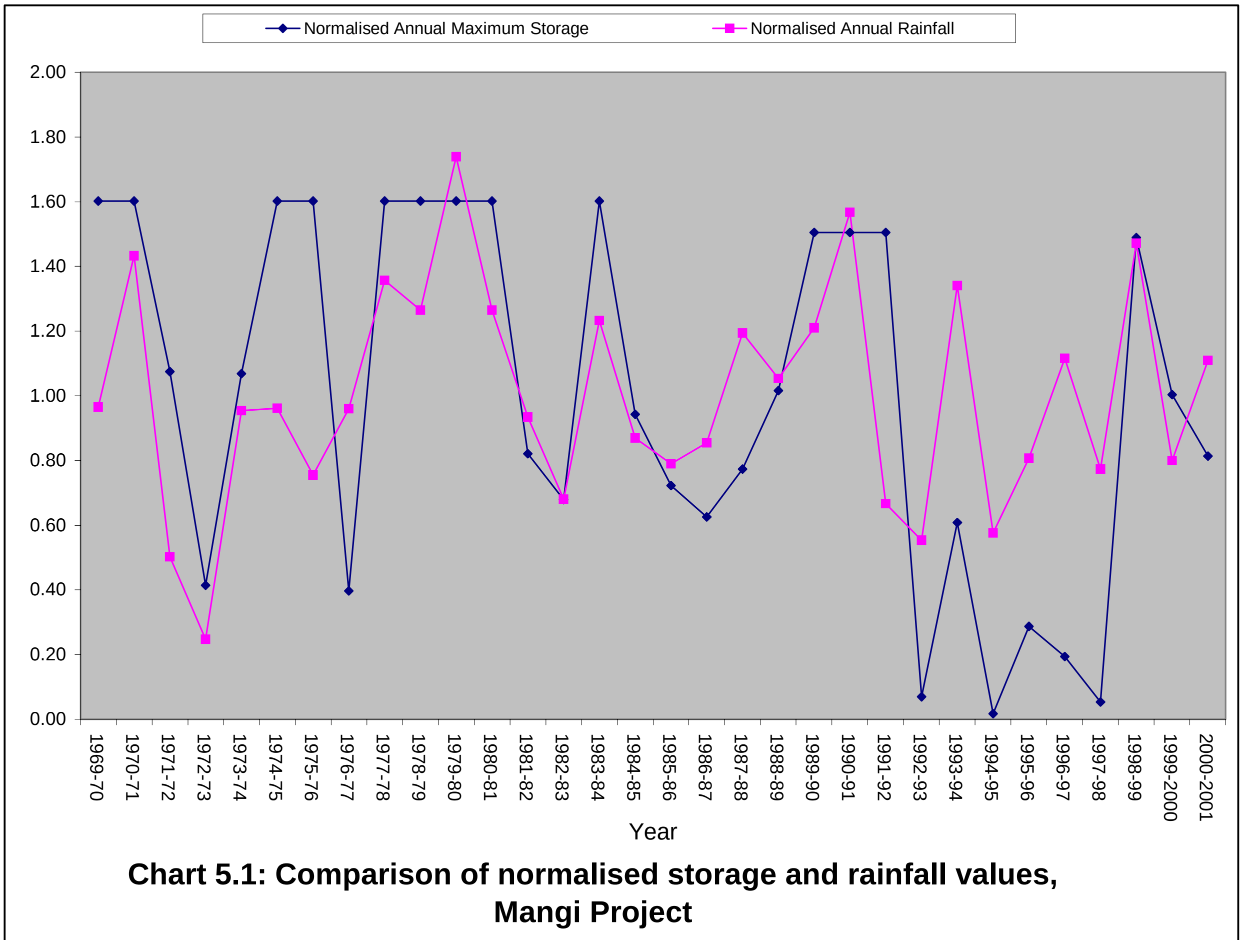


Chart 5.1: Comparison of normalised storage and rainfall values, Mangi Project

The normalised values are presented in Table 5.4 and a graphical comparison is presented in Chart 5.1 below.

It shows that for low rainfall years the annual maximum storage at the dam has reduced appreciably as compared with similar years in the past. This would indicate that, while in the better years the catchment treatment would not matter as much, in the years when rainfall is not adequate it does seem to affect dam storage significantly.

5.1.2 Area served by canal

The data available for the area irrigated by canal is presented in Table 5.5. The data, as expected from the storage data analysis, are marked by extreme variability. For kharif, for example, four clusters can be identified: years when practically no water is drawn from the canal, years when around 25% of the planned irrigation takes place, years when around 60 to 70% of planned area is irrigated and lastly a few years when double or even triple the planned irrigation takes place! The rabi irrigation figures are somewhat more stable. They vary between 25 and 75% with very few years when there is no rabi irrigation. For the hot weather season, we return to the extreme pattern. In fact, the pattern is

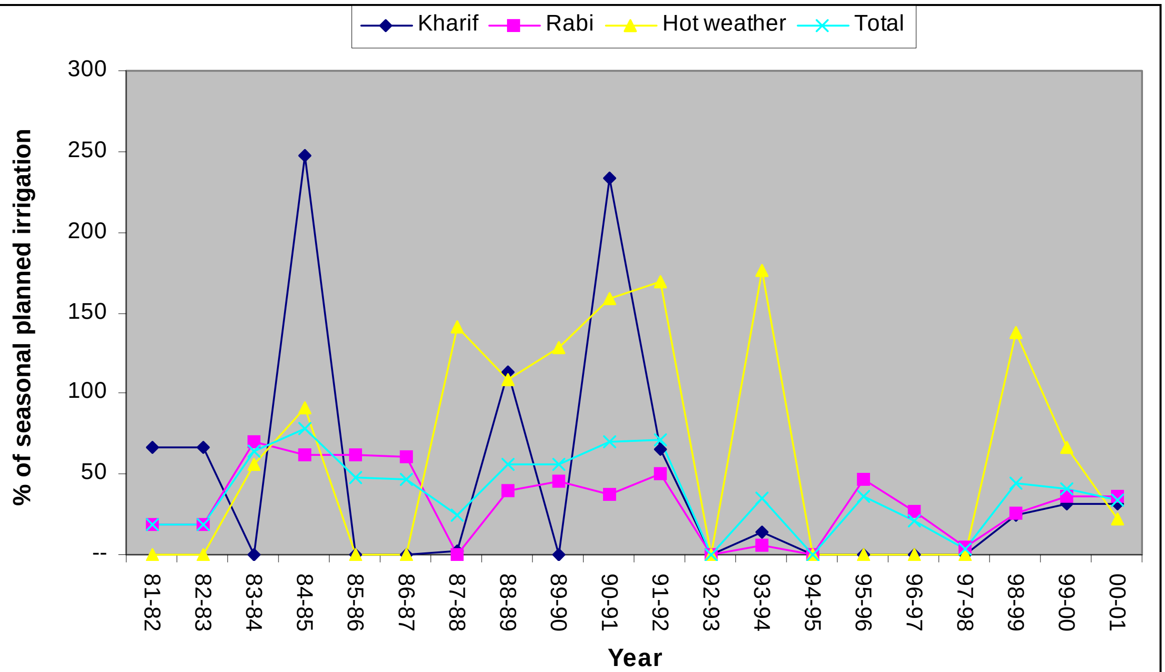


Chart 5.2: Seasonal Variation in Canal Irrigation: Mangi Project

something like an on-off switch: when there is no irrigation there is none, when there is, the area irrigated is more than double the planned irrigation for the season. All in all, the rabi irrigation helps even out the total trend, as may be seen from the trends presented in Chart 5.2 below.

5.1.3 Taking account of well irrigation

The data for canal and well irrigation at the project level is available for the last three years, and they are presented in Table 5.6. Expectedly, they increase the apparent utilisation. What is interesting, however, is the way the kharif, rabi and hot weather figures behave. When it does, well irrigation adds more to kharif and hot weather utilisation, than to rabi utilisation. Given the extreme variation shown by kharif and summer irrigation, this implies that well irrigation adds to the variability rather than stabilises it!

5.2 The Head, Middle and Tail Reach - a continuum

Unlike the sprawling Mula system, the Mangi system is much more compact. It is not as clearly divided into the Head, Middle and Tail reach corresponding to administrative units (in that case the sub-divisions within the system). There is thus more of a gradation and continuum rather than a clear grouping. Hence the discussion below does not follow this grouping.

The LBC has a much smaller command than the RBC. Also there are very few Distributaries and Minors, and many more Direct Outlets. Selection of the command portions concentrated on including a fair share of the DOs and Distributaries which are more like the Minors of the larger systems. The following portions were finally selected, and are given below in order of distance from the dam (chainage).

On the RBC

Direct Outlet 3 --	DO3
Distributary 2 --	Dy2
Direct Outlet 20 --	DO20
Distributary 7 --	Dy7
Direct Outlet 50 --	DO50

On the LBC

Direct Outlet 5 --	DO5
Distributary 2 --	Dy2
Direct outlet 20 --	DO20

5.3 No. of farmers drawing water from the canal

The system has not released any water during the kharif the last three years, that is, the years under consideration.

On the RBC

On DO3, in rabi there was no water received during 98-99, and for the rest of the years the number of farmers receiving water was about 75% and those during the hot weather season were 50 to 75%. On Dy2, 55 to 65% received water in the rabi and 35 to 65% in the hot weather. On DO20, 25 to 55% farmers received water in rabi and 30 to 755 in hot weather. For Dy7 further down, 15 to 45% received water in the rabi. However, on Dy7, no one received water in the hot weather, though 60.5 % received it three years ago. On DO50, which is the last outlet at the tail portion, there have been practically no deliveries, though a few farmers did get water during rabi in one year and during hot weather in another year. (See Tables 5.7a through 5.11a.)

On the LBC

On DO5, one of the first outlets on the canal, farmers did not receive water during in rabi for two and in hot weather for one out of the three years. About 75% of the farmers received water during rabi in one year and 65 to 80% received water during the hot weather in the two years. On Dy2 further down, the proportion of farmers receiving water varied from about 2.5% in one year to between 55 and 60% for the other two years in the rabi season and during the hot weather, 55% of the farmers received water during the one year they received water in the hot weather. On DO20, the last outlet to have received any water on the LBC, it received no water in the rabi season for the three years and 55 to 60% received water in two of the years during the hot weather season. (See Tables 5.12a through 5-14a.)

5.4 Portion of command drawing water from the canal

On the RBC

We begin to get a better idea of what is happening on the ground after taking into consideration the land areas involved. On DO3, one of the first outlets on the RBC, in comparison with the planned irrigation calculated on the basis of the approved crop pattern, the area receiving water varied from 55 to 110% in the two years it received rabi waterings, and the hot weather area comprised 4.9 to 5.9 *times* the planned irrigated area for hot weather. A little further down, on Dy2, the area was about 65% of planned seasonal irrigated area for the rabi and 95 to 300 % for the hot weather. DO20 did not receive any canal water in the kharif, while the proportion of area receiving canal water varied from about 25 to 50 % of the planned irrigation for rabi and from 100 to 200 % for the hot weather. On Dy7 further down, the proportion varied from 20 to 35% for rabi and about 105% for the single year in which it received hot weather waterings. On the last outlet, DO50, no canal water was received for the kharif in any of the years and in only one of the years did the farmers receive canal water during the hot weather.

On the LBC

On DO5, water was received for rabi only in one of the years and the area receiving water was 53% of planned ICA. Water was received in hot weather during two years and both the years the area irrigated was 3.2 *times* the planned ICA. On Dy2, rabi area varied from 3 to 80% of planned ICA and there was no water received in the hot weather during any of the years. On DO20, the tail outlet, rabi area was also zero, and the hot weather area ranged from 65 to 100% of planned ICA.

5.5 Taking wells into account

As elsewhere, if we add the area within the command served by wells, the picture is substantially modified, but not to the same extent as in Mula.

On the RBC

On the first outlet, after accounting for wells, the area ranged from 6.25 *times* to 14.35 *times* the planned ICA in kharif, 85 to 200% in rabi and 7 to 12.5 *times* for the hot weather! The area for Dy2 further down became 80 to 145% in kharif, 70 to 80% in rabi and 1.45 to 3.45 *times* in the hot weather. In DO20, there is substantial kharif well irrigation, and the rabi irrigation rises to between 60 and 95 % and the summer irrigation to between 2 and 4*times* the planned seasonal irrigation. On Dy7 towards the tail, the data is partially faulty, well irrigation data has not been supplied in seasons when there was no rotation. Even there, where data has been given, it indicates the same trend. In DO50, situated at the tail end, kharif irrigation is absent, and there is only a marginal increase in the irrigated area as an effect of taking account of wells.

On the LBC

On DO5 whic is the head portion, after taking account of well irrigation, the irrigated area rises between 13 and 15 *times* the planned ICA in kharif, to between 105 to 155% in rabi and 4.3 to 9.3 *times* in the hot weather. On Dy2 a little further down, the figures range from 2.85 to 3.35 *times* in kharif, 30% to 110% in rabi and 80% to 3.7 *times* in the hot weather. In DO20, the area becomes, 190 to 325% in kharif, only 15 to 20% in rabi and 80 to 175% in the hot weather.

5.6 Some general findings

The main findings here are consistent with the findings in the Mula Project as well, when we take into account the effect of wells in the command, the apparent degree of deprivation is modified substantially and that there is a disproportionate shift in the utilisation in favour of hot weather utilisation, which rises to a level many *times* that originally planned for the project. One can also identify a trend that associates distance towards the tail, with the strength of these effects: that is, the effects are stronger and more pronounced as we approach the head reach within any portion.

An additional factor in deprivation in Mangi and corroborated by irrigation officials is the conflict between those who lift water directly from the backwaters and those in the command area who receive water through canals. Earlier, lifts from the backwater were allowed only sparingly, but now there is a profusion of lifts from the backwaters. There is very little control on how much water is lifted in this way. Often the permission is obtained on grounds that are only a pretext for getting

Fig. 5.1: In Mangi, one of the points of discussion was the permission given for lifting water directly from the dam storage. There is little control exercised over the amount of water they draw. Recently, there has reportedly been a spurt in legal and illegal lifts installed behind the dam and farmers in the command area hold this responsible for the shortage they face.

5.7 Cropping pattern for the command portion receiving water from the canal system directly

In respect of the trends regarding cropping pattern, the actual cropping pattern for the land receiving water from the canal is closer to the approved pattern. However, the pattern of crops irrigated by wells is disproportionately weighed towards hot weather crops and towards kharif in many command portions. (See Tables 5.7b through 5.14b.)

5.8 Physical state of the system

In most of the rotations, tail to head delivery has also been observed fairly consistently on the RBC, though the definition of what comprises the tail in a given rotation is somewhat loosely defined. In contrast, no such discipline is followed on the LBC.

The direct outlets are a little better maintained than in the Mula system. Field channels taking off from them are of relatively short length and have been generally better maintained. We shall not be describing these outlets in great detail and shall confine ourselves to describing the longer distributaries.

On the RBC

On Dy2 on the RBC about half the gates are standing while there is no gate on some of the outlets. Rods are missing from most gates. About 0.75 km of the tail portion does not receive water and is overgrown with often thick vegetation. Before this portion, between O7L and O3R there are a number of points, at least 6 points at which the canal is breached and farmers take water directly from the minor. There are a few places where roads have been made by the farmers across the channel.

On Dy7, the last 1.5 km has not seen water flow through it for the last many years and is consequently silted up and completely overgrown by shrubs and vegetation. Many of the gates are not standing, and the others have often lost rods and control devices. The channel is reported to be flowing well up to the above mentioned 1.5 km point from the tail.

On the LBC

Dy2 on the LBC has a profusion of outlets and very few gated structures, leading to the inference that here we have the regularisation of many breach and their conversion into outlets. Here too, the final about 1.5 km stretch in the tail portion has virtually disappeared. It has been encroached from both sides, and what narrow strip is left is completely overgrown with thick growth. The channel is well preserved up to about half the remaining head portion, and the other half is in a state of disrepair, but so far as conveying water is concerned, still doing that adequately as reported by the farmers.

The deep cut beyond DO14

On the LBC one particular portion seems to have caused a lot of problem. Beyond DO14, the LBC passes through a deep cut portion that is about 10 m and more deep. More than 1.5 m of silt is reported to have collected in this portion, effectively blocking the canal, not allowing water to flow beyond the deep cut and also causing problems due to water spread in the DO14 vicinity. Farmers have tried through private collection to repair this portion, but because of the steepness of the sides, the excavators cannot work and manual labour is proving to be very costly. Moreover the department seems to have virtually stopped even routine maintenance expenditure and it seems unlikely that they will take it up on their own, under their own steam. So, for the present, the problem persists and no water flows beyond DO14.

