Status of Irrigation Management Transfer in India

IRRIGATION SYSTEM RELATED ISSUES IN TURNOVER

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December 1995

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SYSTEM RELATED ISSUES

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1. INTRODUCTION

An irrigation system is a socio-technical system (Figure 1). In the past, irrigation system improvement consists mainly of infrastructural development. The services to be provided by the infrastructure were largely regarded as a natural output, that came by itself after construction. In reality, infrastructure developed in a complex multiorganizational network between different service providers and receivers have to function effectively so that infrastructure can provide the promised services. However, in infrastructure development and subsequent operations of irrigation systems, the question of organizations and their interactions were until recently regarded to be only of a marginal importance.

In an irrigation system, in order to allow the system to be operated and maintained on a sustainable basis, many organizations, mainly service organizations, have to interact. The most frequent participating organizations in irrigation systems are the national irrigation administration (ministries), irrigation agencies, water user associations, private input providers, and the organizations involved in development cooperation. The majority of the organizations involved in irrigation are service organizations. The irrigation project organizations provides support services for the irrigators, the water user organizations provide services for their members (water distribution, and maintenance of turned over system, representation, conflict management, etc.) and the technical cooperation organization provide services for their partner organizations.

The technical subsystem shown in Figure 1 can be broadly divided into two categories for the analysis of this paper. They are the main system and turned over system. The main system consists of storage reservoirs, diversion anicuts, tanks, main and branch canals while the turned over system consists of distributary, minor, subminor, field channels, and drainage system.

Depending on the type of system, the physical boundaries, boundaries of the service organizations, their service functions, their organizational structure and their services may differ. For example, in a large scale gravity irrigation system, the reservoir, main and branch canals will be operated and maintained by an

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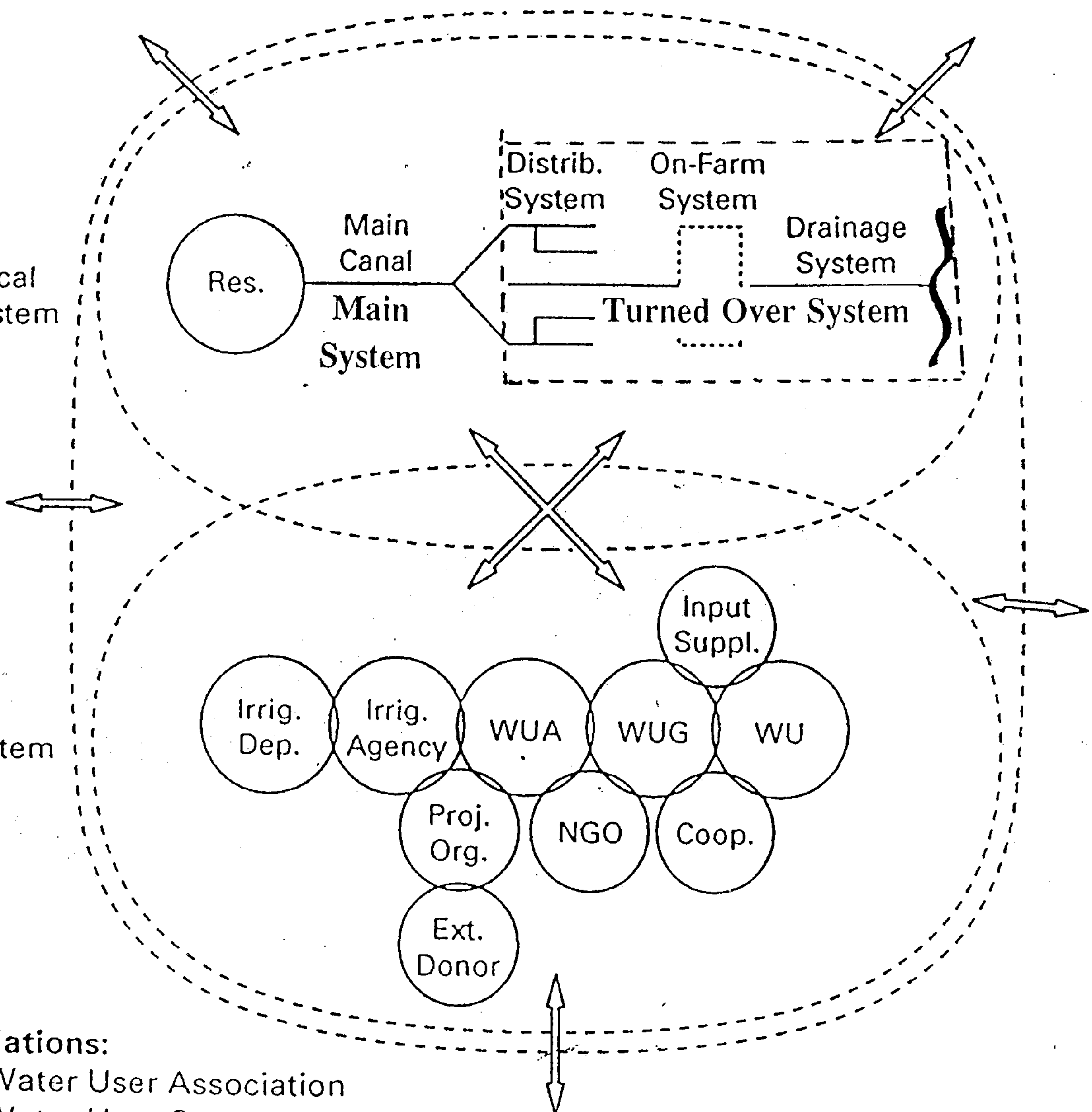
Figure 1: The "socio-technical" irrigation system



Abbreviations:
WUA: Water User Association
WUG: Water User Group
WU: Water User
NGO: Non-Governmental Organization

irrigation agency such as Irrigation Department (ID) while the turned over system will be operated and maintained by the Water Users' Association (WUA). At the point of transfer, it will be managed jointly by the irrigation agency and the Water Users Associations. In a medium scale reservoir (tank) system, the reservoir will be operated by the ID while all other physical infrastructure will be operated and maintained by the WUA. In a small tank system such as found in South India, all the technical subsystem will be operated and maintained by the WUAs.

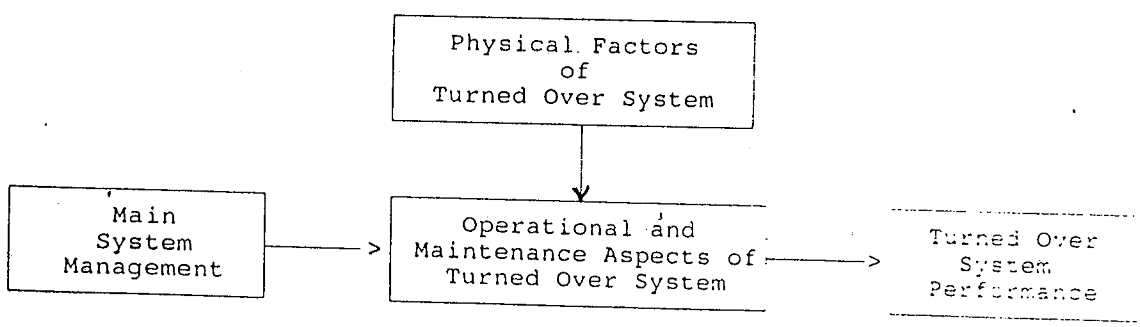
Then, there are Lift Irrigation System (LIS) where the main system is operated by the agency, while pumping equipments, distribution systems and the turned over irrigation system are operated and maintained by the WUAs.

Again in service organizations and service functions, there are large variations. Some WUAs are single function organizations while others are multi-functional organizations. Some WUAs will have water users' groups at field outlet level while others may not have water users groups; they may directly deal with water users. Some WUAs are federated at a higher level while others are not federated. Some have Non-Governmental Organizations (NGOs) support while others do not have the support of any NGOs. Each one of these factors will have an impact on the functioning of turned over system.

When it comes to the question of improving the operation and maintenance of a turned over system, the resource base of the system, the physical infrastructure of the turned over system, the services provided by the main system and services provided by the social subsystem will all have an impact.

The paper focusses primarily on how performance of turned over system is influenced by physical characteristics of the system and main system management.

Pictorially the above stated aspects can be represented as follows:



The sections that follow list out a set of factors affecting the performance of turned over systems. Based on the observations and process documentation made during field studies in about 20 systems in the States of Maharashtra, Gujarat and Tamilnadu, certain hypothesis were developed and tested. In addition, the impact of these factors in terms of improved performance indicators are interpreted. The outcome of these results are discussed in relation to policy implications for turning over part or whole of irrigation systems to WUAs.

2. FACTORS AFFECTING PERFORMANCE OF TURNED OVER SYSTEMS

2.1 Physical and Resource Factors

* Design adequacy.

* System capability to control water level and flow.

* Level of maintenance.

* Communication facilities.

* Night irrigation methods.

* Seepage and percolation losses including operational losses.

* Design command verses actual area irrigated.

* Topography, soil and groundwater conditions.

* Drainage congestion.

* Cropping pattern changes.

* Resource use (rainfall, surface water, groundwater, drainage water, river lift, etc.).

2.2 Main System Management Factors

* Type of agreement between main system and turned over system.

* Functionality of main system.

* Operational arrangement of main system (preparation of schedule, opening and closing date, number of watering, discharge schedule, etc.).

* Resource availability at the main system level.

* Communication and linkages.
* Agency commitment and interactions.

2.3 Factors Affecting Operational Aspects

* Physical factors.
* Main system management factors.
* Operational schedule of turned over system.
* Communication.
* Operational decision-making and implementation process.
* Water Users' discipline.

2.4 Performance of Turned Over System

* Flexibility and reliability of supply.
* farmers satisfaction leading to adequacy, timeliness and equity.
* Increased supply of water.
* Production of high value crops.
* Less trouble in getting water.
* Political mileage.

2.5 Implications for Policy Formulation

* Sustainability of present process (How sustainable is the resource use and physical sustainability).
* Should rehabilitation be part of turned over process or should it be demand driven from WUAs?
* Water rights with regard to surface, ground and drainage water.
* Role of agency in the turned over systems.

3. PHYSICAL AND RESOURCE FACTORS ON PERFORMANCE OF TURNED OVER SYSTEMS

3.1 Design Adequacy

A well designed system is an asset to turnover process. A few examples are cited to show how design factors affect the turnover process and its performance.

1. Kedar tank underwent a fairly extensive rehabilitation under tank modernization project and on-farm work was completed under the Command Area Development Project (CADA) funds. The system is designed in such a way that it is able to capture the drainage water and reuse it in the lower down supply channels. The on-farm development work of providing field-channels to each and every farm plot made it possible to introduce rotational water distribution. The system has considerably improved its water use performance.

2. In Anklev subminor 60 outlets were reduced to 36 functional outlets, properly sized and located in such a way that the operation of the subminor has been improved and water can reach the tail-end portion of the subminor.

3. In Ojhar Scheme, as well as in Mula Scheme, the length of field channels are very long. Some of the field channels run 1.5 to 2 km creating problem of inequity in water distribution between the head and tail-ends due to seepage, percolation and operational losses.

4. In the Parambikulam - Aliyar Project the topography of command area in Malaippakam distributary is very uneven; there was a large inequity in water distribution between head- and tail-end, a variation of 80 percent of its share in the head-end to 30 percent of its share in the tail-end. But after the introduction of underground pipelines with alfalfa-valves, this inequity was considerably reduced with head-enders getting their 100 percent share to 60 percent share in the tail-end.

5. In the 7th Branch Canal of Periyar Vaigai Project (PVP), the sill level of the off-take regulator and the bed level of the canal leading to Pillayarkulam Tank was at higher level than the bed level of main canal with the result that design drawal of water is not possible unless the full supply is maintained.

6. Other design aspects noticed in the turned over system is the sum of the designed outlet discharges including seepage and percolation losses exceeding the design discharge of the minor or distributary canal necessitating rotation of the distributary or minor (Parunde; Anklev); adverse bed slope and inadequate canal cross section to carry the designed discharge

especially at times of rotational supply. (North Kodaimelalazian channel in Tambraparani System).

3.2 System Capability to Control Water Level and Flow

Except a few systems (Kedar, Parunde), most of the systems studied lack proper discharge and level control structures. Both level and discharge control structures such as cross regulators, drops and gated pipe outlets/modules are very important for better water management. Not only existence of these structures is important, but their proper design, location and use are very important. If they are not present or even if they are present under non-working conditions, any schedule drawn up cannot be implemented; because most of such systems are dysfunctional and, therefore, it is difficult to enforce any planned operational plan with such dysfunctional systems. This is the reason that except in Kedar, in almost all systems, rotational water distribution schedule prepared by the WUA could not be implemented in total. In this sense, many systems turned over to WUA are dysfunctional systems. Farmers can clean the channels, remove the silt, bring it to proper section but it would be difficult for them to repair and/or introduce new flow control structures without support from the agency.

3.3 Level of Maintenance

Maintenance level varied from system to system studied. A general conclusion that can be drawn from these case studies is that maintenance of turned over system has improved but that improvement is not sufficient enough to provide equitable distribution of water in the turned over system. Whatever gain that has been achieved in the level of maintenance is mainly because of close supervision by the employees of WUAs, transparent way of spending the maintenance grant, putting in place a procedure to carry out maintenance activities, pressure brought out on the water users and agency in carrying out the maintenance activities, providing and spending more funds on maintenance from the WUAs own resources, working of WUAs jointly with the agency during the times of emergency and hiring labor for maintenance at reduced cost by WUAs and use of labor for maintenance on a shramadana basis.

In most cases studied, field channels are cleaned and maintained by the farmers themselves. Only in Mula, society charges Rs.25/ha as annual maintenance charges and some of the lengthy field channels are also undertaken for cleaning under this fund. It was found that in certain systems where maintenance was under the ID while operation was taken over by the WUAs, there were problems in matching the maintenance with operational needs (Hadsi, Mohini).