5.9 Focused group discussions

The habitat here was scattered into a number of hamlets and settlements instead of a single *gaothan* or village residential area. Basically the whole of the command comprises of the following villages, Mangi, Pothre, Mirgavhan, Khambegaon, Arjunnagar, Nilaj and Bitargaon. Group discussions were organised so as to cover farmers belonging to the selected command portions. Group discussions were carried out at: Pothre (attended by about 25 farmers), Mirgavhan (about 20 farmers), Khambewadi (about 10 farmers), Arjunnagar (about 10 farmers) on the RBC and in village Nilaj on the LBC. Discussion in small groups were also carried out during the Transect Walks since farmers resided nearby their fields and were available for discussion at their homes.

The following points emerged from the discussion.

Pothre (mainly RBC Dy2)

- All the farmers attending the meeting had got water this year and the year before. About 20% of the farmers from the village had not applied.

- Last year many of the farmers refused to apply because water from the canal was causing damage to the jowar crop. Giving water to the jowar crop as late as it was given causes the jowar plant to lodge, the stalk falls, the cob falls to the ground and also blackens. When they saw this happen to the first few farmers, most of the jowar farmers refused to apply for water that season. To avoid this situation, it is essential that the rotation is not too late. This is due to the peculiar behaviour of the black soils in the area which go soft and lose strength when wet causing lodging for the jowar plant.

- Reasons for not applying:

    - The Distributary is in disrepair beyond outlets 10 and 11, so no one beyond that has applied for water. Advance applications by tail-enders are not entertained, they are told to apply after the actual delivery begins. There are at least 35 farmers whose applications have not been entertained.

    - Two farmers said they did not apply because water is not delivered regularly and as scheduled.

- Almost 50% are defaulters, but charges are often collected on the spot and water is given.

- Farmers apply for jowar and give water to sugarcane. This often happens.

- Farmers in the head reach take water twice during each rotation and therefore water does not reach the tail.

- About 10% of the farmers have no access to any other source of water.

- Water should be released in October (by Tulshiche lagna, that is one month after Divali) but is released in December which does more harm than good.

- Water stays in the wells for one to one and a half months after every rotation.

- Water can reach all farmers if planned and implemented well.

- From this year, tail to head sequence has been adopted.

Mirgavhan (mainly RBC Dy7)

- This year everyone did not get water. About 40 ha at the tail portion has bot received water because the channel does not run that far: it is silted up and overgrown with vegetation.

- The tail to head sequence caused a peculiar problem for those in the middle reach this time. The canal was operated for the tail, so the tail farmers began to draw water but the farmers in the head reach got impatient and they forcible began to take water from the head reach. This caused a shortage for the middle reach on the distributary. Farmers said that tail to head can only work if farmers are disciplined.

- Earlier also tail to head sequence was adopted, but for some years now the farmers in the head reach have not been allowing water to reach the tail. This year the reversal of the sequence has meant that water has flowed to many tail portions.

- About 1.5 km of the tail portion is completely non-functional. No water has flowed through it.

- This year the rotations started too late to be of any benefit to the farmers.

- Farmers have no discipline. Everyone takes water any which way. Only the well-to-do farmers have wells and they are the ones who benefit. The poor farmers totally dependent on the canal do not benefit.

- According to one farmer, all those responsible for bad planning should be transferred and arrears should be settled only after adequate assurance is given.

Khambewadi (mainly RBC DO20)

- Everyone who applies, gets water according to the participants and they too had all got water. Many farmers do not apply. Many are defaulters, but everyone gets water. They often apply at the last minute or on the spot.

- Here too farmers complained about jowar lodging due to late rotations.

- Earlier they used to receive 2 to three rotations during rabi, but now since there is less water in the tank and there is great increase in upstream pumping, farmers in the canal commands do not get adequate water.

- Only those with access to other sources of water take crops like wheat, because one or 2 waterings are not sufficient for wheat. Only crops like gram can tolerate 1 or 2 waterings.

- Some of the farmers on DO21 have access to water from the Sina River which they lift. They can take a good rabi crop, though they too cannot take hot weather crops.

- Three years ago, attempt was made to release Kukdi water into the tank, but that was soon stepped. This year the leaders are promising that they will get Kukdi waters released into the tank.

- Some were not in favour of a society because they felt that water charges would not be recovered.

Arjunnagar (DO47 to 50)

- About 25% of the area in the village is irrigated by the Mangi system. This year almost everyone got water.

- This is tail portion of Mangi. Last year too water had reached here but everyone could not get adequate water. This year everyone got adequate amounts of water during the rotation.

- The tail discharge used to taken into a well cum trench from where it was pumped by some farmers who had permissions for the same. They have not been able to do so since water no longer used to reach the tail. However, even this year, there was no sufficient tail discharge.

- On DO47 all except one took water from the canal.

- There was a lot of confusion about whether water would reach the tail portion at all. By the time water actually reach, most of the farmers, who were sceptical had neither applied for water nor had repaired field channels, so even though water did flow to the tail, there was a lot of wastage and it could not reach all the area it could.

- Ever since the MLA has been elected from Mangi (Mangi is the village at which the dam is located), rotations have reduced to one or two per season and pumping from the backwaters has increased very much, so that very little water is left for the canal command.

- Water was released only after the crop had almost wilted, so it was not of great benefit.

- There are no defaulters in the village.

- Earlier there used to be two to three rotations, but now because of lack of repair on the minor, pumping from backwaters and politics we have only one.

- Earlier there used to be a *panch* committee for water matters and they used to listen to complaints. Nowadays it is not clear who one should approach with complaints and no one listens, so they have stopped complaining.

Nilaj (LBC Dy2)

- The deep cut just beyond DO14 (see above) prevents water from reaching the tail. Almost 60% of the ICA here is without water.

- Farmer had collected contribution and attempted to repair the portion, but the attempt was not successful. Since a checkdam has come up in the village, the village can benefit from that water right up to April, so they do not depend on the canal to the same extent. There are about 100 pumps installed on the check dam waters.

- The well water is saline. Half of the sugarcane area is on water from the check dam.

- Some farmers are also not allowing water to go beyond DO14, because then they can get more water. There is heavy seepage that has not been repaired and because of that in spite of the duration of the rotation, not as much area was irrigated as should have been.

- There is no tradition of tail to head on the LBC, the way it is on the RBC. Even in respect of the portion that is served today, it would help a great deal if the tail to head sequence is adopted.

- Water has not reached the tail portion for the last 20 years, according to one farmer and this in spite of having approached the MLAS, the MP and the officials. If water flows to the tail, at least there will be drinking water for the farmers and the cattle.

5.10 Well water going saline in Nilaj village

Discussions with the villagers in Nilaj village showed that the wells in their village have mostly gone saline especially after the Sangoba bandhara was built on the *nallah* next to the village. The problem is quite acute in the wells near the bank of the stream. This salinity has nothing to do with the Mangi project as the project water hardly reach this village. Since most of the wells have gone saline, the people have to bring water from far away places even up to a distance of 2.5 to 3 kms. During the WTS we could see people bringing water on bicycles.

***Table 5.1**: Storage data for Mangi project - 1991-2001*

Storage values in mcum.

Year	Time of year					
	Kharif		Rabi		Hot weather	
	01-Jul	14-Oct	15-Oct	28-Feb	01-Mar	30-Jun
1991-1992	**30.72**	28.05	27.99	14.04	13.96	1.06
1992-1993	**1.42**	1.38	1.38	0.36	0.35	-
1993-1994	-	2.74	6.57	**11.45**	11.42	0.35
1994-1995	**0.35**	0.09	0.09	0.01	0.01	0.16
1995-1996	0.15	4.37	**5.86**	1.42	1.41	
1996-1997	-	3.70	**3.95**	1.39	1.37	0.22
1997-1998	0.22	1.08	**1.08**	0.64	0.63	0.57
1998-1999	0.57	**30.40**	**30.40**	22.92	22.87	16.39
1999-2000	16.39	20.39	**20.49**	10.85	10.78	11.75
2000-2001	11.75	**16.62**	8.55	8.55	8.51	2.76

Maximum storage achieved in the year is shown in bold.

***Table 5.2**: Annual Maximum Storage at Mangi dam - 1964-2001*

Storage values in mcum.

Year	Annual Maximum Storage
1964-65	32.70
1965-66	29.71
1966-67	9.44
1967-68	11.10
1968-69	17.50
1969-70	32.70
1970-71	32.70
1971-72	21.94
1972-73	8.45
1973-74	21.80
1974-75	32.70
1975-76	32.70
1976-77	8.10

Year	Annual Maximum Storage
1977-78	32.70
1978-79	32.70
1979-80	32.70
1980-81	32.70
1981-82	16.77
1982-83	13.87
1983-84	32.70
1984-85	19.25
1985-86	14.76
1986-87	12.77
1987-88	15.79
1988-89	20.75

Year	Annual Maximum Storage
1989-90	30.72
1990-91	30.72
1991-92	30.72
1992-93	1.42
1993-94	12.41
1994-95	0.35
1995-96	5.86
1996-97	3.95
1997-98	1.08
1998-99	30.40
1999-2000	20.49
2000-2001	16.62

***Table 5.3*: Annual Rainfall in Mangi project - 1969-2001**

Year	Rainfall (mm)
1969-70	529.75
1970-71	787.00
1971-72	275.68
1972-73	136.20
1973-74	524.05
1974-75	528.03
1975-76	414.65
1976-77	527.51
1977-78	745.10
1978-79	695.00
1979-80	954.98

Year	Rainfall (mm)
1980-81	694.60
1981-82	512.90
1982-83	373.50
1983-84	676.90
1984-85	477.20
1985-86	433.50
1986-87	469.00
1987-88	655.80
1988-89	578.40
1989-90	664.90
1990-91	860.40

Year	Rainfall (mm)
1991-92	366.00
1992-93	304.00
1993-94	736.02
1994-95	316.00
1995-96	443.30
1996-97	612.50
1997-98	425.00
1998-99	808.00
1999-2000	439.00
2000-2001	609.00

***Table 5.4*: Normalised Annual Maximum Storage and Rainfall in Mangi project**

Year	Annual maximum storage (mcum)	Normalised storage value	Rainfall (mm)	Normalised rainfall value
1969-70	32.70	1.60	529.75	0.96
1970-71	32.70	1.60	787.00	1.43
1971-72	21.94	1.07	275.68	0.50
1972-73	8.45	0.41	136.20	0.25
1973-74	21.80	1.07	524.05	0.95
1974-75	32.70	1.60	528.03	0.96
1975-76	32.70	1.60	414.65	0.76
1976-77	8.10	0.40	527.51	0.96
1977-78	32.70	1.60	745.10	1.36
1978-79	32.70	1.60	695.00	1.27
1979-80	32.70	1.60	954.98	1.74
1980-81	32.70	1.60	694.60	1.26
1981-82	16.77	0.82	512.90	0.93
1982-83	13.87	0.68	373.50	0.68
1983-84	32.70	1.60	676.90	1.23
1984-85	19.25	0.94	477.20	0.87
1985-86	14.76	0.72	433.50	0.79
1986-87	12.77	0.63	469.00	0.85
1987-88	15.79	0.77	655.80	1.19
1988-89	20.75	1.02	578.40	1.05
1989-90	30.72	1.50	664.90	1.21
1990-91	30.72	1.50	860.40	1.57
1991-92	30.72	1.50	366.00	0.67

1992-93	1.42	0.07	304.00	0.55
1993-94	12.41	0.61	736.02	1.34
1994-95	0.35	0.02	316.00	0.58
1995-96	5.86	0.29	443.30	0.81
1996-97	3.95	0.19	612.50	1.12
1997-98	1.08	0.05	425.00	0.77
1998-99	30.40	1.49	808.00	1.47
1999-2000	20.49	1.00	439.00	0.80
2000-2001	16.62	0.81	609.00	1.11
Average	**20.42**	**1.00**	**549.18**	**1.00**

***Table 5.5*: Mangi Project: Area Irrigated by canal by year and season**

Year	Area Irrigated by canal (ha)			
	Kharif	Rabi	Hot weather	Total
(1)	(2)	(3)	(4)	(2) + (3) + (4)
Planned Irrigation	187	2,400	530	3,117
1981-82	125 (67 %)	461 (19 %)	-- (--)	587 (19 %)
1982-83	125 (67 %)	461 (19 %)	-- (--)	587 (19 %)
1983-84	-- (--)	1,686 (70 %)	300 (57 %)	1,985 (64 %)
1984-85	463 (247 %)	1,497 (62 %)	483 (91 %)	2,443 (78 %)
1985-86	-- (--)	1,484 (62 %)	-- (--)	1,484 (48 %)
1986-87	-- (--)	1,445 (60 %)	-- (--)	1,445 (46 %)
1987-88	3 (2 %)	8 (0 %)	751 (142 %)	762 (24 %)
1988-89	211 (113 %)	953 (40 %)	578 (109 %)	1,762 (57 %)
1989-90	-- (--)	1,079 (45 %)	680 (128 %)	1,759 (56 %)
1990-91	437 (234 %)	904 (38 %)	841 (159 %)	2,183 (70 %)
1991-92	122 (65 %)	1,202 (50 %)	895 (169 %)	2,219 (71 %)
1992-93	-- (--)	13 (1 %)	-- (--)	13 (0 %)
1993-94	27 (14 %)	134 (6 %)	936 (177 %)	1,097 (35 %)
1994-95	-- (--)	-- (--)	-- (--)	-- (--)
1995-96	-- (--)	1,115 (46 %)	-- (--)	1,115 (36 %)
1996-97	-- (--)	644 (27 %)	-- (--)	644 (21 %)
1997-98	-- (--)	115 (5 %)	-- (--)	115 (4 %)

1998-99	46 (25 %)	625 (26 %)	728 (137 %)	1,399 (45 %)
1999-2000	60 (32 %)	872 (36 %)	354 (67 %)	1,286 (41 %)
2000-2001	59 (32 %)	875 (36 %)	120 (23 %)	1,054 (34 %)

Note: Planned seasonal irrigation is based on approved crop pattern in project plan.
Figures in parentheses are percentages of planned seasonal irrigation.

***Table 5.6*: Mangi Project: Area Irrigated by canal and wells by year and season**

Year	Season	Area Irrigated (ha)				No. of rotations
		Planned seasonal irrigation	Irrigated by canal	Irrigated by wells	Irrigated by canal and wells	
(1)	(2)	(3)	(4)	(5)	(4) + (5)	(7)
1998-99	Kharif	187	46 (25 %)	150 (80 %)	196 (105 %)	--
	Rabi	2,400	622 (26 %)	281 (12 %)	903 (38 %)	3
	Hot weather	530	728 (137 %)	257 (48 %)	985 (186 %)	3
1999-2000	Kharif	187	60 (32 %)	283 (151 %)	343 (183 %)	1
	Rabi	2,400	872 (36 %)	598 (25 %)	1,470 (61 %)	3
	Hot weather	530	354 (67 %)	-- (%))	354 (67 %)	2
2000-2001	Kharif	187	59 (32 %)	-- (%))	59 (32 %)	1
	Rabi	2,400	875 (36 %)	550 (23 %)	1,425 (59 %)	2
	Hot weather	530	120 (23 %)	350 (66 %)	470 (89 %)	2

Note: Planned seasonal irrigation is based on approved crop pattern in project plan.
Figures in parentheses are percentages of planned seasonal irrigation.