In certain systems, farmers cleaned their channels twice a year: one before the start of the season and another mid-seasonal cleaning (Salipperi, Ojhar); in certain systems, WUAs joined with the ID in cleaning the channel (North Kodaimel Alagian); in some, farmers themselves cleaned the channel on shramadana basis (Dusi-Mamandur); in Pingot, some flexibility in maintenance management was introduced in that when there is sudden breach or repair to be attended to immediately, the society Secretary and chairman can undertake and complete the repair without prior permission from the ID and then claim the expenses which will be reimbursed based on the measurement of work carried out. WUAs, over the years have developed certain procedures of diagnosing the maintenance requirement through walk-through surveys, prioritizing the maintenance components and getting it done through contracting (Ojhar, Parunde). In this connection, societies which have formed outlet committees (water users group) and make them functional are able to do a better job with respect to maintenance of field channels. Also, giving contract to WUAs for carrying out on-farm works and repairs had resulted in cost-effective and better workmanship. (Lower Bhawani Project, Pingot, Periar Vaigai Project).

3.4 Communication Facilities

After the formation of WUAs, the farmers need not go to the agency or to their office; their problems are communicated to the employees of WUAs/Secretary/Chairman of the Society which in turn are taken care by the WUAs. The nearness and easy access to the WUAs make farmers' life easy and their transaction costs are reduced. Similarly, society also finds it easy to communicate with various levels of hierarchy of the ID depending on the level of problem to be solved. They develop access and approach to the various levels of employees of the agency and this helps them to get their work done: formal contact is established at the field and through letter writing, phone calls, telegrams and meeting the officials at their office.

3.5 Night Irrigation Methods

Night irrigation is one of the major problems faced by farmers in water distribution and a deterrent for introduction to planned delivery schedule. For many known reasons, farmers and water distributing personnel do not want to irrigate at nights; however,, in a flow system where there is no storage facilities, water is to be let into the fields; in this process excessive irrigation, under irrigation and wastage of water occurs and the irrigation target during the night is not generally achieved. This then causes a change in the schedule already put in place and creates conflicts between farmers who have taken water during the night and who is to take water in the next day-time. Unless a strict discipline to implement schedule is enforced during nights as in the Northwestern Warabandi System, it would be difficult to enforce a strict planned schedule in the turned over systems.

In the case studies undertaken, a number of methods are adopted to minimize night irrigation problem:

i. In small tank irrigation systems, such as Kedar water delivery is effected between 6.00 a.m. in the morning to 6.00 p.m. in the evening. During night the tank sluice is closed and locked. This helps preventing wastage of water.

ii. Farmers make internal arrangement among themselves such that those with large contiguous land holding agree to irrigate during night, especially when the crop is a water loving crop like paddy and sugarcane and adopt field to field irrigation. (Lower Bhavani Project [LBP]).

iii. In certain cases, society Patkari himself draws up a schedule in which paddy and sugarcane are given watering during the night and those who raise other crops get watering during the day-time.

iv. In certain cases, the quantity of drawals into minor/ distributary during night-time is reduced.

3.6 Seepage, Percolation and Operational Losses

In many systems studied, both seepage and operational losses are very high and this is one of the reasons for tail-enders not getting adequate supplies. This problem becomes more acute when the field channel length increases beyond 500 to 600 m. In unlined channels, especially when the soils are heavy soils, and rotational water distribution is practiced at fairly larger intervals, the soil cracks and increases seepage and percolation losses. Since many field channels are not cleaned of weeds, and desilted, operational losses due to overtopping and burrowed animal holes become higher. Due to these factors, supply of water based on hourly discharge is not accepted by the farmers and almost in all gravity irrigation systems, water charges are based on irrigated area and the type of crop. What are the implications of these large seepage, percolation losses? In many places, the groundwater table is building up (Mohini) and consequently well irrigation is picking up in most of such turned over systems. Many farmers have gone for the use of groundwater at the expense of surface water since they need not pay water charges for percolated water pumped from wells; however, some societies are insisting that farmers should pay water charges for the water drawn from wells which receive its percolated water from those canals and areas which use the purchased water on volumetric basis from the ID.

3.7 Area Irrigated

In many systems studied especially where localization concept was adopted, the actual area irrigated is much higher than the design command area. In such cases the channels designed for design command area are not able to cater to the needs of the actual area irrigated. For example, in Pillayarkulam tank in the Periar Vaigai Project, about 15 acres of the adjacent tank command area is being irrigated from this tank. This creates a conflict between the water users group. In addition, there is encroached area in Dharmasenapatti (PVP) and other localized areas. It is necessary that these additional areas need to be taken into account and a consensus among water users need to be arrived at before implementing a water distribution schedule.

3.8 Drainage Congestion

In certain systems, drainage is the major problem. In some of the sugarcane growing areas, where they are receiving more than adequate quantity of water, groundwater build up is taking place and the yield is getting reduced (Mohini). In some other systems, surface drainage is a major problem. For example, A9 Mahilancheri channel in Valappar river of cauvery command is a tail-end channel subjected to both flooding and scarcity of water in view of its location. The farmers of Salipperi have used their association resources to desilt the drainage channel and clear the drainage congestion which has considerably enhanced the yield potential of A9 Mahilancheri command area.

3.9 Topography, Soils and Groundwater Conditions

Topography, soils and groundwater conditions have an impact on the performance of turned over system. In undulating terrains, farmers use pipeline distribution (PAP). In catenary type of land formation, the head-enders have pervious and porous soil while the tail-enders have heavy clay soils. Under these conditions, farmers in the turned over system who have lands at the head-end are allowed to take water twice in a rotation and charged for the additional water use (Parunde). Undulating terrains, steep slopes and porous soils contribute to surface drainage and groundwater build-up. Farmers conserve such drainage water through recharge by building percolation ponds and diverting excess water to dug wells and Bandharas (PVP, Parunde, Mula).

3.10 Cropping Pattern Changes

One of the major and visible changes in the turned over system is the switch over from low value to high value crops and changes in cropping pattern. Also, one can see changes from traditional varieties to high yielding varieties. In certain systems intercropping has taken place. All these factors go to show that the farmers confidence in getting adequate, reliable and flexible supply of water after the system has been turned over has increased considerably.

3.11 Resource Use

An innovation that has taken place after turning over the system to WUAs is the integrated water use and conservation of water by the WUAs. Water from various sources such as rainfall, surface water, ground water and drainage water are used in an integrated manner. This is mainly due to water charges that the farmers have to pay for water on a volumetric basis. The farmers go for well and drainage water because they provide the required flexibility; moreover in some states electricity is free and they can pump as much groundwater as they want for which they need not pay any water charges.

During heavy rain, farmers divert the surface water to replenish wells, percolation ponds and Bandharas and to conserve water. Drainage water through Nala bunding and percolated water into wells are lifted and used. Water conservation has assumed a significant role mainly because farmers have to pay for water and in certain cases, conservation has produced flexibility in supplying the crop demand (Example LBP, PVP, Parunde, Ojhar, Mula, etc.).

In water short systems such as the Parambikulam - Aliyar Project where canal water is received once in 24 months for only 135 days, WUA have gone for groundwater use with drip irrigation system to conserve water and raise coconut orchards.

All these factors go to show that reliability of supply is the most important aspect in water distribution; once the farmers are convinced that they are going to get a reliable supply, then they try to introduce flexibility in their water supply by integrating the use of rainfall, surface water, groundwater and drainage water. Reliability and flexibility provide the ideal environment for the farmers to go for high value and high yielding varieties (HYV) of crops.

4. MAIN SYSTEM MANAGEMENT FACTORS AFFECTING TURNOVER

4.1 Types of Agreement Between Main System and turned Over System

The functioning of the turned over system is affected by the type of agreement entered between the agency and the WUAs. In large scale gravity irrigation systems, in the States of Maharashtra and Gujarat, water is supplied on a volumetric basis to WUAs and they in turn supply water on area and crop basis. In this process, in Maharashtra water saved in Kharif cannot be carried forward to Rabi and Hot-weather season while water saved in Rabi can be used in Hot-weather season. In certain systems, there is a fear that if WUAs do not use the allotted water, then their water supply in the subsequent renewal of the Memorandum of Understanding (MOU) would be cut and therefore, there is a tendency to waste water.

In the case of medium tanks in Maharashtra (Parunde, Hadsi) the release of water is based on the request made by the Chairman of the society and the Government agency's job is to release the water as per the request of the chairperson of the society. Of course, at the beginning of the season, the SO makes sure that the system is cleaned and is ready for receiving the water. In these medium systems, water is charged by the agency on the volumetric basis. However in Gujarat (Pingot and Baldeva) agency charges the WUAs based on area irrigated and crop type. These joint management arrangements provide the necessary flexibility for the farmers to meet their crop water requirement. In Lift Irrigation Schemes too, there is an agreement between the society and the irrigation agency on the amount of water that they can pump. However, in this case, the irrigation agency base their charges on cropped area and type of crops and not on volumetric basis. Whatever the mode of contract between the agency and WUAs, the WUAs charges the farmers both on the basis of area irrigated and crop type and hours of pumping. In the case of Bhima (LIS) where water charges is based on hours of pumping, observations indicate that the farmers use water efficiently and there is certain water saving while this is not the case where water charging is area and crop based. As long as water is provided to farmers on area basis and not on volumetric basis, the question of saving water may not be of much concern to the beneficiaries. On the other hand, the farmers may use as much water as possible which may recharge the groundwater aquifer and fill the percolation ponds. This water can then be used by farmers without any water charge. Therefore, the present agreement of water delivery and water charging may provide some incentive for WUAs to save water while it does not provide incentive to water users (farmers) to save water. Basically, then the present procedure provides incentives for maximizing productivity and production and not for effecting water saving and improving water use efficiency.

In the State of Tamilnadu, no such agreement exists between agency and WUAs. The farmers do not pay water charges separately. It is included in land tax. Also, land tax is collected by the Revenue Department and not by the Irrigation Agency. The WUAs are established as part of CADA programme by the Agricultural Engg. Department and the ID senior officials in many large irrigation systems is not even aware of the existence of WUAs and their activities.

4.2 Functionality of Main System

A number of systems studied has main system problems while a few others are in fairly good condition. For example, Mahi-Kadana System (Mahi Right Bank Canal), Parunde main system and Kedar main system are in good condition while in Hadsi, canal seepage was high; canal is lined only about 400 to 500 metres. The canal in PAP leading from Thirumoorthy dam, especially in the lower reaches, was very much dilapidated; the Periyar main canal in PVP could not draw its designed discharge due to large amount of silt deposition; design capacity of Bheston minor (Mohini system) is 92 cusecs; but due to many reasons, it fluctuates and flows with a capacity of less than 50 cusecs. The ID in MWCS looks into the allocated discharge by gauge reading at the inlet to the subminor while it does not look into the tail-gauge reading. Tail flows are very much less due to poor system condition and maintenance problems. In Pingot 18 proportional dividers were constructed; but many of them are not working properly due to inefficient head and, therefore, they were damaged. In Periyar-Vaigai Project, the 7th BC sill level is at a higher elevation and it cannot draw its design discharge unless the downstream 'Kallandiri' regulator is raised to head-up water. The agency could not do anything with the operation of this regulator since it serves the constituency of Public Works Department Minister.

The operational arrangement such as preparation of schedule, fixing the opening and closing dates of main canal, number of watering and rotation schedule is prepared generally at the Executive Engineer's office and communicated to the subdivision and section offices and to the WUAs 10 to 15 days earlier than the date of opening. Based on these dates, with the section officers' help, the society prepares an operation schedule for turned over system. But what is planned and actually executed there is large differences. For example in Parambikulam - Aliyar Project, they are supposed to provide water in the main canal for 7 days 'on' and 7 days 'off' for a period of 135 days.

Instead of this, the following is the schedule followed:

Begin Date	Ending Date	Total Days	No. of Rotation
26.10.94	5.11.94	11	1
27.11.94	27.12.94	31	2
3.1.95	17.1.95	15	1
25.1.95	8.2.95	15	1
15.2.95	27.2.95	13	1
7.3.95	18.3.95	12	1
26.3.95	9.4.95	15	1
Total		112	8

Instead of 135 days, they got only 112 days due to rainfall in the command area. Farmers were not compensated with 24 days of flow which they have missed due to rainfall. More over, the schedule changes are not communicated to farmers in time for them to get prepared for receiving the water. In 1992-93, because of low storage position in the Parambikulam complex of reservoirs, the Thirumoorthy dam which supplies water to Malaipakkam distributary operational schedule was suddenly changed to 7 days 'on' and 14 days 'off'. During the 7 days of additional closure period, the Thirumoorthy dam used to get sufficient supply from Parambikulam main canal to provide sufficient discharge during the 'on' period; however, this kind of unplanned introduction of change in the schedule is not communicated to the farmers effectively.

Many large scale systems are watershort systems and they depend entirely on monsoon rainfall runoff. Predicting the monsoon rainfall and the associated runoff needs analysis of sufficient and systematically collected data which are not available in a number of systems. Therefore, any schedule prepared based on past records may at times would not hold good due to vagaries of monsoon. This is more so in regions where the coefficient of variation of rainfall and runoff is very high. Therefore, preparation of operation plan of the reservoir and seasonal planning needs considerable care and frequent updating. Because of the stochastic nature of reservoir inflow, main canal operation becomes unreliable and at times fluctuating. These conditions then lead to preparing the operational plans in consultation with farmers and revising the operation plan prepared at the beginning of the season based on reservoir and inflow conditions. Such a revised operation plan needs to be communicated effectively with the users and the operating agencies. Presently many of our systems do not have the capability of transmitting the real time data for effective decision-making.

In spite of all these inadequacies, the turned over system studied under the case studies were getting sufficient water. The following data obtained from Bhima illustrates this point.

Area Irrigated and AI/DC Before and After Turnover

Year	Season	Before		After	
		Area (ha)	AI/DC (cusec)	Area (ha)	AI/DC (cusec)
1988-89	Kharif Rabi Summer	69.55 101.45 86.85	1.70 0.45 0.34	55.40 98.00 73.19	0.35 0.17 0.12
1989-90	Kharif Rabi summer	53.20 113.15 85.70	1.10 0.58 0.40	52.40 88.80 73.45	0.44 0.25 0.24
1990-91	Kharif Rabi summer	58.30 104.40 95.20	0.61 0.65 0.45	69.00 88.80 -	0.49 0.50 -

This is a serious issue as far as sustainability of turned over system is concerned.