***Table 5.7a*: Mangi project -- RBCDO3: Seasonwise area irrigated by canal and wells**

No. of farmers: 8. ICA: 3.20 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	0.19	-- (--)	2.75 (1432 %)	2.75 (1432 %)	0
	Rabi	-- (--)	2.46	-- (--)	2.20 (89 %)	2.20 (89 %)	2
	Hot weather	6 (75 %)	0.54	3.20 (588 %)	3.60 (662 %)	6.80 (1250 %)	3
1999-2000	Kharif	-- (--)	0.19	-- (--)	1.20 (625 %)	1.20 (625 %)	0
	Rabi	6 (75 %)	2.46	2.70 (110 %)	2.20 (89 %)	4.90 (199 %)	3
	Hot weather	6 (75 %)	0.54	2.60 (478 %)	1.20 (221 %)	3.80 (699 %)	1
2000-2001	Kharif	-- (--)	0.19	-- (--)	2.00 (1042 %)	2.00 (1042 %)	0
	Rabi	6 (75 %)	2.46	1.40 (57 %)	3.20 (130 %)	4.60 (187 %)	2
	Hot weather	4 (50 %)	0.54	2.40 (441 %)	1.40 (257 %)	3.80 (699 %)	1

***Table 5.7b*: Mangi project -- RBCDO3: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 8. ICA: 3.20 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	-- (--)	3.20 (100 %)
	Well	1.50 (32 %)	-- (--)	1.15 (24 %)	0.60 (13 %)	1.50 (32 %)
	Total	1.50 (19 %)	-- (--)	1.15 (14 %)	0.60 (8 %)	4.70 (59 %)
1999-2000	Canal	0.80 (15 %)	-- (--)	-- (--)	2.70 (51 %)	1.80 (34 %)
	Well	1.30 (62 %)	-- (--)	0.40 (19 %)	0.20 (10 %)	0.20 (10 %)
	Total	2.10 (28 %)	-- (--)	0.40 (5 %)	2.90 (39 %)	2.00 (27 %)
2000-2001	Canal	0.80 (--)	-- (--)	-- (--)	1.40 (--)	1.60 (--)
	Well	1.40 (37 %)	-- (--)	0.40 (11 %)	1.60 (42 %)	0.40 (11 %)
	Total	2.20 (29 %)	-- (--)	0.40 (5 %)	3.00 (39 %)	2.00 (26 %)

***Table 5.8a*: Mangi project -- RBCDy2: Seasonwise area irrigated by canal and wells**

No. of farmers: 68. ICA: 87 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	5.22	-- (--)	4.42 (85 %)	4.42 (85 %)	0
	Rabi	51 (59 %)	67.01	45.40 (68 %)	5.64 (8 %)	51.04 (76 %)	2
	Hot weather	56 (64 %)	14.80	44.60 (301 %)	6.27 (42 %)	50.87 (344 %)	3
1999-2000	Kharif	-- (--)	5.22	-- (--)	5.50 (105 %)	5.50 (105 %)	0
	Rabi	55 (63 %)	67.01	44.40 (66 %)	4.65 (7 %)	49.05 (73 %)	2
	Hot weather	39 (45 %)	14.80	16.40 (111 %)	9.20 (62 %)	25.60 (173 %)	1
2000-2001	Kharif	-- (--)	5.22	-- (--)	7.44 (142 %)	7.44 (142 %)	0
	Rabi	53 (61 %)	67.01	43.40 (65 %)	5.45 (8 %)	48.85 (73 %)	2
	Hot weather	32 (37 %)	14.80	14.40 (97 %)	7.25 (49 %)	21.65 (146 %)	1

<u>Table 5.8b</u>: Mangi project -- RBCDy2: Seasonwise crop pattern of area irrigated by canal and wells

No. of farmers: 68. ICA: 87 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	45.40 (50 %)	44.60 (50 %)
	Well	2.30 (19 %)	-- (--)	2.22 (19 %)	3.24 (27 %)	4.07 (34 %)
	Total	2.30 (2 %)	-- (--)	2.22 (2 %)	48.64 (48 %)	48.67 (48 %)
1999-2000	Canal	5.80 (10 %)	-- (--)	-- (--)	44.40 (73 %)	10.60 (17 %)
	Well	2.50 (17 %)	-- (--)	3.90 (27 %)	3.25 (23 %)	4.70 (33 %)
	Total	8.30 (11 %)	-- (--)	3.90 (5 %)	47.65 (63 %)	15.30 (20 %)
2000-2001	Canal	6.00 (10 %)	-- (--)	-- (--)	43.40 (75 %)	8.40 (15 %)
	Well	0.55 (3 %)	-- (--)	7.24 (37 %)	4.55 (23 %)	7.25 (37 %)
	Total	6.55 (8 %)	-- (--)	7.24 (9 %)	47.95 (62 %)	15.65 (20 %)

<u>Table 5.9a</u>: Mangi project -- RBCDO20: Seasonwise area irrigated by canal and wells

No. of farmers: 22. ICA: 36 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	2.17	-- (--)	10.15 (468 %)	10.15 (468 %)	0
	Rabi	6 (27 %)	27.84	6.60 (24 %)	12.15 (44 %)	18.75 (67 %)	0
	Hot weather	16 (73 %)	6.15	12.70 (207 %)	12.15 (198 %)	24.85 (404 %)	2
1999-2000	Kharif	-- (--)	2.17	-- (--)	11.05 (509 %)	11.05 (509 %)	0
	Rabi	12 (55 %)	27.84	14.60 (52 %)	6.25 (22 %)	20.85 (75 %)	3
	Hot weather	7 (32 %)	6.15	6.20 (101 %)	6.25 (102 %)	12.45 (203 %)	1
2000-2001	Kharif	-- (--)	2.17	-- (--)	8.30 (383 %)	8.30 (383 %)	0
	Rabi	12 (55 %)	27.84	15.40 (55 %)	10.30 (37 %)	25.70 (92 %)	2
	Hot weather	9 (41 %)	6.15	10.20 (166 %)	11.10 (181 %)	21.30 (346 %)	1

***Table 5.9b*: Mangi project -- RBCDO20: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 22. ICA: 36 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	6.60 (34 %)	12.70 (66 %)
	Well	11.10 (90 %)	-- (--)	0.15 (1 %)	0.15 (1 %)	0.95 (8 %)
	Total	11.10 (35 %)	-- (--)	0.15 (0 %)	6.75 (21 %)	13.65 (43 %)
1999-2000	Canal	2.40 (12 %)	-- (--)	-- (--)	14.60 (70 %)	3.80 (18 %)
	Well	7.30 (82 %)	-- (--)	1.05 (12 %)	0.25 (3 %)	0.25 (3 %)
	Total	9.70 (33 %)	-- (--)	1.05 (4 %)	14.85 (50 %)	4.05 (14 %)
2000-2001	Canal	3.40 (13 %)	-- (--)	-- (--)	15.40 (60 %)	6.80 (27 %)
	Well	9.30 (85 %)	-- (--)	0.30 (3 %)	0.30 (3 %)	1.10 (10 %)
	Total	12.70 (35 %)	-- (--)	0.30 (1 %)	15.70 (43 %)	7.90 (22 %)

***Table 5.10a*: Mangi project -- RBCDy7: Seasonwise area irrigated by canal and wells**

No. of farmers: 167. ICA: 267 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	16.03	-- (--)	-- (--)	-- (--)	0
	Rabi	49 (18 %)	205.73	47.50 (23 %)	12.10 (6 %)	59.60 (29 %)	2
	Hot weather	63 (24 %)	45.42	47.60 (105 %)	7.40 (16 %)	55.00 (121 %)	3
1999-2000	Kharif	-- (--)	16.03	-- (--)	-- (--)	-- (--)	0
	Rabi	120 (45 %)	205.73	57.10 (28 %)	12.60 (6 %)	69.70 (34 %)	2
	Hot weather	-- (--)	45.42	-- (--)	-- (--)	-- (--)	0
2000-2001	Kharif	-- (--)	16.03	-- (--)	-- (--)	-- (--)	0
	Rabi	73 (27 %)	205.73	65.20 (32 %)	19.40 (9 %)	84.60 (41 %)	2
	Hot weather	-- (--)	45.42	-- (--)	-- (--)	-- (--)	0

***Table 5.10b**: Mangi project -- RBCDy7: Seasonwise crop pattern of area irrigated by canal and wells*

No. of farmers: 167. ICA: 267 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	47.50 (50 %)	47.60 (50 %)
	Well	-- (--)	-- (--)	-- (--)	12.10 (62 %)	7.40 (38 %)
	Total	-- (--)	-- (--)	-- (--)	59.60 (52 %)	55.00 (48 %)
1999-2000	Canal	-- (--)	-- (--)	-- (--)	57.10 (100 %)	-- (--)
	Well	-- (--)	-- (--)	-- (--)	12.60 (100 %)	-- (--)
	Total	-- (--)	-- (--)	-- (--)	69.70 (100 %)	-- (--)
2000-2001	Canal	-- (--)	-- (--)	-- (--)	65.20 (100 %)	-- (--)
	Well	-- (--)	-- (--)	-- (--)	19.40 (100 %)	-- (--)
	Total	-- (--)	-- (--)	-- (--)	84.60 (100 %)	-- (--)

***Table 5.11a**: Mangi project -- RBCDO50: Seasonwise area irrigated by canal and wells*

No. of farmers: Not Available. ICA: 11.74 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	Not Available	0.70	-- (--)	-- (--)	-- (--)	0
	Rabi	Not Available	9.04	0.40 (4 %)	0.50 (6 %)	0.90 (10 %)	0
	Hot weather	Not Available	2.00	2.40 (120 %)	0.90 (45 %)	3.30 (165 %)	2
1999-2000	Kharif	Not Available	0.70	-- (--)	-- (--)	-- (--)	0
	Rabi	Not Available	9.04	2.00 (22 %)	0.50 (6 %)	2.50 (28 %)	3
	Hot weather	Not Available	2.00	-- (--)	0.90 (45 %)	0.90 (45 %)	1
2000-2001	Kharif	Not Available	0.70	-- (--)	-- (--)	-- (--)	0
	Rabi	Not Available	9.04	2.80 (31 %)	0.20 (2 %)	3.00 (33 %)	2
	Hot weather	Not Available	2.00	-- (--)	0.20 (10 %)	0.20 (10 %)	1

***Table 5.11b**: Mangi project -- RBCDO50: Seasonwise crop pattern of area irrigated by canal and wells*

No. of farmers: Not Available. ICA: 11.74 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	0.40 (14 %)	2.40 (86 %)
	Well	-- (--)	-- (--)	-- (--)	0.50 (36 %)	0.90 (64 %)
	Total	-- (--)	-- (--)	-- (--)	0.90 (21 %)	3.30 (79 %)
1999-2000	Canal	-- (--)	-- (--)	-- (--)	2.00 (100 %)	-- (--)
	Well	-- (--)	-- (--)	-- (--)	0.50 (36 %)	0.90 (64 %)
	Total	-- (--)	-- (--)	-- (--)	2.50 (74 %)	0.90 (26 %)
2000-2001	Canal	-- (--)	-- (--)	-- (--)	2.80 (100 %)	-- (--)
	Well	0.20 (100 %)	-- (--)	-- (--)	-- (--)	-- (--)
	Total	0.20 (7 %)	-- (--)	-- (--)	2.80 (93 %)	-- (--)

***Table 5.12a**: Mangi project -- LBCDO5: Seasonwise area irrigated by canal and wells*

No. of farmers: 9. ICA: 13.6 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	0.82	-- (--)	11.60 (1422 %)	11.60 (1422 %)	0
	Rabi	-- (--)	10.47	-- (--)	11.60 (111 %)	11.60 (111 %)	0
	Hot weather	-- (--)	2.31	-- (--)	10.00 (433 %)	10.00 (433 %)	3
1999-2000	Kharif	-- (--)	0.82	-- (--)	11.00 (1348 %)	11.00 (1348 %)	0
	Rabi	-- (--)	10.47	-- (--)	11.00 (105 %)	11.00 (105 %)	3
	Hot weather	6 (67 %)	2.31	7.40 (320 %)	14.00 (606 %)	21.40 (926 %)	1
2000-2001	Kharif	-- (--)	0.82	-- (--)	10.60 (1299 %)	10.60 (1299 %)	0
	Rabi	7 (78 %)	10.47	5.60 (53 %)	10.40 (99 %)	16.00 (153 %)	2
	Hot weather	7 (78 %)	2.31	7.40 (320 %)	11.40 (493 %)	18.80 (813 %)	1

***Table 5.12b*: Mangi project -- LBCDO5: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 9. ICA: 13.6 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
	Well	9.70 (72 %)	-- (--)	1.14 (8 %)	1.60 (12 %)	1.00 (7 %)
	Total	9.70 (72 %)	-- (--)	1.14 (8 %)	1.60 (12 %)	1.00 (7 %)
1999-2000	Canal	3.20 (43 %)	-- (--)	-- (--)	-- (--)	4.20 (57 %)
	Well	10.20 (65 %)	-- (--)	0.80 (5 %)	0.80 (5 %)	3.80 (24 %)
	Total	13.40 (58 %)	-- (--)	0.80 (3 %)	0.80 (3 %)	8.00 (35 %)
2000-2001	Canal	3.80 (41 %)	-- (--)	-- (--)	2.00 (22 %)	3.40 (37 %)
	Well	0.47 (11 %)	-- (--)	1.00 (22 %)	1.00 (22 %)	2.00 (45 %)
	Total	4.27 (31 %)	-- (--)	1.00 (7 %)	3.00 (22 %)	5.40 (40 %)

***Table 5.13a*: Mangi project -- LBCDy2: Seasonwise area irrigated by canal and wells**

No. of farmers: 89. ICA: 97.45 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	5.85	-- (--)	18.70 (320 %)	18.70 (320 %)	0
	Rabi	2 (2 %)	75.04	2.40 (3 %)	21.00 (28 %)	23.40 (31 %)	2
	Hot weather	49 (55 %)	16.57	46.40 (280 %)	15.50 (94 %)	61.90 (374 %)	0
1999-2000	Kharif	-- (--)	5.85	-- (--)	16.70 (286 %)	16.70 (286 %)	0
	Rabi	49 (55 %)	75.04	54.00 (72 %)	19.60 (26 %)	73.60 (98 %)	2
	Hot weather	-- (--)	16.57	-- (--)	13.70 (83 %)	13.70 (83 %)	1
2000-2001	Kharif	-- (--)	5.85	-- (--)	19.50 (334 %)	19.50 (334 %)	0
	Rabi	51 (57 %)	75.04	56.60 (75 %)	24.20 (32 %)	80.80 (108 %)	2
	Hot weather	-- (--)	16.57	-- (--)	17.80 (107 %)	17.80 (107 %)	1

***Table 5.13b*: Mangi project -- LBCDy2: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 89. ICA: 97.45 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (-- %)	-- (-- %)	-- (-- %)	2.40 (-- %)	46.40 (-- %)
	Well	11.53 (36 %)	-- (-- %)	5.20 (16 %)	9.60 (30 %)	5.50 (17 %)
	Total	11.53 (14 %)	-- (-- %)	5.20 (6 %)	12.00 (15 %)	51.90 (64 %)
1999-2000	Canal	-- (-- %)	-- (-- %)	-- (-- %)	54.00 (100 %)	-- (-- %)
	Well	11.09 (40 %)	-- (-- %)	5.10 (18 %)	8.77 (31 %)	2.90 (10 %)
	Total	11.09 (14 %)	-- (-- %)	5.10 (6 %)	62.77 (77 %)	2.90 (4 %)
2000-2001	Canal	-- (-- %)	-- (-- %)	-- (-- %)	56.60 (100 %)	-- (-- %)
	Well	12.00 (32 %)	-- (-- %)	7.30 (20 %)	12.20 (33 %)	5.80 (16 %)
	Total	12.00 (13 %)	-- (--)	7.30 (8 %)	68.80 (73 %)	5.80 (6 %)

***Table 5.14a*: Mangi project -- LBCDO20: Seasonwise area irrigated by canal and wells**

No. of farmers: 8. ICA: 19.2 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal	Area irrigated by wells	Area irrigated by canal and wells	No. of rotations
1998-99	Kharif	-- (--)	1.15	-- (--)	2.20 (191 %)	2.20 (191 %)	0
	Rabi	-- (--)	14.78	-- (--)	2.50 (17 %)	2.50 (17 %)	0
	Hot weather	5 (63 %)	3.26	3.20 (98 %)	2.50 (77 %)	5.70 (175 %)	2
1999-2000	Kharif	-- (--)	1.15	-- (--)	3.70 (321 %)	3.70 (321 %)	0
	Rabi	-- (--)	14.78	-- (--)	2.70 (18 %)	2.70 (18 %)	3
	Hot weather	4 (50 %)	3.26	2.20 (67 %)	2.80 (86 %)	5.00 (153 %)	1
2000-2001	Kharif	-- (--)	1.15	-- (--)	2.60 (226 %)	2.60 (226 %)	0
	Rabi	-- (--)	14.78	-- (--)	2.60 (18 %)	2.60 (18 %)	2
	Hot weather	-- (--)	3.26	-- (--)	2.70 (83 %)	2.70 (83 %)	1

***Table 5.14b*: Mangi project -- LBCDO20: Seasonwise crop pattern of area irrigated by canal and wells**

No. of farmers: 8. ICA: 19.2 ha. All areas in ha.
Figures in parentheses are percentages of the season's area irrigated by that source.