At the present state of turnover process in India, many turned over systems especially in Gujarat and Maharashtra are not facing any water shortage. In fact, they are getting more than what they used to get as the table above indicates. This high allowance of water to turned over system has implications for the sustainability of turnover process which will be discussed later.

4.3 Agency Commitment and Interactions

From the agency point of view, there are two sets of concerns. The lower level officials feel that turnover process is a threat to their job security and income earning and therefore, they are not well disposed towards turnover process. The other one is the concern of higher level officials. These officials think that turnover of part of the irrigation systems to WUAs would reduce their commitment and expenditure to that part of the system and, therefore, they can concentrate their resources in maintaining and managing the main system and provide adequate support services to the WUAs. What is not taking place now is the needed support services to the WUAs during the transition period. Once the system is turned over, the agency has started withdrawing their support both in terms of technical support and human resources development support. Such support is vital during transfer from agency managed system to farmer managed system. This support should be given either by the agency or by a non-governmental organization. The case studies investigated in this research substantiates that this support is essential. For example, in Parunde the Asst. Executive Engineer provided the needed support; in Kedar, Anna University provided the support;

in Pingot and Baldeva, AKRSP (I) provided the support; in Anklev, WALMI (Gujrat) provided the support; and in Mula CASAD provided the needed support. This support during the formative years of transition was very useful for the successful functioning of the WUAs and the turned over systems. The time of transition for effective turnover of the system varies from system to system. Experience indicates that there should be a joint management between the agency and the WUAs during the transition period.

5. FACTORS AFFECTING OPERATIONAL ASPECTS OF TURNED OVER SYSTEM

The factors affecting operational aspects of turned over systems are listed under Section 2.3. The physical and main system management factors were discussed under Sections 3 and 4, respectively. This section looks at preparation of operational schedule of TO system, operational decision-making and implementation process and water users' discipline and leadership qualities of WUAs.

5.1 Water Distribution in Baldeva Irrigation System

This is a medium irrigation system in the State of Gujarat. In this system, first the WUA decides the water delivery schedule and intimates the same to ID and accordingly the ID staff open canal gates in the presence of AE. Quantum of water to be delivered to the WUA is decided by the ID based on the storage in the dam, requirements of the farmers, and the schedule drawn by the WALMI. According to SO the water delivery schedule is not strictly enforced; only the starting (first rotation) and the ending dates (last rotation) are strictly followed. The discharge in the canal can be changed as per the needs of the WUA. During the first two days of canal rotation, the ID watchman monitor the water distribution but later only the WUA watchman and operator do so.

There appears to be no insurmountable conflicts regarding schedule of water deliveries between the WUA and the ID because the ID is always ready to deliver water according to the requirements of WUA.

When the water is received, mostly members distribute water among themselves by mutual understanding. The farmer who takes water first completes his irrigation and then another farmer starts. Water distribution is monitored by the operator appointed by the WUA and not by the committee members. When the rotation starts, the WUA decides the area to be irrigated first, i.e., head or tail. Flow measurement is by depth and not by discharge.

Farmers themselves operate the gates along the main canal and let water to the water courses. Farmers say they know when to expect water; but generally, they do not get water at the expected times. However, they do get water with a delay of a day or two. Farmers feel that there is less inequity in water distribution between head and tail; however, they feel there is inequity in water-taking between the rich and poor farmers. The number of disputes over water has not decreased over time; but the WUA is able to solve the disputes effectively as compared to before. The communication between ID officials and WUA has not improved; there is a need to communicate effectively between the two.

Groundwater is very much used in this command and is on the increase after canal irrigation started. There are 88 wells (both dug and tubewells) in the Left Bank Canal (LBC).

The command area of the LBC is 1155 ha. Of this, only 350 ha was actually irrigated during the 1994 season. The reason for less irrigated area is due to water losses in summer and change in cropping pattern with more than 95 percent area occupying sugarcane. The sugarcane crop requires 3 to 4 times more water than conventional crops need in each rotation. Moreover, association members do not strictly obey the WUA water distribution schedule, causing considerable wastage and seepage losses.

5.2 Water Distribution in Kedar Tank Irrigation System

This is one of the small tank systems in Tamilnadu undertaken for rehabilitation under EC tank modernization project and handed over to WUA with the assistance of Anna University.
The WUA has appointed a Neerkatti (Patkari) to be in charge of water distribution. The Neerkatti opens the main sluice of the tank everyday by about 6.00 a.m. and closes the sluice by 6.00 p.m. The entire command area is divided into 4 blocks. The Neerkatti informs the previous day about the next days irrigation schedule to the farmers of a particular block where he will give water next day. In the initial stages of crop growth it takes about 3 days and during the later stages it takes about 5 days for a rotation. Normally farmers take about 4 to 5 cm of water. Individual farmers are responsible for diverting the water to their fields. Presence of farmer during watering of his field is important; if he is not present during his rotation, then he will miss the chance of irrigating his field. The area cultivated has increased from 200 acres in 1983 to 284 acres in 1993. Sugarcane, a cash crop, is a new introduction. Normally the tank water before the turnover was hardly sufficient for raising a single crop of rice. Now, even after the successful raising of paddy, tank has still water which enhances the growing period of fish. Because of this enhanced storage, longevity of bore wells and its yields have increased. There are about 59 borewells, 45

energized and 14 non-energized. Each borewell can irrigate an average of 2 acres. The success of this turned over system is attributed to dynamic leadership of the president, well-defined rules put in place, transparent way of conducting business and the considerable financial and other support received from supporting departments and Anna University.

5.3 Water Management in Dusi-Mamandur Tank

Dusi-Mamandur Tank is one of the two largest ancient tank systems in Tamilnadu. It is under the maintenance of the Public Works Department. The PWD's responsibility in water distribution ends with the opening of sluice gates; even that also on the requisition of the WUA president or executive committee members. From the outlet point of the sluice, it will be the responsibility of WUAs in sharing and distributing the water among eighteen villages within the command area.

The main canal is operated through a set of neerkattis. Each village within the command nominates two neerkattis; these neerkattis are the ones who interact with each other and divide and distribute the water among themselves. Each village has an informal association with a leading farmer taking leadership of that village. The distribution is so designed that there is a large scale reuse of drainage water. The drainage channels are bunded along its course and the drainage water is reused for irrigation either by gravity or by lifting through diesel pumps.

Based upon the requisition of the farmers of a particular village the treasurer of the WUA will write a letter to the officer in-charge of Dusi-Mamandur tank asking him to open the sluice gate by such level and make the water available to the village.

Field channel cleaning and main irrigation channel cleaning are done regularly. The tail reach farmers need to contribute more in cleaning the channel because the water availability is a problem for them. Initially, the tail reach farmers clean the channel in their village and moves upward, and joins with the middle reach villagers and clean the middle reach channels. Farmers in both these two reaches then join with the head reach villages and clean the head reach portion.