Year	Source of irrigation	Area under				
		Sugarcane and other perennials	Two-seasonals	Kharif	Rabi	Hot weather
Approved crop pattern		--	--	6 %	77 %	17 %
1998-99	Canal	-- (--)	-- (--)	-- (--)	-- (--)	3.20 (100 %)
	Well	2.15 (73 %)	-- (--)	0.20 (7 %)	0.30 (10 %)	0.30 (10 %)
	Total	2.15 (35 %)	-- (--)	0.20 (3 %)	0.30 (5 %)	3.50 (57 %)
1999-2000	Canal	1.20 (55 %)	-- (--)	-- (--)	-- (--)	1.00 (45 %)
	Well	2.28 (49 %)	-- (--)	1.30 (28 %)	0.30 (6 %)	0.80 (17 %)
	Total	3.48 (51 %)	-- (--)	1.30 (19 %)	0.30 (4 %)	1.80 (26 %)
2000-2001	Canal	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
	Well	2.13 (59 %)	-- (--)	0.50 (14 %)	0.50 (14 %)	0.50 (14 %)
	Total	2.13 (59 %)	-- (--)	0.50 (14 %)	0.50 (14 %)	0.50 (14 %)

Chapter 6

Findings: The Walen Project

6.1 Storage at the dam site

Walen is very different from the other two projects that we have been considering. It has a small and compact command, but is different in many respects from the other two projects. The Mula project has a large catchment that cuts across many agro-climatic zones including the high rainfall zones and has a command that lies in the drought prone rain shadow region. In effect it is a mechanism to transfer the water from high rainfall zones to the low rainfall drought prone region. In contrast, the catchment as well as the command area of the Mangi project lie in the drought prone region, hence its extreme variability so far as storage is concerned.

Unlike Mula, the catchment area of Walen as well as the command area lie in a single agro-climatic zone, as would anyway be expected of a project of such a small size. Walen lies on the Eastern slopes of the Western Ghats, and has a high enough rainfall of around 2500 mm. Unlike Mangi, therefore, it does not have to bother whether there is sufficient rainfall to fill the dam. The Walen reservoir fills every year and overflows year after year. As the gauge data show, by the beginning of October every year, full supply level are reached and maintained for a couple of months. Therefore here, there is very little possibility of availability of water behind the dam becoming a critical constraint leading to deprivation.

6.2 Area served by canal and wells

Walen has an ICA of 271 ha. Well data is not available, but since there are very few wells in the command, it is not of much consequence. The irrigation is a modified form of field-to-field irrigation practised in the Konkan region, in which, water from one field is simply let into another field and there are no defined field channels for delivery of water. The difference, to some extent, is that the farmers do not wait to have a good amount of standing water in their fields in the manner it is practised in the Konkan.

The planned crop pattern corresponds to a kharif delivery to 20% of the planned seasonal irrigated area and a rabi delivery for 80% of the planned seasonal irrigated area. There are no hot weather deliveries scheduled and the pattern is one known as the *`aath-mahi'* or eight-month irrigation pattern.

The area to be irrigated was earlier planned at 271 ha and had grown to 754 ha and then to 918 ha in later revised proposals sent for approval. However, the increase in proposed ICA seems to be manipulative to some extent, a device to keep per ha costs within limit for the revised proposals. There seems to be no indication of such an increase in planned irrigation on the ground. For that reason, the initial assumption of a planned seasonal irrigated area of 271 ha is taken as the reference planned seasonal irrigated area for what follows.

The comparison with the planned seasonal irrigated area yields the following figures. (See Table 6.1a) The number of applications received in kharif vary from 25 to 30% of the total beneficiaries. Thus between 70 And 75% of the farmers in the command do not get water since they do not apply. However in rabi, the proportion of farmers who do receive water is much higher and ranges from 50 to 75% over the last three years. Thus in terms of number of farmers not getting water, rabi deprivation is not as pronounced as kharif deprivation.

However, for a proper assessment, we should also take into account the area irrigated every season in comparison with the planned seasonal irrigated area (See Table 6.1a below). Such a comparison shows that in kharif, between 60 and 70% of the planned seasonal irrigated area gets water; while for the rabi the same proportion varies from 20 to 40% of the planned seasonal irrigated area. In short, though a smaller number of farmers apply in kharif they irrigate a greater proportion of the planned seasonal irrigated area, while in the rabi a greater number of farmers apply but irrigate a smaller proportion of the planned seasonal irrigated area.

6.3 Crop Pattern

The crop pattern approved for the project implies a kharif seasonal component of 20% and rabi seasonals of 80%. The actual pattern shows that farmers prefer a much greater proportion of kharif seasonals in the irrigated area. (See Table 6.1b.) The crop pattern shows a pattern of about 30 to 40% of kharif seasonals and a corresponding 60 to 70% of rabi seasonals. Last year, sugarcane has also made its entry into the crop pattern, though it has not received any hot weather watering from the dam.

6.4 Physical state of the system

The canal has been lined with stone pitching for almost half its length. Farmers complain that the pitching does not work and there is heavy seepage from the canal. They attribute this to crabs who break away the weak mud mortar within the pitching and make for preferential seepage paths that progressively widen in the course of time. The later tail portion is completely unlined and some portion is being lined in the same manner.

Cross drainage seems to be a major problem and at many points farmers were complaining of water flowing into or from the canal sides. There were also complaints of siltation due to the water flowing

Fig. 6.1: Heavy seepage from the canal is the main problem reported in Walen. Here the farmers have tried to take care of the problem by dumping earth on the heaviest seepage spot. Their contention is that crab damage to the mud mortar of the canal lining and piping result in heavy seepage

into the canal.

The outlets, on the whole have been well maintained. However, here too, in the head reach we have an electric pump and diesel pump installed right into the canal and there are also a couple of places where the farmers have tunnelled through the pitching and drawn water through the breach.

But the major problem seems to be the waterlogging caused by canal seepage. The major crops are rice in the kharif and wheat in the rabi, though now some area is also being devoted to sugarcane. The land pattern has a distinct Konkan pattern with plain patches of heavy clay soils with poor drainage but good water holding capacity alternating with sloping patches of light soils with poor water holding capacity. The heavier soils often are laid out along the gradient in a chain of patches that forms a terrace. These are soils the farmers preferentially irrigate and they are also the ones prone to waterlogging. A constant source of canal seepage aggravates this condition and around the course of the canal we have an undulating but definite strip of waterlogged land. Farmers estimate that they may be losing more than they gain, and are insisting on a proper lining of the canal. This is an instance of the kind of `indirect' deprivation caused by the canal.

6.5 Focused Group Discussion

The discussion was held in village Walen. Almost all the original 271 ha of ICA lies within Walen. Some parts are in Hadshi and Kolvan. About thirty farmers including the village Sarpanch attended.

The points raised at the discussion were as follows:

- Almost 90% of the area in the village is served by the canal. The rest is inaccessible by gravity. Hadshi and Kolvan between them comprise only about 4 ha area of the command.

- Tail to head sequence is followed in the outlets of the canal, and everyone gets water during a rotation. No one is denied water.

- About 50% farmers may be defaulters. However, they too are given water and they have to fill the application forms.

- The major problem is canal seepage. It is very heavy. Moreover, since tail to head sequence is followed, all the time the head reach receive seepage, their is waterlogging, the crops are damaged or do not even germinate. It also means that the second crop cannot be taken in time since the water does not drain away for a long time. Land beside the canal is waterlogged for as long as two months and nothing can be sown on it.

- There is a steep slope and hilltop on the other side of the canal. This leads to heavy siltation. Villagers volunteer every year and clear it but the department has not been extending any help in this respect.

- At present there is field to field irrigation, but there is a need to develop and maintain field channels. This needs to be planned by the department and proper guidance is needed.

- Many `ousiders', especially city people are buying land in the village. But most of this land is unproductive land. Very little irrigated land under the canal has been sold. Nevertheless the trend is on the increase.

- In case of delay they complain to the officials and they have found the officials responsive to their complaints.

- The Walen Gram Panchayat has passed a resolution calling on the department to stop canal deliveries until the canal is repaired and lined properly. They feel the issue of canal seepage and consequent waterlogging cannot be tackled in any other way.

- No political influence is being used to release the water into the river for lift schemes who will use the water for sugarcane. This year there is said to be a target of 80 to 100 acres of sugarcane on the Walen water.

- Most of the defaulters are big farmers and political leaders.

- No maintenance has been carried out after the formation of the MKVDC.

<u>Table 6.1a</u>: Walen Project: Seasonwise area irrigated by canal

No. of farmers: 111. ICA: 271 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Season	No. of farmers applying	Planned irrigation area	Area irrigated by canal
1998-99	Kharif	33 (29.73 %)	54	36.25 (66.88)
	Rabi	74 (66.67 %)	253	47.25 (21.79 %)
1999-2000	Kharif	35 (31.53 %)	54	37.75 (69.65 %)
	Rabi	84 (75.68 %)	253	92.22 (42.54 %)
2000-2001	Kharif	27 (24.32 %)	54	35.2 (64.94 %)
	Rabi	57 (51.35 %)	253	47.36 (21.84 %)

<u>Table 6.1b</u>: Walen Project: Seasonwise crop pattern of area irrigated by canal

No. of farmers: 111. ICA: 271 ha. All areas in ha.
Figures in parentheses are percentages of the seasonal planned irrigation area.

Year	Area under	
	Kharif	**Rabi**
Approved crop pattern	**54.20 (20 %)**	**271.01 (80 %)**
1998-99	36.25 (43.41 %)	47.25 (56.59 %)
1999-2000	37.75 (29.05 %)	92.22 (70.95 %)
2000-2001	35.2 (42.64 %)	47.36 (57.36 %)

Chapter 7

Quantifying Deprivation within the Command

7.1 The focus: deprivation within the command

Conceptually, extending the concept of the tail-enders issue and viewing it as part of a wider issue of deprivation is one of the most fruitful outcomes of the pre-project discussions. However, as those discussions also revealed, the widening of the concept makes it open to an interpretation that widens it in many directions and there is a need to clearly define its limits and ensure that we do not lose focus on the original issue of tail-enders that we started out with.

In the light of the above, it was decided to limit the issue of deprivation to that of deprivation within the command. Thus it was decided that we consider only existing commands, as designated and delimited by the projects under consideration. This means that the issue of deprivation be contextualised to a) the farmers who have been designated as beneficiaries of irrigation within the command and also, that we restrict ourselves to b) deprivation in terms of irrigation water.

7.1.1 No natural measure of deprivation

There is no natural measure of deprivation. Different methods and criteria will measure different quantities. There also need not be a single measure of deprivation and many different types of quantification may be needed to explore different aspects of deprivation. In what follows, we confine ourselves directly to delivery of, and access to, water within the command. There is possibly a need to take into account the impact of the deprivation we describe here as well as associated factors and their impact on livelihood. This issue is briefly discussed but not developed in the concluding section.

One of the factors that needs to be taken into account here is that the methods and duration of data collection and amount of effort to be expended on it had been decided before the issue of quantification had been fully discussed and decided. This was naturally so because the study aims at an exploration, rather than a formal and full-fledged study. However, these conditions also form a given constraint within which the quantification has to operate.

An attempt is made below to develop progressively detailed indices of deprivation within the command. The unit of consideration here is the selected sub-command portion within the designated command of the Mula project. Ideally, the unit of quantification needs to start from the individual farmer. However, the constraints of the study did not allow for comprehensive individual information to be collected from all farmers in the sub-command portion. However, the procedures to be discussed below are capable of being adapted to different units at different scales starting from the individual farmer to minor level, distributary level, section level, sub-division level and project level analysis.

7.1.2 The exercise below is of an illustrative nature

The quantification attempt is restricted here to the information collected from the Canal Inspectors (CIs) in the Mula Project. This is because the discussion below is meant more as an exploration and an illustration. It is thus offered more as a suggestion to be discussed and finally decided upon for a common exploration in the future. Also the Mula command, being fairly large with well defined head, middle and tail reaches, the information from that project is expected to be more meaningful in bringing out the relationship between location and degree of deprivation.

7.1.3 The constraints

There a few other constraints that need to be taken into consideration while analysing the quantification presented below. There are indications that the official figures provided by the CIs are often underestimates and that in practice a) a lot more water is being released into the command, b) the number of farmers receiving water is more and c) the amount of water they receive is also greater than that indicated by the CIs. However, without a comprehensive and long term effort to monitor and record water use in the sub-command it is not possible to quantify this. In terms of deprivation as quantified below, there are two possible types of impact: a) the deprivation at the sub-command level may be smaller than indicated here, and b) the relative deprivation within the command may be greater for deprived farmers than may be apparent from the sub-command figures. Both these possibilities need to be kept in mind while looking at the quantification being presented here.

For purposes of comparison, the sub-commands have been classified into head, middle and tail regions in three ways: i) At the project level, as mentioned earlier for the different sub-divisions, ii) Within a given reach, depending on where the distributary takes off from, iii) On the distributary, whether the sub-command lies in the head, middle or tail reaches of the distributary. This should help us identify how location correlates with degree of deprivation.

7.2 Deprivation as number of farmers deprived of canal irrigation

The first and simplest kind of quantification is simply who gets canal water and who does not. This is important from the point of view of delineating that section that is totally excluded from the system. Degrees of deprivation then come into operation only within the section that is not excluded. For this purpose, the Index for deprivation within the sub-command is taken as the proportion of farmers not getting water to the total number of farmers listed as beneficiaries in the sub-command. The season-wise and year-wise details are presented in Table 7.1a at the end of the chapter and the average values for the period 1998-2001 are presented below in Table 7.1b.

***Table 7.1b**: Deprivation: As farmers not receiving canal irrigation*

Deprivation Index values are in %

Name of Dist./ Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index -- Average 1998-2001			
					Kharif	Rabi	H.w.	Total
Dy1M1	Head	Head	Middle	372	89.61	76.25	83.42	83.09
Dy2Tail	Head	Middle	Tail	371	96.86	92.90	95.42	95.06
SDyM3L	Middle	Head	Middle	85	82.35	65.49	78.82	75.56
Dy5M1	Middle	Tail	Middle	200	93.00	88.67	92.83	91.50
Dy1M9	Middle	Middle	Tail	100	100.00	98.17	100.00	98.78
Dy4M1	Middle	Tail	Head	256	88.54	38.15	50.00	58.90
Dy1M3	Tail	Head	Head	197	100.00	94.42	100.00	98.14
Dy3M5-WUA	Tail	Tail	Tail	176	89.61	76.25	83.42	64.27
Dy3M5-D	Tail	Tail	Tail	509	N.Av.	N.Av.	N.Av.	N.Av.
TDyM4	Tail	Middle	Middle	250	99.07	88.53	78.80	88.80
PBCDM10	Tail	Tail	Tail	167	89.61	76.25	83.42	62.34

Deprivation Index

= (No. of farmers in command - No. of farmers receiving water) x 100/No. of farmers in command

It may be seen from the table that the degree of deprivation defined in this manner is very loosely correlated with location. This indicates that deprivation in terms of how many farmers get water and how many do not is not very closely related. Of course it is possible that the pattern may change after the CI data are corrected for those who receive water `unofficially'. However, this should not change the pattern significantly, unless we accept a special offsetting relationship inversely related to location in this respect. That seems unlikely. Assuming that the trend as exhibited is valid, it would indicate that equity within the command is not related to location, but to other factors, possibly the leadership in the area and other social factors.

7.2 Deprivation: As area not receiving canal irrigation

The next obvious Index is the area within the sub-command that does not receive (directly, as will be discussed in the next section) canal irrigation. This plays a role that is parallel to the role of the Index above, but with respect to the land in sub-command.

However, the standard of comparison is not very clear. Projects are planned on the basis of approved crop patterns and are meant to irrigate definite proportions of the area during the different seasons. It would be unfair to compare the area not irrigated in kharif with the entire ICA of the sub-command if only 10% of the area is supposed to be served by the kharif releases. In the quantification below, the area irrigated for each season is therefore compared, not with the total ICA in the sub-command, but the planned seasonal irrigation based on the approved crop pattern included in the project plan. (See Chapter 4 for the approved crop pattern for the Mula project.)

Thus deprivation Index is worked out in the following manner: the area actually irrigated in that season is subtracted from the irrigated area planned for that season and expressed as a percentage of the latter. It should be noted that it is possible for this Index to be negative. A negative value would indicate that the area irrigated is actually *larger* than the planned irrigated area. The season-wise and year-wise details are presented in Table 7.2a at the end of the chapter and the average values for the period 1998-2001 are presented below in Table 7.2b.