The level of involvement varies with the location of the villages. The involvement of upstream villagers is not encouraging; however, as one moves down the channel, the downstream villagers involvement increases. The farmers themselves share the expenses of these cleaning.

Dusi-Mamandur is a water short tank. However, to use the meagre water available in the tank and to irrigate a successful crop, they have framed norms. They strictly follow these norms. These norms specify which are the villages that will get irrigation depending on the storage in the tank. By this arrangement, crop losses for want of water is avoided since those who do not get tank water make alternative arrangements.

The WUA fixed the rules for the distribution and sharing of water. Over the years they have arrived at a consensus of irrigating a village depending upon the storage position in the tank. For example, if the tank storage level is less than 8 feet, only head-end 3 villages will get water for a single crop. If the water level reaches 30 ft (FTL), all the 18 villages will get water for 2 crops.

Tank water supply has considerably reduced during the last 10 years. It has filled up only 2 out of 10 years. Because of the poor water availability, considerable number of dug wells have come up on the command. Many farmers are now dependent upon dug wells for irrigation. There are 421 energized wells and 142 non-energized wells in the command. Since electricity is free, they are not very much worried about using tank water. Groundwater market also exists in the command. While the head reach farmers go for paddy crop, tail-end farmers go for other field crops such as groundnut, ragi and gingelly.

Each village level organization employs 3 laskars (Neerkattis). One neerkatti will divert water into the field channel by forming cross bund across minor/distributary canals; one neerkatti will carry out watch and ward duty in the upper reaches of these canals whether water is blocked or not. The third neerkatti will irrigate the fields. All the three are paid by the farmers of that village.

Turn system is followed in distributing the water. The fields are divided into 3 zones. Each zone will get water for one day. So, the first zone will get water again on the fourth day. The neerkatti will irrigate 3 to 4 fields at a time by forming cross bunds across the field channel. Water will move from one field to the other. Each block will get water for 7 hours each day. Because of this turn system, all fields will get an equal amount of water. Also, because of these turns, the upper, middle and tail reaches will get their shares regularly and equally. This system is a classic example of how a system gets adapted to environmental change and makes best use of the resource when the management is transferred to an organized beneficiary community.

5.4. Water Distribution in Parunde Irrigation System

Parunde is a medium irrigation scheme with one main channel of 2.5 km length and capacity of 206 lps. The command area of the scheme is 172 ha of which 60 ha get irrigated by lift irrigation. There are 10 field outlets each with a chak committee. In kharif, supplementary irrigation is provided; before starting rabi season, primary irrigation planning is done.

When the scheme was handed over, the following information was provided: tank capacity curve; water flow data and pattern; rainfall data; pan evaporation data; operation test results of the canal and entire canal system; farm and farmers data under each chak and lift scheme; soil classification of each chak and capacity of each lift irrigation schedule by the performance test.

Tank water is released from the tank by the Government Patkari and from that point, society Patkari takes over and distributes the water to the farmers from head to tail.

In every rotation, there were 4 to 5 patkaris employed on a daily wage for overseeing the water distribution. No specific duration was fixed for each rotation. Before the first rotation, a meeting is called for and at that meeting the date of the first rotation is announced. The date of release of water and the amount of release of water from the tank is conveyed to the government patkari as per the instruction of the society's chairman. Mutual adjustment of sharing turns among farmers takes place. Each outlet carries 30 lps. It is divided into two streams and two farmers share the water at 15 lps. Water fees are collected based on the crop and area. The society has framed well-defined rules which are known to each and every farmer. Here, patkari appointed by the society play a vital role in water distribution. In the tank irrigation, transfer of water from kharif to rabi and from rabi to hot-weather season is possible. At the beginning of the first rotation, water is released to a chak only if the field channel is cleaned by the chak committee.

Some farmers feel that some chaks do not clean their channel properly; rich farmers get more water; tail to head distribution does not take place always. Although the society with the help of the ID prepares a schedule of rotation, in reality actual water rotation is not according to the schedule. The society has faith in agency officers; because they are the people who helped to form the society.

The farmers feel that they have accrued the following benefits after the formation of the society: increase in agricultural production; more employment to people; increase in cattle population; transport facilities; new crops like flowers are grown; establishment of rice mills, shops for packaging material and fertilizer, and supply of fresh vegetables. The most important benefit is that they know their water rights and that they can demand for it.

5.5 Water Distribution in Phulewadi Lift Irrigation Scheme

The Mahatma Jotirao Phule Cooperative Lift Irrigation Scheme (LIS) utilizes the tail water from Radhanagari Hydroelectric Project by lifting from Panch Ganga. In this LIS, cultivation of sugarcane has been very successfully achieved and cultivators are taking advantage of the tail water for irrigation year after year with good profits. Water is lifted from KT weir and distributed through cement pipes buried underground. In the command area, this pipeline has 25 valves. For distribution of water valves are opened and water is taken through open channels. The command area water channel was constructed by the society while field channels were constructed by individual farmers. The society is managed by chairman, and elected Executive Committee with paid staff comprising 1 joint secretary, 1 surveyor, 1 water distribution supervisor, 1 clerk and 4 patkaris.

In kharif, there is very little demand for water because of good rainfall. In rabi, water is rotated once in 15 days. Each rotation is completed within one and a half-weeks. Farmers who applied for water through the Chairman was issued water. An application form had to be filled providing the following information: Name of applicant; Valve number; Name of the land with survey number; Category of land holder; Type of crop and area to be irrigated; and No dues certificate for water charges. The distribution valves are opened by society patkari. Everyday 4 or 5 valves are opened; the patkari informs the farmer the time of water delivery so that they can remain in the field at the time of delivery to their field. The canal closure is the main problem in getting water from Radhanagari dam. They operate the dam 7 days and then close it for 10 days. This procedure is carried out from end of November to June/July because of shortage of water in the dam. The water distribution record is maintained by a clerk. The clerk informs the patkari who in turn informs the farmer about getting water. Ninety percent of farmers raise sugarcane; only 10% raise other crops like wheat, groundnut, soya bean, maize, fodder grass and vegetables.

Some farmers feel that the EC members and powerful farmers take more water. Dispute arises when two farmers want to take water at the same time from a valve. Those who do not keep their channel clean are not given water. After the formation of WUAs, availability of river lifted water increased; groundwater level also increased; there was change in cropping pattern; and improvement in cultural practices. The WUA provides other support services and guidance for best crop management practices.

5.6 Water Distribution in Bhima Lift Irrigation Scheme

Bhima Water Users' Association consists of the three villages: Bhima, Dhanol and Chanchpur. The LIS gets its water from Panam

Reservoir main canal. In this canal, water should flow continuously; but in rabi 1994-95, the canal was closed many times due to leakages and breaches. The WUA lifts water from the canal by two pumps and there are 14 outlets for distribution of water. As per the laid down policy, the water for lift irrigation scheme can be used only after the irrigation requirement in the gravity command area is met; but in reality, the water is used by the WUA when the canal is flowing without any restriction. The area irrigated by LIS is Bhima = 52 ha; Dhanol = 65 ha; and Chunchpar = 70 ha; Total = 187 ha. In distributing the water, preference is given to those who lost their turn in the previous rotation. Generally five or six farmers are given water at a time. There are two pumps with 30 hp motors. If there is demand from only 3 farmers, then only one pump is operated. If the demand is less than 3 farmers, pumps are not operated. The operators keep record of total time used by each farmer. The secretary, chairman and operators supervise the water distribution.

The farmers have to pay 50% of the government water charge to the ID in advance. If they do not pay, then the ID forwards the list of farmers who have not paid to the society chairman, requesting him to stop issue of water to those farmers who have not paid. Crops grown are cotton, maize, tur, wheat and oil seeds.

Water distribution schedule cannot be strictly adhered to because electricity is available only for 10 to 12 hours a day. When the power resumes, water is supplied to those farmers whose turn is due or who could not complete the irrigation (as a result of power cut).

Generally members get their turn as expected; but the main problem is the irregularity of availability of water in the canal, main canal breaches, electricity cut and leakages in underground pipelines and consequent repairs.

The WUA collects water charges from farmers on a hourly basis to pay electricity. Farmers pay directly to ID, which are 50% of the ID charges on crop area basis.

The agency watchman also supervises water distribution. The WUA undertake repairs of underground pipelines by giving contract to private parties; however, they supervise the overall repair work being carried out by private contractors.

The Bhima LIS is a single function society involved only in water distribution.

The agency watchman and the society clerk measures the crop area in each season and charges a fee as per the measurements. They charge an extra fee of 50% as a fine if the area recorded in the water demand form is less than the actual measurement.

The table below gives yield from LIS and direct irrigation.

YIELD IN QUINTALS		
Crop	LIS	Direct Irrigation
Wheat	13.0	14.0
Maize	12.0	9.0
Tur	9.0	9.0
Oil Seeds	13.0	13.0
Gram	7.0	7.0
Cotton	6.0	

There is not much yield variation; however, water used in LIS was less because water was supplied on hourly basis. Farmers took only what the required quantity of water. In direct irrigation, farmers take water without any time restrictions. Tail-end suffers from less water.

5.7 Water Distribution in Mohini Water Cooperative Society

For the society owned area water traverses from Ukai reservoir through Kakrapar weir, Kakrapar Left Bank Main Canal, Bardoli branch canal, Chalthan branch canal, Bheston minor and 3L, 4L, 5L, 1R subminors which constitutes the command area of MWCS. The water availability in Bheston minor varies from year to year in proportion to the variation in outflow from Ukai reservoir.

All minors, branch canals and main canals are unlined. Due to lack of periodical maintenance, channels and structures tend to damage frequently and repairs are not carried out immediately due to inadequate grant sanctioned by the government.

Before turning over the system to MWCS, the distribution network of canals were renovated; additional outlets were added; and the water courses were lined.

Due to lack of maintenance by ID, there are tremendous weed growth and silting in canals. The excessive silting causes rise in gauge reading at the measuring flume and causes higher payment to ID thereby.

Three patkaris are employed by society to operate the four subminors. As per rule, patkaris should operate the subminor outlets while farmers should distribute the water within the outlet among themselves. It was seen during one rotation, that both middle and tail reach farmers were obstructing the subminor outlet without prior permission of patkari. During the rotation, many farmer were not interested in taking irrigation water at night. They wanted their turns during the day and for that they gave incentive (bribe) to patkari to get turn as per their convenience. Though farmers do not irrigate during night, the patkari does not close the outlet gates and as a result wastage of water occurs with water flowing to the drains.

Head-end farmers receive more water than the other area members. They even take water twice in a rotation. Because of inadequate maintenance, in 1994, there was great inequity in the water distribution. The tail-enders could not irrigate their field.

Initially RWS based on specified duration was attempted. This did not work because the water in the subminor was fluctuating; soil conditions were varying with ploughed and unploughed soils having different water intake time.

The society and the ID collectively decided that society can take water for six days in rotation by heading up (closing CR gates). However, society does not obey the rule and they often make heading up for more than six days, thereby disturbing the water requirements of downstream people. Society fails in preventing wastage of water flowing into the drains from subminors. Farmers irrigate their land excessively and even twice in a rotation.

The patkaris of the society cannot handle their duties as per the laid down norms. These canals are supposed to be maintained exclusively by the ID. The farmers do not contribute labor and time to the maintenance. They have, however, done some maintenance work on behalf of the ID but the expenditure has yet to be reimbursed to farmers by the ID.

The complete rotation schedule is given in the newspaper by ID about 15 days in advance of each season. However, planned schedule was not implemented in practice. The table below illustrate this point.

	Start Date	End Date
Planned	7/11/94	20/2/95
Actual	29/10/94	12/3/95

The planning of rotation schedule is carried out at division level at the Divisional Office by the Executive Engineer before the season. The implementation of the above rotation schedule is carried out for section level by the Section Officer (SO). The schedule is not developed in consultation with and to meet the needs of water users.

At the point of transfer, the agency delivers water to WUA (subminors level); the ID patkari and the WUA patkari should note the gauge reading every one hour. They hardly note the gauge reading more than 3 times a day. When delivery is not on schedule or less than agreed upon then the society contacts the ID. Then the department takes action by increasing the delivery as much as possible or extending the rotation period.

The MWCS wants to operate the CR across Bhestan minor in such a way that the water in subminor will be assured upto tail-end. However, the ID do not permit MWCS to do so. The ID gives permission to operate CR gates such that the subminor should not flow more than its designed capacity. The ID examines gauge readings at the beginning of the subminor and do not bother about discharges at tail reaches.

After the formation of MWCS, the ID need to spend less time on collection of water charges; however, they have to spend more time and money to keep the channels maintained properly. Even with all these efforts, maintenance in this system is not upto the level of satisfaction. Irrigated area has increased from 400 - 500 acres to 900 acres. Most of the farmers have switched over to sugarcane which is remunerative.

5.8 Water Distribution in Anklev Subminor

Anklev subminor forms part of the Mahi Right Bank Canal (MRBC). The water distribution system of MRBC project comprises a main canal of design discharge capacity of 7000 cusecs, offtaking from the right side of Wanakbori weir, and having a length of 73.6 km. The project consists of six branch canals and 39 distributaries, minors, sub-minors. All the main and branch canals are lined whereas distributary, minors, subminors are unlined.

Anklev subminor passes through three villages starting from Bhetasi zero outlet (Navakhal minor) and passes through Bhetasi, Ambali and Anklev villages, Its length is 9 km. In 1993-94, approximately 365 ha of land is irrigated through canal water whereas 635 ha was irrigated through wells. In rabi, 424 ha of land was irrigated by canal water and 574 ha by well water. The culturable command area of the Anklev subminor is 1000 ha. Main crops of this area are: paddy, tobacco, banana, vegetables; wheat, mustard, cotton; bajra and groundnut. The entire Anklev subminor is unlined. Before turning over, it was rehabilitated and the number of outlets were reduced to 36 from 60.