***Table 7.2b*: Deprivation: As area not receiving canal irrigation (averages)**

Deprivation Index values are in %

Name of Dist./ Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index -- Average 1998-2001			
					Kharif	Rabi	H.w.	Total
Dy1M1	Head	Head	Middle	346	86.62	70.69	-24.89	69.37
Dy2Tail	Head	Middle	Tail	445	96.17	92.72	65.86	92.53
SDyM3L	Middle	Head	Middle	141	81.34	74.10	18.81	73.76
Dy5M1	Middle	Tail	Middle	150	89.58	84.80	43.06	84.26
Dy1M9	Middle	Middle	Tail	134	100.00	92.24	100.00	95.97
Dy4M1	Middle	Tail	Head	644	92.40	63.43	-104.62	65.33
Dy1M3	Tail	Head	Head	139	100.00	93.83	100.00	96.80
Dy3M5-WUA	Tail	Tail	Tail	315	97.33	90.35	44.05	90.45
Dy3M5-D	Tail	Tail	Tail	605	93.72	85.14	24.17	85.02
TDyM4	Tail	Middle	Middle	144	97.90	72.11	-135.89	70.24

PBCDM10	Tail	Tail	Tail	229	96.80	93.19	59.97	92.68

Deprivation Index
= (Planned seasonal Irrigated Area - Area receiving canal water) x 100/ Planned seasonal Irrigated Area

It may be seen that the figures for deprivation on this basis still do not show a close relation with location. As we shall see below, we need to take account of well irrigation and that forms a decisive step in the quantification.

7.3 Direct and indirect deliveries: taking account of wells -- simple addition

Our discussion with the farmers shows that almost in all places, wells within the command are virtually canal recharge wells. Our discussion also shows that depending on the duration of rotation the wells give between one to even three waterings for the crop. This does not seem to depend too much on the actual area irrigated, so long as every portion of the sub-command gets *some* water. In effect, this is project water being delivered to the farmer, though in an indirect manner. There is every indication that this in fact is a major resource and not a minor supplement and irrigation policy needs to take note of this phenomenon.

Therefore we need to take account of well irrigation by treating it as indirect delivery of water to the farmers. The simplest form in which this may be done is simply to add together the areas irrigated by canal and wells and treat them together as the area irrigated by the project. There is a certain degree of overlap between these areas, but for the moment, pending more detailed investigation we may assume that they are correlated, and that they do not disturb the *trends* that the data show.

The season-wise and year-wise details of treating well and canal irrigation area together as irrigated area are presented in Table 7.3a at the end of the chapter and the average values for the period 1998-2001 are presented below in Table 7.3b.

***Table 7.3b*: Deprivation: As area not receiving canal or well irrigation (averages)**

Deprivation Index values are in %

Name of Dist./ Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index -- Average 1998-2001			
					Kharif	Rabi	H.w.	Total
Dy1M1	Head	Head	Middle	346	19.50	-23.26	-487.48	-43.87
Dy2Tail	Head	Middle	Tail	445	57.36	53.13	-182.12	40.54
SDyM3L	Middle	Head	Middle	141	1.18	49.00	-158.99	16.22
Dy5M1	Middle	Tail	Middle	150	72.20	70.75	-23.89	65.58
Dy1M9	Middle	Middle	Tail	134	90.05	67.81	100.00	79.11
Dy4M1	Middle	Tail	Head	644	75.65	48.24	-190.47	45.17
Dy1M3	Tail	Head	Head	139	34.34	-33.69	-31.00	-4.97
Dy3M5-WUA	Tail	Tail	Tail	315	97.33	84.89	30.82	86.81
Dy3M5-D	Tail	Tail	Tail	605	85.87	68.34	-86.16	66.26
TDyM4	Tail	Middle	Middle	144	68.37	43.95	-303.14	33.01
PBCDM10	Tail	Tail	Tail	229	92.72	90.15	27.58	87.41

Deprivation Index

= (Planned seasonal Irrigated Area - Area receiving canal water - Area irrigated by wells) x 100
/ Planned seasonal Irrigated Area

A comparison with the earlier table 7.2b would show that there is a significant change in the values, that there is a much closer relation with location and the hot weather situation completely changes. These trends are consistent with those observed in the field.

7.4 Incorporating number of rotations into the Index

Simple addition of area irrigated by canal and the area irrigated by wells, as seen above, does bring out the importance of well irrigation and shows a closer link with location, it also underestimates the degree of deprivation. The appearance of negative values in the annual average as well as the very high negative figures for the hot weather -- yes, hot weather crops have been in excess of the approved crop pattern, but do they really receive that much water? -- indicates the need for corrective measures in this respect.

We actually need to come to a comparison of the planned *water* use within the season and the water actually delivered to the area, directly through canal or indirectly through wells. For this, in addition to the area irrigated during each season, we also need to take account of the number of rotations in each season.

However this is not as simple as it sounds, and we need to decide on a couple of things and make those assumptions explicit. The first point is about well irrigation. While the link of canal irrigation with number of rotations, how do we link the number of rotations to the well irrigation component. As we have indicated earlier, our discussions with the farmers indicates that with one rotation of sufficient duration, the farmers can provide between one to sometimes three waterings to the crop from the well. We may safely (that is, without underestimating deprivation) assume that every rotation provides for well recharge sufficient for one watering. Also wells are capable of providing at least one watering on their own. For this reason we have taken the number of waterings from well irrigation as equal to the number of rotations in the season with an additional watering during kharif.

The second point that needs to be taken into consideration concerns the other term of the comparison. Granted that the above assumption gives us a measure of the total water *delivered* directly or indirectly to the farmer during a season, but what do we compare it with? What `*ought*' to have been the water delivered to the farmer in this way? There are two types of answers to this question that we have considered.

7.5 Deprivation assuming an `ideal' number of rotations

The Mula system, when it was planned, was planned to deliver water at a fairly frequent interval to the farmer. It was planned to provide in the rabi, a rotation of about 14 or 15 days duration with an interval of about 5 or 6 days between rotations. This gives us a figure of 6 rotations on an average for the rabi season. For the hot weather season, considering the smaller area planned for irrigation, the system was designed to provide a rotation of about 10 days with a two-day interval between rotations. This gives a figure of 10 rotations during the hot weather. In addition the system was supposed to deliver two rotations in the kharif season. Thus under the assumption of the system working ideally, we have the number of rotations that `ought' to have been provided as 2 in kharif, 6 in rabi and 10 in hot weather.

Under these assumptions, it is then possible to quantify the deprivation in the following manner. The amount of water delivered is assumed to be represented by the product of the area irrigated and the number of rotations actually provided for canals as well as wells. The reference product for each season is then the product of the planned irrigated area on the basis of the approved crop pattern and the `ideal' number of rotations for that season. The shortfall in comparison with the reference product expressed as a percentage of the reference product then gives us the deprivation.

The season-wise and year-wise details of treating well and canal irrigation area together and accounting for the ideal number of rotations are presented in Table 7.5a at the end of the chapter and the average values for the period 1998-2001 are presented below in Table 7.5b. (What if we only treat canal water in this way? For those interested, the season-wise and year-wise details of treating only canal irrigation area and accounting for the ideal number of rotations are presented in Table 7.4a and the average values for the period 1998-2001 are presented in Table 7.4b at the end of the chapter.)

***Table 7.5b*: Deprivation: Based on area-rotations product -- ideal number of rotations**

Deprivation Index values are in %

Name of Dist./ Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index -- Average 1998-2001			
					Kharif	Rabi	H.w.	Total
Dy1M1	Head	Head	Middle	346	38.25	45.55	-36.88	33.18
Dy2Tail	Head	Middle	Tail	445	65.84	79.39	33.56	70.77
SDyM3L	Middle	Head	Middle	141	39.46	76.96	38.13	64.87
Dy5M1	Middle	Tail	Middle	150	77.41	87.12	70.64	83.13
Dy1M9	Middle	Middle	Tail	134	90.05	89.27	100.00	90.85
Dy4M1	Middle	Tail	Head	644	76.21	76.77	41.91	72.00
Dy1M3	Tail	Head	Head	139	45.67	41.38	69.18	45.89
Dy3M5-WUA	Tail	Tail	Tail	315	98.66	92.44	84.92	92.58
Dy3M5-D	Tail	Tail	Tail	605	89.01	84.17	65.21	82.52
TDyM4	Tail	Middle	Middle	144	74.50	75.38	7.29	66.11
PBCDM10	Tail	Tail	Tail	229	96.02	95.53	86.14	94.37

Deprivation Index

= (Product of area x number of rotations for planned seasonal irrigated Area
- Product of area x number of rotations for area receiving canal water
- Product of area x number of rotations for area irrigated by wells) x 100
/ Product of area x number of rotations for planned seasonal irrigated area

7.6 A more `pragmatic' approach to rotations

The approach just described in respect of reference number of rotations may be approached in another way. Firstly, it may be argued that over the years the capacity of the system having undergone a change it may not be pragmatic to expect those may ideal number of rotations as earlier. Secondly, it may be argued that since well recharge also counts as indirect project water delivery, and since it seems to be the case one rotation provides for an additional watering from the well, each rotation may be taken to represent two. Of course, needless to say, this would imply a conscious decision to integrate groundwater and surface water (as has been done in some degree in Ozar) and the system would have to change accordingly. However, it does seem a plausible assumption and a quantification has been worked out on that basis.

The season-wise and year-wise details of treating well and canal irrigation area together and accounting for the more pragmatic number of rotations are presented in Table 7.7a at the end of the chapter and the average values for the period 1998-2001 are presented below in Table 7.7b. (For those interested, the season-wise and year-wise details of treating only canal irrigation area and accounting for the more pragmatic number of rotations are presented in Table 7.6a and the average values for the period 1998-2001 are presented in Table 7.6b at the end of the chapter.)

<u>Table 7.7b</u>: Deprivation: Based on area-rotations product -- pragmatic number of rotations

Deprivation Index values are in %

Name of Dist./ Minor/ Outlet	Project location	Reach location	Dist. Location	No. of farmers	Deprivation Index -- Average 1998-2001			
					Kharif	Rabi	H.w.	Total
Dy1M1	Head	Head	Middle	346	10.71	-8.91	-356.28	-42.19
Dy2Tail	Head	Middle	Tail	445	48.52	58.78	-121.45	44.19
SDyM3L	Middle	Head	Middle	141	2.33	53.92	-106.24	32.94
Dy5M1	Middle	Tail	Middle	150	64.85	74.25	2.13	68.10
Dy1M9	Middle	Middle	Tail	134	83.72	78.54	100.00	83.39
Dy4M1	Middle	Tail	Head	644	62.56	53.54	-93.64	46.74
Dy1M3	Tail	Head	Head	139	18.09	-17.24	-2.72	-2.24
Dy3M5-WUA	Tail	Tail	Tail	315	97.33	84.89	49.74	85.61
Dy3M5-D	Tail	Tail	Tail	605	78.01	68.34	-15.96	66.56
TDyM4	Tail	Middle	Middle	144	61.24	50.76	-209.04	34.82
PBCDM10	Tail	Tail	Tail	229	93.23	91.07	53.78	89.88

Deprivation Index, same as 7.5b but with more pragmatic number of rotations assumed

= (Product of area x number of rotations for planned seasonal irrigated Area
- Product of area x number of rotations for area receiving canal water
- Product of area x number of rotations for area irrigated by wells) x 100
/ Product of area x number of rotations for planned seasonal irrigated area

7.7 The different Indices compared

The triennial average values of deprivation for each type of Index have been worked out and presented for comparison below in Table 7.8.

***Table 7.8*: Deprivation by different norms compared**

Name of Dstb./Minor/ Outlet	Project location	Reach Location	Dist. Location	Norm for Deprivation						
				Number of farmers not receiving water	Area not receiving canal water			Area receiving neither canal nor well water		
					Simple area	Area and ideal number of rotations	Area and pragmatic number of rotations	Simple area	Area and ideal number of rotations	Area and pragmatic number of rotations
				Norm 1	Norm 2	Norm 4	Norm 6	Norm 3	Norm 5	Norm 7
Dy1M1	Head	Head	Middle	83.09	69.37	84.99	69.98	-43.87	28.07	-43.86
Dy2Tail	Head	Middle	Tail	95.06	92.53	96.22	92.44	40.54	70.77	41.53
SDyM3L	Middle	Head	Middle	75.56	73.76	87.49	74.98	16.22	64.87	29.74
Dy5M1	Middle	Tail	Middle	91.50	84.26	92.64	85.28	65.58	83.13	66.27
Dy1M9	Middle	Middle	Tail	98.78	95.97	98.24	96.47	79.11	90.85	81.70
Dy4M1	Middle	Tail	Head	58.90	65.33	82.59	65.18	45.17	72.00	44.01
Dy1M3	Tail	Head	Head	98.14	96.80	98.22	96.43	-4.97	45.89	-8.22
Dy3M5-WUA	Tail	Tail	Tail	64.27	90.45	94.73	89.46	86.81	92.58	85.16
Dy3M5-D	Tail	Tail	Tail	N.Av.	85.02	92.29	84.57	66.26	82.52	65.04
TDyM4	Tail	Middle	Middle	88.80	70.24	84.10	68.20	33.01	66.11	32.22
PBCDM10	Tail	Tail	Tail	62.34	92.68	96.74	93.48	87.41	94.37	88.73

It may be seen that the norms for canal and well together correlate more closely with location and reflect the effect of location more closely than the other indices.

7.8 Further issues: Impact on productivity and livelihood issues

There is a need to consider other factors that have an impact on productivity and are related to system efficiency and management. For example, the salinisation of groundwater has led to distinct effects on productivity. Even though the same amount of water is being provided, if it is producing less, should this not count as deprivation? This is a very serious issue in the Mula command. At present, the quantification that has been attempted above does not take this kind of thing into account, partly because the data required are very different. However this is one aspect that needs to be considered.

The second thing that needs consideration is how it affects livelihood needs in the area. Deprivation that affects five ha and a well in the command and delivers 50% less water than planned to someone who also holds another 5 ha of land outside the command is likely to be very different from deprivation where the holder has only a 0.5 ha holding in the command and does not own a well and has 50% water delivered.

Lastly, the Mula command already shows the pernicious effects of not taking wells and local, smaller source into account in project planning and implementation. It is time to take a more integrated approach and adopt a regional approach to water that looks upon project waters as one element in the regional picture and plans, restructures and implements projects accordingly. The findings of this study point to the need for a much more comprehensive study based on an integrated approach.

***Table 7.1a*: Deprivation: As farmers not receiving canal irrigation**

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index											
					1998-99				1999-2000				2000-2001			
					Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total
Dy1M1	Head	Head	Middle	372	100.00	76.88	85.22	87.37	85.75	75.81	79.30	80.29	83.06	76.08	85.75	81.63
Dy2Tail	Head	Middle	Tail	371	100.00	92.45	93.53	95.33	95.42	91.11	95.69	94.07	95.15	95.15	97.04	95.78
SDyM3L	Middle	Head	Middle	85	98.82	68.24	71.76	79.61	80.00	58.82	76.47	71.76	68.24	69.41	88.24	75.29
Dy5M1	Middle	Tail	Middle	200	95.00	93.50	91.00	93.17	97.00	88.50	92.00	92.50	87.00	84.00	95.50	88.83
Dy1M9	Middle	Middle	Tail	100	100.00	97.00	100.00	98.00	100.00	97.50	100.00	98.33	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	82.42	82.42	38.67	67.84	84.38	10.94	61.72	52.34	98.83	21.09	49.61	56.51
Dy1M3	Tail	Head	Head	197	100.00	98.48	100.00	99.49	100.00	94.42	100.00	98.14	100.00	90.36	100.00	96.79
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	76.88	85.22	73.30	85.75	75.81	79.30	58.33	83.06	76.08	85.75	61.17
Dy3M5-D	Tail	Tail	Tail	509	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.	N.Av.
TDyM4	Tail	Middle	Middle	250	100.00	90.40	85.60	92.00	97.20	86.80	78.00	87.33	100.00	88.40	72.80	87.07
PBCDM10	Tail	Tail	Tail	167	100.00	76.88	85.22	71.86	85.75	75.81	79.30	56.09	83.06	76.08	85.75	59.08

Deprivation Index

= (No. of farmers in command - No. of farmers receiving water) x 100/No. of farmers in command

Table 7.2a: Deprivation: As area not receiving canal irrigation

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index											
					1998-99				1999-2000				2000-2001			
					Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total
Dy1M1	Head	Head	Middle	372	100.00	74.62	-41.47	76.52	81.87	70.59	-61.63	64.75	78.01	66.87	28.43	66.84
Dy2Tail	Head	Middle	Tail	371	100.00	91.72	48.02	92.53	94.48	91.77	74.86	91.88	94.03	94.66	74.71	93.18
SDyM3L	Middle	Head	Middle	85	98.71	75.95	-24.46	79.37	80.60	65.59	37.77	70.20	64.70	80.76	43.11	71.72
Dy5M1	Middle	Tail	Middle	200	93.94	88.53	20.00	86.62	94.91	83.33	37.50	85.39	79.88	82.55	71.67	80.76
Dy1M9	Middle	Middle	Tail	100	100.00	88.37	100.00	93.96	100.00	88.37	100.00	93.96	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	89.56	66.23	-115.81	64.91	91.87	60.18	-59.53	66.17	95.77	63.88	-138.52	64.91
Dy1M3	Tail	Head	Head	197	100.00	98.52	100.00	99.23	100.00	91.43	100.00	95.55	100.00	91.54	100.00	95.61
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	92.86	12.70	90.96	100.00	89.82	53.57	91.88	91.98	88.38	65.87	88.51
Dy3M5-D	Tail	Tail	Tail	509	100.00	87.99	20.04	88.88	100.00	82.77	23.76	86.40	81.16	84.66	28.72	79.77
TDyM4	Tail	Middle	Middle	250	100.00	72.72	-124.93	72.11	93.71	73.13	-124.06	69.73	100.00	70.48	-158.67	68.88
PBCDM10	Tail	Tail	Tail	167	94.76	98.72	86.90	96.33	98.73	85.74	24.67	87.47	96.90	95.12	68.34	94.23

Deprivation Index

= (Planned seasonal Irrigated Area - Area receiving canal water) x 100/ Planned seasonal Irrigated Area

Table 7.3a: Deprivation: As area not receiving canal or well irrigation

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index											
					1998-99				1999-2000				2000-2001			
					Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total
Dy1M1	Head	Head	Middle	372	27.66	-15.12	-481.65	-35.25	13.93	-25.47	-558.94	-52.33	16.91	-29.19	-421.84	-44.04
Dy2Tail	Head	Middle	Tail	371	60.65	56.55	-200.33	42.58	59.34	53.66	-179.69	41.79	52.11	49.18	-166.34	37.25
SDyM3L	Middle	Head	Middle	85	-73.70	50.84	-202.25	-16.90	37.61	40.49	-140.03	28.26	39.62	55.66	-134.69	37.30
Dy5M1	Middle	Tail	Middle	200	79.15	76.57	-37.50	70.69	74.91	67.16	-35.83	64.12	62.55	68.53	1.67	61.93
Dy1M9	Middle	Middle	Tail	100	78.29	57.64	100.00	68.90	91.86	45.79	100.00	68.44	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	73.24	47.99	-213.24	42.64	73.13	44.44	-152.49	44.46	80.58	52.30	-205.67	48.42
Dy1M3	Tail	Head	Head	197	31.98	-14.68	-38.49	3.45	39.83	-38.28	-16.91	-4.18	31.20	-48.12	-37.59	-14.17
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	88.19	4.76	88.05	100.00	85.15	45.63	88.97	91.98	81.33	42.06	83.40
Dy3M5-D	Tail	Tail	Tail	509	100.00	74.38	-53.51	77.33	100.00	62.11	-78.10	69.45	57.60	68.52	-126.86	52.00
TDyM4	Tail	Middle	Middle	250	69.55	43.21	-262.48	35.60	69.30	49.93	-291.90	37.18	66.28	38.73	-355.05	26.25
PBCDM10	Tail	Tail	Tail	167	89.84	95.76	51.97	90.60	96.67	82.92	-2.62	83.47	91.66	91.78	33.41	88.17

Deprivation Index
= (Planned seasonal Irrigated Area - Area receiving canal water - Area irrigated by wells) x 100
/ Planned seasonal Irrigated Area

***Table 7.4a*: Deprivation: Based on area-rotations product -- ideal number of rotations and canal water**

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index											
					1998-99				1999-2000				2000-2001			
					Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total
Dy1M1	Head	Head	Middle	372	100.00	87.31	57.56	85.66	90.93	85.29	67.67	83.97	89.00	88.96	85.69	88.53
Dy2Tail	Head	Middle	Tail	371	100.00	95.86	84.41	95.09	97.24	95.88	94.97	96.01	97.02	98.22	94.94	97.56
SDyM3L	Middle	Head	Middle	85	100.00	87.97	62.66	86.80	90.30	82.80	87.55	84.81	82.35	93.59	88.62	90.85
Dy5M1	Middle	Tail	Middle	200	96.97	94.26	76.00	92.32	97.45	91.67	87.50	92.17	89.94	94.18	94.33	93.42
Dy1M9	Middle	Middle	Tail	100	100.00	96.12	100.00	97.35	100.00	96.12	100.00	97.35	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	94.78	83.12	56.84	81.75	95.94	80.09	68.09	81.40	95.77	87.96	52.30	84.62
Dy1M3	Tail	Head	Head	197	100.00	99.26	100.00	99.49	100.00	95.72	100.00	97.08	100.00	97.18	100.00	98.08
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	96.43	73.81	94.06	100.00	94.91	90.71	95.29	95.99	94.19	96.59	94.84
Dy3M5-D	Tail	Tail	Tail	509	100.00	94.00	76.01	92.69	100.00	91.38	84.75	92.08	90.58	92.33	92.87	92.08
TDyM4	Tail	Middle	Middle	250	100.00	86.36	32.52	81.67	96.85	86.57	55.19	84.26	100.00	90.16	48.27	86.37
PBCDM10	Tail	Tail	Tail	167	100.00	99.36	96.07	99.04	99.36	92.87	84.93	93.00	98.45	98.37	96.83	98.18

Deprivation Index
= (Product of area x number of rotations for planned seasonal irrigated Area
- Product of area x number of rotations for area receiving canal water) x 100
/ Product of area x number of rotations for planned seasonal irrigated area

***Table 7.5a*: Deprivation: Based on area-rotations product -- ideal number of rotations, canal and well irrigation**

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index											
					1998-99				1999-2000				2000-2001			
					Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total
Dy1M1	Head	Head	Middle	372	63.83	42.44	-74.50	30.73	23.00	37.26	-31.79	25.40	27.91	56.94	-4.37	43.40
Dy2Tail	Head	Middle	Tail	371	80.32	78.28	9.90	69.51	62.10	76.83	44.06	69.74	55.09	83.06	46.73	73.06
SDyM3L	Middle	Head	Middle	85	13.79	75.42	9.32	55.24	47.31	70.25	51.99	63.58	57.27	85.22	53.06	75.78
Dy5M1	Middle	Tail	Middle	200	82.18	88.28	58.75	83.21	77.45	83.58	72.83	81.01	72.61	89.51	80.33	85.17
Dy1M9	Middle	Middle	Tail	100	78.29	85.88	100.00	86.37	91.86	81.93	100.00	86.17	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	78.46	73.99	37.35	69.91	77.19	72.22	49.50	70.09	72.98	84.10	38.87	76.00
Dy1M3	Tail	Head	Head	197	65.99	42.66	58.45	49.06	39.83	30.86	76.62	38.63	31.20	50.63	72.48	49.98
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	94.09	71.43	92.15	100.00	92.58	89.13	93.48	95.99	90.66	94.21	92.12
Dy3M5-D	Tail	Tail	Tail	509	100.00	87.19	53.95	85.10	100.00	81.05	64.38	82.31	67.02	84.26	77.31	80.16
TDyM4	Tail	Middle	Middle	250	84.77	71.60	-8.74	63.28	72.44	74.96	21.62	67.36	66.28	79.58	8.99	67.69
PBCDM10	Tail	Tail	Tail	167	97.54	97.88	85.59	96.17	97.30	91.46	79.48	90.93	93.21	97.26	93.34	95.99

Deprivation Index
= (Product of area x number of rotations for planned seasonal irrigated Area
- Product of area x number of rotations for area receiving canal water
- Product of area x number of rotations for area irrigated by wells) x 100
/ Product of area x number of rotations for planned seasonal irrigated area

Table 7.6a: Deprivation: Based on area-rotations product -- pragmatic number of rotations, canal water

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	**Project location**	**Reach Location**	**Dist. Location**	**No. of farmers**	**Deprivation Index**											
					1998-99				**1999-2000**				**2000-2001**			
					Kharif	**Rabi**	**H.W.**	**Total**	**Kharif**	**Rabi**	**H.W.**	**Total**	**Kharif**	**Rabi**	**H.W.**	**Total**
Dy1M1	Head	Head	Middle	372	100.00	74.62	-41.47	69.71	93.96	70.59	-7.75	75.61	78.01	77.91	52.28	75.76
Dy2Tail	Head	Middle	Tail	371	100.00	91.72	48.02	89.62	98.16	91.77	83.24	93.93	94.03	96.44	83.14	94.85
SDyM3L	Middle	Head	Middle	85	100.00	75.95	-24.46	72.11	93.53	65.59	58.51	76.89	64.70	87.17	62.07	80.67
Dy5M1	Middle	Tail	Middle	200	93.94	88.53	20.00	83.77	98.30	83.33	58.33	88.09	79.88	88.37	81.11	86.10
Dy1M9	Middle	Middle	Tail	100	100.00	92.24	100.00	94.41	100.00	92.24	100.00	95.97	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	89.56	66.23	-43.87	61.43	97.29	60.18	-6.35	71.70	91.53	75.92	-59.01	67.51
Dy1M3	Tail	Head	Head	197	100.00	98.52	100.00	98.93	100.00	91.43	100.00	95.55	100.00	94.36	100.00	95.93
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	92.86	12.70	87.45	100.00	89.82	69.05	92.83	91.98	88.38	88.62	89.10
Dy3M5-D	Tail	Tail	Tail	509	100.00	87.99	20.04	84.56	100.00	82.77	49.17	87.95	81.16	84.66	76.24	83.27
TDyM4	Tail	Middle	Middle	250	100.00	72.72	-124.93	61.26	97.90	73.13	-49.38	76.05	100.00	80.32	-72.45	71.19
PBCDM10	Tail	Tail	Tail	167	100.00	98.72	86.90	97.96	99.58	85.74	49.78	89.36	96.90	96.75	89.45	96.16

Deprivation Index, same as 7.4a but with more pragmatic number of rotations assumed
= (Product of area x number of rotations for planned seasonal irrigated Area
- Product of area x number of rotations for area receiving canal water) x 100
/ Product of area x number of rotations for planned seasonal irrigated area

<u>Table 7.7a</u>: Deprivation: Based on area-rotations product -- pragmatic number of rotations, canal and well water

Deprivation Index values are in %

Name of Dist./Minor/ Outlet	Project location	Reach Location	Dist. Location	No. of farmers	Deprivation Index											
					1998-99				1999-2000				2000-2001			
					Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total	Kharif	Rabi	H.W.	Total
Dy1M1	Head	Head	Middle	372	27.66	-15.12	-481.65	-46.37	48.66	-25.47	-339.29	-60.60	-44.18	13.87	-247.89	-19.61
Dy2Tail	Head	Middle	Tail	371	60.65	56.55	-200.33	35.56	74.73	53.66	-86.46	53.95	10.18	66.12	-77.56	43.06
SDyM3L	Middle	Head	Middle	85	-72.41	50.84	-202.25	5.43	64.87	40.49	-60.02	44.59	14.54	70.44	-56.46	48.81
Dy5M1	Middle	Tail	Middle	200	64.36	76.57	-37.50	64.52	84.97	67.16	9.44	71.11	45.21	79.02	34.44	68.67
Dy1M9	Middle	Middle	Tail	100	56.58	71.76	100.00	71.20	94.57	63.86	100.00	78.96	100.00	100.00	100.00	100.00
Dy4M1	Middle	Tail	Head	256	56.92	47.99	-108.82	36.43	84.79	44.44	-68.33	54.49	45.97	68.20	-103.78	49.30
Dy1M3	Tail	Head	Head	197	31.98	-14.68	-38.49	-7.63	59.89	-38.28	22.06	6.62	-37.61	1.26	8.27	-5.70
Dy3M5-WUA	Tail	Tail	Tail	176	100.00	88.19	4.76	83.41	100.00	85.15	63.76	90.08	91.98	81.33	80.69	83.34
Dy3M5-D	Tail	Tail	Tail	509	100.00	74.38	-53.51	68.51	100.00	62.11	-18.73	73.08	34.03	68.52	24.38	58.08
TDyM4	Tail	Middle	Middle	250	69.55	43.21	-262.48	22.40	81.63	49.93	-161.26	50.34	32.55	59.15	-203.37	31.72
PBCDM10	Tail	Tail	Tail	167	95.08	95.76	51.97	91.91	98.20	82.92	31.59	86.20	86.42	94.52	77.80	91.53

Deprivation Index, same as 7.5a but with more pragmatic number of rotations assumed
= (Product of area x number of rotations for planned seasonal irrigated Area
- Product of area x number of rotations for area receiving canal water
- Product of area x number of rotations for area irrigated by wells) x 100
/ Product of area x number of rotations for planned seasonal irrigated area

Chapter 8

Broad conclusions and emerging issues

In this chapter we discuss our broad conclusions, the emerging issues and trends, and the possible ways to tackle them. Project-wise findings and conclusions have already been discussed in detail in the previous chapters and a further summary is provided in the Annexure. The suggestions and recommendations below are of two types. There are those that are of a practical nature and could be adopted without much change in the system. And there are others that necessitate a change in how we perceive, plan and manage irrigation projects, in view points and frameworks and also in certain policy initiatives. There is no `Chinese Wall' between these two sets of suggestions and nor are they presented here as if there were.

8.1 Reduced Inflows

There is every indication that there is one or other kind of trend towards reduced inflows at the dam site for two out of the three projects under consideration. The existence of the trend itself is not so much related to the size of the project but has more to do with the characteristics of the agro-climatic zones where the projects are located, the stability of the rainfall regimes, and the type and extent of upstream development of new storages like percolation tanks, minor irrigation tanks, nallah bunds and other soil and water conservation measures. Inflows into the Mula dam do show an overall trend of reduced flow, though here the variation is not extreme and dependability is not as greatly compromised. (It is possible that the impact of reduced inflows at Mula site may have significant impact on *downstream* projects since the proportionate reduction in downstream inflows is much larger.) However, in the Mangi project the fluctuations are very high and lows are much more frequent in recent years. The conclusion, however, does not hold for the Walen tank, which has a high rainfall catchment and fills regularly. This factor has an impact on deprivation since a fixed and expected schedule cannot be followed, even for a sizeable component of water.

The large project shows a greater resilience in face of this trend, so that only in especially bad years does it result in a substantial shortfall. For the medium project, however, its sensitivity to low rainfall years seems to have increased as upstream development has taken place in the catchment. For low rainfall years the storage available plummets drastically providing practically very little irrigation in those years. This indicates that while in the better years, the catchment treatment would not matter as much, in the years when rainfall is not adequate it does affect dam storage significantly.

Large projects utilise more assured, high rainfall

However this trend also needs to be seen in conjunction with another factor that is indirectly related to catchment size. In the case of smaller projects the rainfall regime is more or less the same both in the catchment and command areas. So for the smaller (medium and small) projects located in the drought prone zone, if there is a shortfall in the rainfall, there is a resultant decrease in water availability in the dam then directly affects the crops in the command areas. In the case of larger projects, as can be seen from the case of Mula dam, the catchments are large and they tend to cut across different rainfall regimes and include high and more assured rainfall zones. Those dams are in effect means of diverting the water from high and assured rainfall zones to water scarce areas. Thus the dependability of the available water, even if the quantum may be reduced in absolute terms, is still a feature often found associated with larger projects. As we saw in the discussions of Mula and Mangi projects these have implications not only in the way deprivation operates in projects of different sizes but also the ways to tackle the problem.

Need for integrated planning of large and small sources

The first implication is the need for an integrated planning of water resources at the basin level in which watershed development works and surface storages of different sizes are planned together. Larger water storages that have to be planned as terminal storages (structures) need to take into account expected inflows into the larger structures *before and after* upstream watershed development. Inflows need to be estimated both on the basis of present runoff availability as well as the runoff availability once the catchments are fully developed. Long term planning has to be based on the latter and the difference needs to be treated a s a transitional surplus. This would help in planning the larger sources and their service area more realistically. The lack of integration of various kinds of water resources is one of the many reasons for the crisis in the water sector and there is an urgent need to adopt an approach that integrates the various kinds of water resources. Conventional thinking has often actively discouraged such integration. The new movements and approaches that have evolved out of a criticism of the prevalent conventional thinking and practice also tend to advocate the rejection of one or the other kind of resource rather than their integration.

Integration has potential to overcome limitations of both kinds of sources

Integration has the potential to overcome the limitations of both kinds of sources. For the local system, the exogenous water supplement can provide critical support needed for livelihood assurance that is sufficiently dependable in critical years. Integration implies that it is the local system, rather than the individual irrigator who receives the water supplement from the larger system. In such a case, the local water system plays multiple roles -- as a system for harvesting and utilising local water, as a buffer or holding system for the larger system creating greater control over the timing and quantum of water application for the individual user, and as a semi-autonomous management unit much more compatible with participation and `turnover'.

Such type of an integrated planning may be outside the realm of this particular study as it only looks at deprivation within the command. However, it turns up here as well, as one of the reasons for the deprivation within the command. (For example, in some of the tail portions, new checkdams on the river have resulted in fall of demand for canal water leading to lack of applications leading to fall in collections leading to lack of maintenance leading to cessation of canal deliveries.) The discussion above serves to point out that at least some of the factors responsible for deprivation within the command lie outside the command as well and we may have to look for remedies outside the command as well if we are to tackle the problem fully.

Re-assess inflows and rework command area planning

Undoubtedly, the above discussion relates to long term measures and they will take time. In the short term, what immediately needs to be taken up and can be taken up as part of conventional command management, is to re-assess the present inflow after giving due allowance for catchment area development and redesign the service according to this assessment. This is especially relevant for already completed projects which have been in operation for quite some time. This would perhaps imply a shrinkage in the service and may involve a reduction in the number of people who are entitled to water or in the number of rotations or the quantum of water delivered. In general, it may call for a number of rationalising measures. This also has implications for the size of the irrigation bureaucracy. (Can we justify the same size with a shrunken command?) More attention may have to be paid the issue of increasing irrigation efficiency and norms of water distribution. The main point here is to begin immediately to think of ways and means of coping with the decreased inflows at the dam sites.

8.2 The issue of groundwater and wells

The other aspect of integration is the integration of surface and ground water. The study clearly brings out that the degree and character of deprivation radically changes with access to well water within the command. It is quite well known that wells in the command areas are primarily recharged with the percolation from canals and irrigated areas. In that way well water has also to be considered as water from the project. However, in present practice canal water and well water are both treated and managed separately – the canal water falls in the public domain and well water is treated as a private property. There is a need to bring in well water in the command areas under the public domain. As discussed elsewhere, the only legal provision today is that the ID can charge the farmers with wells in the command areas, and even this provision is not enforced.

The paat-mot sambandh -- to break or not to break?

In fact, in Maharashtra, till recently there was an explicit understanding *against* integration of wells and canal water, under what is known as breaking the *paat-mot sambandh* (the *paat*, that is, canal and *mot*, that is, the traditional device that lifted water from the wells, relationship). Ironically, actual developments today, implicitly accept and even assert this relationship! As we have seen earlier, in the Mula project, when announcements are made inviting farmers to fill in forms for water demand, for the last few years the announcement is generally that `all those who have access to well water would be given two rotations during rabi'. This effectively means that only those who have access to well need to apply for canal water. Though it does not say so, all those who do not have access to water are discouraged from applying. This is a device the ID has come up with to forestall legal actions like those in the past where users have gone to court against the ID demanding crop loss compensation because they did not get sufficient water to raise their crops and had to incur crop losses. It is tantamount to shirking the responsibility of providing sufficient water for farmer's crops. Moreover, the announcements do not remedy the situation – they only accentuate deprivation as access to canal water gets restricted to those who have wells or those who can gain access to well water. This, in a way, institutionalises deprivation.

Ozar model of integration needs to be studied and followed

Thus there is a need for an integrated approach to groundwater and surface water management. The separation of groundwater and surface water management has been an explicit assumption and a desideratum of the conventional approach to surface irrigation systems. However well intentioned and desirable it may have been, their separation, in actual control as well as ownership and utilisation rights, has had a pernicious effect. Their integration advocated by SOPPECOM and as has been demonstrated to a good extent in the case of the WUAs in Ozar, Nashik district, can, to a large extent, take care of the type of deprivation that exists in the absence of access to well water. Such an integration can also lead to much closer control over the timing and quantum of water application and help service a larger area much more effectively.

Data that do not take wells into account are misleading

In the absence of such integration, even the data that is available on irrigation gives a very distorted picture of the impact of irrigation projects. In the statistics that is generally available on irrigation there is data given on source-wise irrigation like tanks, ponds, wells, canals, etc. In the case of Maharashtra, irrigation on wells accounts for about half of about 17% irrigation. Now this is misleading. If we look at where the bulk of the well irrigation comes from we can see that a significant portion of it is in the irrigation command itself. In fact, the Maharashtra Water and Irrigation Commission (1999) estimates that about 40% of the well irrigated area lies in the command areas. These figures become easy tools in the hands of critics of irrigation projects as their intention is to condemn the projects and not reform them. Area irrigated by project water is likely to be of the order of twice the area actually reported as canal irrigation.

Similarly, the *degree* of deprivation is likely to be overstated if we do not take wells in the command decisively into account. As has been demonstrated in Chapter 7, only the data that take wells into account show a correlation to and express tail-ender deprivation. While the impact of canal irrigation is likely to be underestimated by not taking wells into account, the degree of deprivation is likely to be over-estimated. As our previous chapter shows, even after taking wells into account the tail-ender problem remains a significant and serious problem that needs immediate attention.

8.3 The physical state of the system

The study brings out very clearly that the physical status of the system is a factor contributing to deprivation. In light of the state of the system reported in the respective chapters, it would be an understatement simply to say that the distribution systems have not been maintained properly. Things are much worse. None of the distributaries and minors has the capacity to carry water as per the design capacity. No financial allocations have been made for repair, maintenance and improvement. It is reported by the people and admitted by ID officials, that the situation has worsened in the last 5 years that coincide with the formation of the different corporations like MKVDC, GMIDC, etc. Even field channels are not maintained properly by farmers.

Lack of maintenance and active damage -- a vicious circle

While on one end of the spectrum we have lack of maintenance, on the other we have things an active modification of the system. Whether it is pumping of water from the canals directly to the fields or into wells, or siphoning off canal water through pipes into wells, or making pits within the canals on the lines of intake wells to facilitate lifting water directly from the canal, or whether it the much more ubiquitous blocking of minors and breaching of channel banks to divert water to their fields -- each of these causes active damage to the system.

There is something like a vicious circle operating here. Because of lack of maintenance rotations cannot be completed as per schedules (even with a shrunken area), which forces people to resort to various dubious means, as described above, to get access to water. Here again the size of the project does not seem matter. Within this, we noticed a progressive deterioration in the situation as we moved from head reach to the middle to the tail reach of the project *or* the distributary *or* the minor. In this process, each of these elements accentuates deprivation: those who are at the tail end of the system become more and more affected as the system more and more loses its capacity carry water till the end.

WUAs as facilitating measures

This is an issue which calls for urgent action and it is not something the people on their own, on a voluntary basis can do. As we see later, things are much better if people take over the system by forming a WUA, but the crucial issue is whether the necessary measures are carried out *before* turn over. The people have shown willingness to cooperate and contribute if the Department makes a definite commitment and funds allocation for system improvement and maintenance.

And users do need to adhere to certain self-discipline in this matter which will be greatly facilitated by the people taking over the management through WUAs.

8.4 The crop pattern: need to shift to volumetric quotas

Another important issue which needs serious consideration is the crop pattern as it exists today in the command areas. The study clearly brings out the disproportionate shift towards HW utilisation – in fact many times more than planned or as envisaged in the approved cropping pattern. It is pretty well known that in most of the irrigation projects the approved cropping pattern is generally not adhered to. This has also nothing to do with the size of the project. Any number of *pnchanama*s by the ID is not proving to be of any help in this matter.

For example in the case of Mula Project, the study shows that the actual area irrigated by canal and wells in Hot weather is 2.6 times the planned area and in the cropping pattern, the area under sugarcane is more than 15% instead of 5% as per the project plan. In effect this means that a much larger proportion of the actual water is used in the HW and similarly a much larger proportion is used for sugarcane and this is bound to deprive certain portions of the command of access to water.

WUAs as instrument of rationalising water distribution

Here the best way is to decide on water quotas rather than crop patterns, shift to volumetric supply and leave it to the users to decide what crops they want to take, provided they operate within the water quota allotted to them in the different seasons. This will simplify management issues between the department and the farmers. The WUAs can be an instrument to bring this about. If the entire command of a project is covered with WUAs then water quotas proportionate to the storage at dam can be fixed for each of the WUAs and the WUAs can decide on norms for internal distribution of that quota. To do justice to the project plan, the plan can become the basis for working out the water quotas. For example, in Maharashtra. water quotas are generally fixed for WUAs on the basis of proportionate share the WUA has in the ICA, the approved crop pattern and water norms. Once the quota is fixed, *then* the users are free to take any crops they want provided they can manage it within the quota and rotations that would be provided to the WUA.

Giving the WUAs more say

At present neither the farmers nor the WUAs have much say in the present set up in the scheduling of rotations, for example. However, they do have definite views on this scheduling as has been brought out in the FGDs. Efficient project management requires the management of variable supplies, especially, shortages. Today shortages lead to intense unregulated, individual competition that accentuates deprivation. What is required for efficient management is a prior agreement with the farmers on the management of supplies, especially shortages that would result in a more equitable sharing of surpluses as well as shortages.

Without WUAs there is a difficulty in giving farmers a say in project management. This is because selected committees of farmers have little standing among the farmers, and secondly, they have very little ability to enforce decisions that taken with their participation. WUAs on the other hand would have both, and their existence throughout the command would go a long way towards managing shortages and mismatches.

8.5 `Why apply?' -- the tail-enders' mental block

There are many people in the designated commands who do not bother to apply for water and their proportion is much higher in the tail end of the project command as well as of the sub-commands. Since year after year they have not been getting water they have got into a mental state where they do not even demand their due share. Here being at the physical tail end matters very much. In the present set up of project management and given the status of the distribution system, tail-enders are at a definite disadvantage.

Another reason for this mental block is that once they apply for water and the application is sanctioned then they are often forced to pay the water charges, whether they get water or not, or how much they get. Here again forming WUAs can help them in getting their due share as once the WUA is formed, the ID has to fix the water quota for the WUA and also give them a share proportionate to the availability of water. In fact, in many cases the tail-enders have realised this potential of WUAs and users from the tail end portion of the commands are more interested in forming WUAs as compared to the users from the upper reach of the command.

8.6 Waterlogging, salinity and other related problems

Not getting access to water is only one type of deprivation. There are other types of deprivation. For example not getting enough water or rotations for the requirements of different crops in different seasons is one of such types. This is prevalent in all the projects studied, irrespective of size. The system is not in a position to deliver the number of rotations as planned. The second example is of timeliness of water delivery. This is illustrated by the experience of Mangi where only one rotation was given in rabi and since it was given late the people who took the rotation had a loss of production as compared to the people who did not use or get access to the rotation. This issue is discussed in detail in the chapter on Mangi. The third aspect is waterlogging and salinity which is more prevalent in the upper reaches of the commands. Along with land even the wells have been affected. There is no ready made answer about how one does tackle this, especially after such situations have already arisen.

In new projects care should be taken to see that water is applied much more scientifically taking the soil characteristics, etc into account. Canal seepage is something which needs to be tackled as lot of areas close to the canals are getting waterlogged because of percolation. Also sufficient emphasis is not given for constructing and maintaining proper drainage. In many parts of the commands natural drains have disappeared after the projects have come up and the gradients are flat and so there is no outfall form where the water can flow out.

8.7 Tail to head not sufficient

Very often it is suggested that tail to head irrigation can take care of the tail-end problem. This is only partially true. As discussed in the chapter on Mangi project, during the last rabi season the ID distributed water on the basis of this principle. Though the tail-enders of the project did get access to water to some extent, the losers were the farmers from the middle reaches. Once the irrigation started from the tail end after a few days the farmers from the upper reaches lost patience and they started taking water and as a result the ID had to hurry through the rotation and open up outlets and distributaries in the upper reaches even before the farmers from the middle reaches could complete their irrigation. Whatever system is followed, it should be well understood by both the supplier and the user and both should follow a common discipline in its implementation.

8.8 Some simple measures

Especially in the matter of number of rotations, any of the problems above, though by no means all, could be addresses as follows:

a) To avoid excess supply or use of water, especially in the upper reach of the system, water quotas be allocate equitably and adhered to in all sub-commands.
b) Once the quantity of water available for irrigation is assessed, the supply or distribution needs to be decided by the ID and the farmers together, especially the number of rotations, the opening and closing of canal seasons. WUAs would greatly facilitate this process.
c) More number of rotations are always good for light and medium soils in the command. However, farmers need to control their water use to between 40 and 60 mm at a time if more rotations are to be possible with the same amount of water. WUAs could motivate the farmers to do this and initiate a dialogue between the farmers and the officials.

8.9 WUAs are an important part of the solution

The final point to be made is that the formation of WUAs is an important component of the solution to the problem of deprivation. SOPPECOM has been in the forefront in forming WUAs and also extending training to them and advocating the formation of WUAs. Experience in Maharashtra does show that participatory irrigation management through WUAs can be an institutional way to take care of many aspects of deprivation. This is corroborated by the experience of the WUAs in this study as well. For example the situation on Minor 1 on Distributary (Dy4M1) is much better as compared to the situation in other sub-commands in the sample. The Shiv Shaki Water Users Association has been functioning on this minor for the last 5-6 years. SOPPECOM had helped the people in forming the WUA on this minor and provided inputs for the first three years of its operation. In fact this WUA had to face lot of problems in the initial stages of its formation as one Ex-MLA from the jurisdiction of the WUA refused to pay the water charges on the argument that he has never paid water charges prior to the takeover by the WUA. It goes to the credit of the WUA that it could straighten him out within a couple of years and now he has reportedly started paying the water charges to the WUA. As reported in the chapter on Mula project the situation is much better even in terms of the maintenance of the minor and channels. Thus, some of the major factors that contribute towards deprivation in the command areas can be taken care of by shifting to participatory mode of irrigation management.

A word of caution: Not by WUA formation alone

However, we also need to emphasise that WUAs can perform better only if both the parties, that is the ID and the WUA, are willing to respect their responsibilities and discharge them seriously. Otherwise we get into situations like that of Minor 5 on Distributary 3 (Dy3M5) in the tail portion of Mula command. There the WUA, called the Renuka Mata Society, is functioning but the situation is not any different from what is existing on other minors without WUAs.

Here the main constraint has been that the WUA took over the minor without rehabilitation of the minor and system improvement by the ID. Because of this the water cannot reach nearly one-third of the command under the jurisdiction of the WUA. Though it is mandatory that the ID should carry out proper rehabilitation and improvement of the minor before the `turn over', somehow the ID convinced the office bearers (in Renuka Mata, the Chairman of the WUA is a former contractor with the ID!) to take over the minor without any such work being done. If this type of a situation develops, gradually the people would lose faith in WUAs since they cannot find a visible difference in the situation. On the other hand the WUAs also would have to enforce certain discipline amongst their members in terms of water use, maintenance of field channels, paying of water charges and also putting a stop to lifting/siphoning of water from the canals, etc.

Not without capability building

The Government of Maharashtra has taken a policy of bringing the entire irrigation under participatory management and has also declared that farmers would not get water if they do not form WUAs by 2003. This is quite a tall order given the present set up as the irrigation bureaucracy need to change its mental make up and equip itself for this task. There is a need for training and capability building of both the ID officials and the irrigators. As we discovered during the field work of the Walen minor irrigation project, the concerned officers of the project are not even aware that the procedures for registration of the WUAs had been simplified. They were insisting that each farmer should get individual evidence from the Talathi (village revenue official) of the land he held in the ICA of the project. This process, known in Marathi as *7/12cha Uthaara kaadhne*, is a very time consuming process and very often it cannot be done unless the farmers bribe the Taltathi. With SOPPECOM initiative this requirement has already been done away with, the procedure simplified, notified by the ID and instructions to this effect have been issued. Yet none of this seems to have percolated down to the lower rungs of the bureaucracy. There is also a need for the government to collaborate with experienced NGOs in this field. But the government does not seem to be taking any such initiatives.

Separate the issues of water rights and turnover

Another aspect of turning over the system to WUA is that there is the danger of *freezing* the water rights they exist today. Not that they have any explicit rights. But it is no secret that present practices are based on wasteful use of water and if present practice is to become the sole basis of establishing quotas, this may result in their acquiring shares that may be well out of proportion of their equitable right. This is an issue that needs further attention and discussion. We need to discuss whether or not a distinction should be made between turnover and acquiring permanent water rights over present quantum of water use. There is a need to distinguish between the two and to treat present water use as a *provisional* right subject to later study and negotiation. The need for this arises because present use is likely to depart from and may be far in excess of what could be considered a rightful and reasonable due to wasteful system that has evolved, especially in command areas. Freezing water rights at present levels would then be tantamount to rewarding waste and doing it inadvertently as part of turnover would compound it further.

Federation to handle inter-WUA matters

Forming WUAs at the minor will not also solve many of the larger problems that affect inter-WUA matters or matters that affect many WUAs. For example problems like the scheduling of rotations, resolution of conflicts between WUAs in upper and tail reach, or between farmers who are dependent on direct lifts from the backwaters of the dam and farmers who are dependent on the canals. To tackle these issues probably we have to go for successively higher levels of organisation like a distributary level federation of minor level WUAs and so on, ultimately forming an apex body at the level of the project itself. In fact SOPPECOM did make an effort to form such a federation on one of the distributaries on the Mula project and also got the necessary bye-laws of the proposed federal society approved by the Cooperative Department. However SOOPECOM could not make much of a headway in this because of the lack of interest shown by the ID, thought the minor-level WUAs had passed the necessary resolutions for federating into a federal society.

Bringing wells in command under jurisdiction of WUA

The other issue is what do we do with the wells in the command areas. Under the present practices the WUAs have no jurisdiction over the wells in the command area. Here we have to take a stand that the wells also have to be brought under the jurisdiction of the WUAs. This would have legal implications as presently wells are treated as private property. The states would have to bring in certain policy initiatives in this regard.

8.10 Making WUAs instruments integration of water sources, equitable access and sustainable use

The formation of the WUA and turn over of the system after system rehabilitation and improvement goes a long way towards tackling deprivation within the command. However, as we have earlier said, deprivation in the sense of deprivation within the command is only one aspect of deprivation. To tackle the issue of deprivation in the full sense, we need the WUAs to become instruments for the integration of water sources, sustainable use and equitable access.

The experience of the three WUAs on Waghad project (the WUAs are in Ozar in Nashik district) formed by Samaj Parivarthan Kendra (SPK) with help from SOPPECOM could give us some directions in this regard. This is a subject for a separate study, but we can summarise the main aspects as follows: 1) SPK could mobilise funds from the Soil conservation department to build 2 *bandhara*s and 14 bunds on the streams and *nallah*s adjoining the command, 2) these structures were used to harvest local rain water and also to store the unused water from the quota of the WUAs; 3) the wells in the command were monitored and showed the people with the help of data that the increased water levels in the wells are because of the irrigation the command and the water stored in the structures; 4) integrated and conjoint use of local water and exogenous water coming from Waghad project and the water from the wells, 5) at least in one WUA – Mahatma Phule WUA – the SPK could convince and persuade the members to pay water charges to the WUA for the increased water levels in their wells at 50 per cent of the canal water charges. As a result of all these efforts the data which the WUAs have kept shows that they could increase the actual irrigated area by about 3 to 4 times within 5 years of the existence of the WUAs (from 1995-96 to 1999-2000). Though it calls for a detailed study, this is enough to conclude that the experience is worth following.

Annexure

Mula, Mangi and Walen Projects: Summarised findings

Sr. No	Village/ Sub-command	Planned Irri. Area (ha)	Area irrigated by canal during last three years (ha)			Area irrigated by canal and wells during last three years (ha)		
			Max	Min	Av.	Max	Min	Av.
MULA PROJECT -- Head Reach								
1.	**Dy1M1: ICA - 345 ha. No. of farmers - 372**							
	Kharif	204.60	45.00	0	27.36	176.10	148.00	164.70
	Rabi	252.96	83.80	64.20	74.13	326.80	291.20	311.80
	Hot weather	29.76	48.10	21.30	37.17	196.10	155.30	174.83
	Villages: Pimpri Avghad (PA), Kondhwad (K), Shilegaon (S)							
	• Last 0.5 km of the Minor is completely non-functional. • Many outlets not functioning. Channel walls breached in 13 places. Siltation in many places has reduced capacity. Stormwater ingress also reported. • Groundwater is saline and only sugarcane, wheat and ghas can be taken. • More than 50% in PA do not bother to apply because a) receive less no. of waterings but have to pay full charge, b) well recharge is adequate for many, c) about 10% report lack of field channels, d) about 20% are defaulters, and e) bribes cost less than water charge. • About 10% have not got water in K and S because they are defaulters. About 25% have not bothered to apply. They are at tail Field channels not maintained. • In K and S leaders were reported to be the ones in the head reach of the minor and consumed all the water.							
2.	**DY2Tail: ICA - 44.92 ha, No. of farmers - 371**							
	Kharif	244.71	14.60	0	9.37	117.20	96.30	104.33
	Rabi	302.55	25.05	16.15	22.03	153.75	131.45	141.8
	Hot weather	35.59	18.50	9.00	12.15	106.90	94.80	104.42
	Villages: Kendale Budruk (KB), Kendale Khurd (KK), Chandkapur (C)							
	• Last 2 km of the Dist, tail is not functioning at all. Channel is encroached, overgrown with weeds and prosopis. Five breach on channel walls. • Groundwater has turned saline and only ghas, sugarcane and wheat can be taken. • Number of rotations decreased, not sufficient for crop. • In KB, farmers apply for smaller area than what they irrigate. Fifty per cent do not apply at all. Eighty per cent have access to wells or river lift. • In KB, farmer encroachment on field channels. Fifty per cent area out of service because field channels not maintained. • No one from C gets water, while at most 20% from KK apply. Distributary has lost capacity, field channels not maintained, and no water for last five years, so no expectation. • Prefer to rely on wells. • Defaulters drop out.							

MULA PROJECT -- Middle Reach								
	SDyM3L: ICA - 140.61 ha, No. of farmers - 85							
3.	Kharif	77.34	27.30	1.00	14.43	134.34	46.70	76.43
	Rabi	95.61	32.90	18.40	24.77	56.90	42.40	48.77
	Hot weather	11.25	14.00	6.40	9.13	34.00	26.40	29.13
	Village: Sonai							
	• Pumps have been installed in the head and middle portions of the Minor. More than nine breach. • No repair and maintenance by officials. Farmers contributed and repaired 75% of the minor last year. • Ninety per cent of land has reportedly turned saline and 40 % is waterlogged for more than a month. • 25% farmers do not apply since they have other means to access water.							
	Dy5M1: ICA - 150.00 ha, No. of farmers - 200							
4.	Kharif	82.50	16.60	4.20	8.60	30.90	17.20	22.93
	Rabi	102.00	17.80	11.70	15.50	33.50	23.90	29.83
	Hot weather	12.00	9.60	3.40	6.83	16.50	11.80	14.87
	Village: Babhulkheda							
	• Water seldom goes beyond the third gate. Minor is overgrown with weeds, shrubs and prosopis and babhul. • About 35 % of the farmers, beyond 3L have not got water for last ten years. • About 25% do not apply because of arrears. •							
	Dy1M9: ICA - 134.00 ha, No. of farmers - 100 approx							
5.	Kharif	73.70	0	0	0	16	0	7.33
	Rabi	91.12	10.60	0	3.53	49.40	0	29.33
	Hot weather	10.72	0	0	0	0	0	0
	Village: Khupti							
	• The channel resembles thick shrub forest. Last two years it has not received water. • Forty per cent farmers have stopped applying. • CIs indifferent. No reliability of deliveries.							
	Dy4M1: ICA - 644.08 ha, No. of farmers - 256							
6.	Kharif	354.24	37.00	15.00	26.93	95.20	68.80	86.26
	Rabi	437.97	174.40	147.90	160.16	243.35	208.9	226.68
	Hot weather	51.53	122.90	82.20	105.43	161.40	130.10	149.67
	Village: Khadke							
	• There is a WUA. • Everyone gets water. Everyone in the ICA is registered with the WUA.							

MULA PROJECT -- Tail Reach

	Dy1M3: ICA - 139.00 ha, No. of farmers - 197							
7.	Kharif	76.45	0	0	0	52.60	46.00	50.20
	Rabi	94.52	8.10	1.40	5.83	140.00	108.40	126.37
	Hot weather	11.12	0	0	0	15.40	13.00	14.57
	Village: Jeur-Haibati							
	• Proper outlets have been virtually abandoned. Minor breached at 6 points. At another 6 points non-irrigators `steal' water. • On outlet o1L, the farmers' lands were some what higher and it was getting progressively more difficult for them to get water. Now they have not received water for the last five or six years. • Only 2 out of 70 farmers at tail end have even bothered to apply. • Soils are light, percolation is high and once the minor runs, wells are amply recharged. So very few apply, enough for the minor to run. The rest rely on wells and unauthorised drawals.							
	Dy3M5-WUA: ICA - 315.00 ha, No. of farmers - 176							
8.	Kharif	173.25	13.9	0	4.63	13.90	0	4.63
	Rabi	214.20	24.9	15.30	20.67	40.00	25.30	32.36
	Hot weather	25.20	22.00	8.6	14.10	24.00	13.70	17.43
	Village: Bhavi Nimgaon							
	• Tail portion of M5 turned over to WUA. State of repair is not very different. Channel not repaired and improved at turnover. Breach have been regularise by installing pipe sections at breach. • Forty per cent lying in tail portion are still unserved despite WUA formation. Minor does not have sufficient capacity. • After formation of society number of rotations as specified in MoU have been regularly supplied. • After formation of GMIDC, more and more difficult for WUAs to collect even the legitimate dues from them.							
	Dy3M5-D: ICA - 605.00 ha, No. of farmers - 509							
9.	Kharif	332.75	62.70	0	30.90	141.10	0	47.03
	Rabi	411.40	70.90	49.40	61.13	155.90	105.40	130.27
	Hot weather	48.40	38.70	34.50	36.70	109.80	74.30	90.10
	Village: Mathachi Wadi (Sultanpur)							
	• Portion of M5 not turned over. Gates, falls, rods all broken or missing.. Breached at least at 16 points. Electric pumps have been installed inside the channel. • About 10% farmers at tail portion have not received water for last 7 years. • 90% of the area is served by wells. • No society formation. Since WUA formed further down in tail portion, minor runs regularly and everyone in between gets water. So initiative in forming WUA has weakened.							

	TDyM4: ICA - 144.49 ha, No. of farmers - 250 approx							
10.	Kharif	79.47	5.00	0	1.67	26.80	24.20	25.13
	Rabi	98.25	29.00	26.40	27.40	60.20	49.20	55.07
	Hot weather	11.56	29.90	25.90	27.27	52.60	41.90	46.60
	Village: Dhor Jalgaon							

	• In disrepair but not to extreme degree. Greater bank damage in some portions. Minor is severely silted. • No one beyond O3L has maintained field channels, since they don't get water anyway and no one applies. • Sub-minor 2R guzzles a lot of water and when it is in operation none of the outlets beyond it get water. • Ten per cent take all water by force so 90% do not get water. • More and more people have stopped applying and more and more of them steal water or bribe officials. Almost 60% do so.							
11.	**PBCDM10: ICA - 229.00 ha, No. of farmers - 167**							
	Kharif	125.95	6.60	1.60	4.03	12.80	4.20	9.17
	Rabi	155.72	22.20	2.00	10.60	26.60	6.60	15.33
	Hot weather	18.32	13.80	2.40	7.33	18.80	8.80	13.27
	Village: Chitli (C) and Burhanpur (B)							
	• Should serve as an exhibit in disrepair. Farmers have cut many crossings. There Is heavy seepage and leakage. • Before O3R, at least 12 pumps have been installed in the channel. At least at two points underground pipes inside the channel take water directly into farmers wells. • No one beyond O3R receives water. • Society formed, but no turnover since farmers are insisting on channel being repaired and improved.							

MANGI PROJECT: RBC

1.	**RBCDO3: ICA - 3.20 ha, No. of farmers - 8**							
	Kharif	0.19	0	0	0	2.75	1.20	1.98
	Rabi	2.46	2.70	0	1.37	4.90	2.20	3.90
	Hot weather	0.54	3.20	2.40	2.73	6.80	3.80	4.80
2.	**RBCDy2: ICA - 87.03 ha, No. of farmers - 68**							
	Kharif	5.22	0	0	0	7.44	4.42	5.77
	Rabi	67.01	45.40	43.40	44.40	51.04	48.85	49.65
	Hot weather	14.80	44.60	14.40	25.13	50.87	21.65	32.71
3.	**RBCDO20: ICA - 36.00 ha, No. of farmers - 22**							
	Kharif	2.17	0	0	0	11.05	8.30	9.83
	Rabi	27.84	15.40	6.60	12.20	25.80	18.75	21.80
	Hot weather	6.15	12.70	6.20	9.70	24.85	12.45	19.53
4.	**RBCDy7: ICA - 267.18 ha, No. of farmers - 167**							
	Kharif	16.03	0	0	0	0	0	0
	Rabi	205.73	65.20	47.50	56.00	84.6	59.6	71.30
	Hot weather	45.42	47.60	0	15.87	55.00	0	18.33
5.	**RBCDO50: ICA - 11.74 ha, No. of farmers - Not Available**							
	Kharif	0.70	0	0	0	0	0	0
	Rabi	9.04	2.80	0.40	1.73	3.00	0.90	2.13
	Hot weather	2.00	2.40	0	0.80	3.30	0.20	1.47
6.	**LBCDO5: ICA - 13,60 ha, No. of farmers - 9**							
	Kharif	0.82	0	0	0	11.6	10.6	11.07
	Rabi	10.47	5.60	0	1.87	16.00	11.00	12.87
	Hot weather	2.31	7.40	0	5.60	21.40	10.00	16.80
7.	**LBCDy2: ICA - 97.45 ha, No. of farmers - 89**							

	Kharif	5.85	0	0	0	19.50	16.70	18.30
	Rabi	75.04	56.60	2.40	37.67	80.80	23.40	59.27
	Hot weather	16.57	46.40	0	15.47	61.90	13.70	31.13
8.	**LBCDO20: ICA - 19.20 ha, No. of farmers - 8**							
	Kharif	1.15	0	0	0	3.70	2.20	2.83
	Rabi	14.78	0	0	0	2.70	2.50	2.60
	Hot weather	3.26	3.20	0	1.80	5.70	2.70	4.47
	Villages: Pothre (P), Mirgavhan (M), Khambewadi (K), Arjunnagar (A), Nilaj (N) roughly in order from head to tail reach.							
	• About 0.75 km tail portion of Dy2 on RBC does not receive any water. Before this portion between O7L and O3R there are at least 6 breach. • The last 1.5 km tail portion of Dy7 on RBC does not receive any water for many years, is silted up and overgrown with vegetation.							
	• Dy2 on LBC has too many outlets and very few gated structures; mostly regularised breach. Final 1.5 km of the minor has virtually disappeared with encroachments from both sides and siltation and vegetation. • Because of unrepaired deep cut just beyond DO14 on the LBC, all outlets beyond DO14 do not receive water. Pothre (mainly RBC Dy2) • About 20% farmers had not got water. • Last year wrong timing of jowar irrigation had led to crop damage. • Advance applications of farmers beyond outlets 10 and 11 (about 35 farmers) are not entertained. • Farmers in head reach take water twice and water does not reach the tail. Mirgavhan (mainly RBC Dy7) • About 40 ha at tail has been left out. • Tail to head sequence, but problems for middle farmers because head reach farmers got impatient and took water after tail-enders, so middle reach was deprived. • Rotation starts to late. • Farmers have no discipline. Well to do farmers with wells benefit, depriving others. Khambewadi (mainly RBC DO20) • Jowar lodging due to wrong timing rotation. • Great increase in upstream pumping, hence shortage of water and many farmers deprived. Arjunnagar (mainly DO 47 to 50) • This was first year almost everyone got water. • However even this year, tail discharge was very small and those earlier dependent on it could not irrigate. • Confusion about whether water would reach, hence not well utilised. • Rotations have come down from three to one. Nilaj (Mainly tail of LBC Dy2 and outlets beyond) • Large area falls beyond DO14 deep cut. Almost 60% of ICA without water. No rotation from tail to head as on RBC, so water does not reach even as far as it could. Tail portion has not received water for last 20 years. • Well water is saline. Tail portion needs water at least for drinking water canal could be useful.							

WALEN PROJECT								
	Kharif	54.20	37.75	35.20	36.40	--	--	--
	Rabi	216.81	92.22	47.25	62.28	--	--	--
	Hot weather	N. A.	N. A.	N. A.	N. A.	N. A.	N. A.	N. A.
	Village: Walen							
	• Heavy seepage through canal walls. Crab damage to mud mortar of pitching on canal walls causes seepage. • Cross drainage not well channelled. Complaints of canal siltation due to stormwater flows into canal. • Waterlogging for up to two months for substantial strip adjacent to canal. • Everyone gets water. Seepage and waterlogging are serious problems. Panchayat passed a resolution seeking stoppage of canal delivery until canal is lined properly.							