Before the subminor was turned over to WUA, all the 60 outlets used to be opened simultaneously; as a result the water level in the canal was never maintained. Farmers used to obstruct the canal and take water and would never remove the obstruction once they had irrigated their land. There was rampant misuse and wastage of water by the farmers. WALMI (Anand) has propagated the idea of efficient water use by following rotational water supply. According to the WALMI's plan, the Anklev subminor and Nawakhal minor were to be run alternatively for a period of 168 hours.

In the head and middle reach areas, there are no problems in distributing water among members. Even when canal water level is less, they use all kinds of means to divert water to their fields. Whereas in the tail area water supply is inadequate; rich and powerful farmers take precedence than poor and marginal farmers. The powerful ones normally cross bund the canal and divert the water to their fields. Each turn is not restricted to specific duration. They can take water as long as is required to irrigate the area. In the tail area, some have to irrigate their field at night, and at night, the water level is also high because farmers of the head and middle area are not irrigating their field at night in rabi season because it is cold outside. Both during kharif and summer season, water requirement is high and, therefore, conflicts arise during those periods. There are instances where overtopping and flooding of water at night has taken place in the areas in and around subminor. The major problem appears to be inadequate maintenance.

The SO, Anklev operates the head regular at Bhetasi. By his order and according to rotation, gate is opened and closed.

The amount of water released is measured at the main gate. The Agency patkari and WUAs patkari are supposed to take readings every two hours. Gauge readings are not observed very frequently. Water distribution is done by the farmers themselves. When a farmer wants water during on-days he opens the gate of the outlet and closes it when his irrigation is over unless another farmer wants water. The observations indicate that water distribution is somewhat reliable for head and middle area when it is distributed at full supply level. Even with full supply, the water supply is not reliable to tail-end areas. If the water level in the subminor is less than full supply level, then water distribution problem was observed in all the sections of the subminor. Some farmers have started taking water from places other than regular outlets by siphoning through pipes and also inserting cement pipes. The main reason for taking water like this is that in some outlets farmers do not get water properly due to higher elevation of fields and due to flow depth being less than full supply depth. For head-enders, water delivery rotation has become regular but not for tail-enders; it is a problem of distributing the water within subminor.

Reasons attributed for poor water distribution:

* No rotational distribution is put into practice.

* Higher seepage losses along the subminor.

* Not maintaining full supply level in the subminor.

* Weak leadership within WUA.

* No effective communication between user members and WUA.

* Rules are not strictly followed.

* Influential people taking all water in the tail-end.

* Regular monitoring and continuous supervision during rotation is not there.

* Meeting between members, WUA and agency after very rotation not taking place.

WUA is not able to maintain the subminor. Some farmers feel that the maintenance grant is not properly utilized.

5.9 Water Distribution in Lower Bhavani Project (LBP)

In LBP, some kind of rigid Warabandhi schedule is followed. In this schedule, the week is divided into two rotation periods of 3½ days each, i.e., Sunday 6.00 a.m. to Wednesday 6.00 p.m. and the other from Wednesday 6.00 p.m. to Sunday 6.00 a.m. The advantage of this system is: that all the farmers get his time share on a particular day and farmers time is fixed with the day irrespective of the day and time of the arrival of water to the sluice. So farmers become well aware of their own time share.

The PWD generally provides water from the dam during two seasons, i.e., twice a year. The first turn is from August-December for 120 days for wet crops, especially paddy, and the second turn is from January-March for 90 days for irrigating dry crops, especially groundnut.

There is no restriction imposed either by the agency or by the WUA in selecting crops to be grown by farmers.

By knowing the extent of the area irrigated in a sluice, the farmers divide the 3½ day spell by the extent of area and get the time allotted for each acre. For example if the extent of irrigated area under a sluice is 100 acres, then the time allotted for each acre is 84/100 = 0.84 hrs/acre. So a farmer is allotted 0.84 hrs/acre in a spell. Thereby each farmer receives water twice a week based on their land holding size. One is from Sunday morning to Wednesday evening, and the other is from Wednesday evening to Sunday morning. Farmers receive their share of water at the specified time during both spells.

Farmers in this area are practicing this rotation for a long time and strictly follow it irrespective of the quantity of water flowing through the sluice whether it is sufficient or insufficient. Since numerous open dug wells have come up in the area, farmers are utilizing their groundwater in conjunction with surface water whenever necessity arises.

A number of informal methods of using this time share have been developed in this project. For example, at the time of transplanting, farmers need continuous supply of a large volume of water. During the transplanting period, two or three farmers (normally relatives or homogeneous group) come together and with their combined period of time share and also with the use of well water, if any available, they used to take up transplanting one by one. Other methods such as consolidating the time share by mutual understanding, giving one's time share to his neighbor at critical times of water shortage and sharing the well water (because of free electricity) are also adopted.

In the system, farmers themselves manage the water distribution. All farmers are well aware of their time share and they strictly adhere to it except where there is mutual agreement and understanding.

In LBP, operation and distribution is being carried out by the PWD. The water release from the dam is determined and announced through the local newspaper by the collector of the district in consultation with PWD officials. Farmers are not consulted in this matter. During the first turn period, canal supply is continuous. During the second turn period, PWD follows 14½ days initial supply after opening. After that 7½ days 'off' and 10½ days 'on' schedule. Once when the farmers come to know of the opening of the dam, then they know when to expect water in their distributary canal based on their experience. For example, to get water in Mettupalayam distributary it takes 2 to 2½ days after opening of the dam. In this method, there is fairly good equity between head- and tail-end farmers. Farmers feel that water distribution has considerably improved where OFD works were completed. The groundwater use with free electricity has provided the necessary flexibility for the farmers to grow crops of their own choice.

Before the execution of the On Farm Development (OFD) progam, disputes often arose between two farmers over their start of time because there were illegal use of water by making unauthorized cut and small breaches in the channel. After the execution of lined channel, the chances for disputes have considerably reduced.

The major problem in LBP is not getting adequate water (design discharge). The operation and maintenance of the main system is under the control of the PWD. So far, no rehabilitation work was undertaken by the PWD since the LBP construction and the starting of its operation. The PWD is doing the cleaning and desilting of the main and distributary canals here and there before the start of the season. It has done some lining at vulnerable points of breach to minimize the amount of leakage and seepage in the main canal and distributary.

The main and branch canal of the LBP are earthen canals. The seepage loss during the 15 to 20 days after opening the canal is 12 cusecs/mile, and after 20 to 30 days it is 10 cusecs/mile. Subsequently, it stabilizes at 5 cusec/mile.

During both the first and the second turn, illegal siphoning and lifting of water goes on, particularly during the night. Farmers get together and form a group to illegally lift water from canal by using diesel pumps and hiring laborers at Rs 40/night. The PWD has little power to take any action on illegal water lifters. Out of 41 cases filed by the PWD, 38 cases were dismissed for lack of evidence.

Maintenance of main canals and branch canals are not upto standard due to insufficient grant.

Interference from politicians and political parties is other source of constraint to better maintain and operate the system.

5.10 Water Distribution in Ojhar Societies

Ojhar village has federated associations of three Water User Societies: Ban Ganga, Mahatma Phule and Jay Jogeshwar Societies. The ID prepares the schedule for main canal and gives to societies 10 days before. Societies prepares its schedule and distribute it to members. Each society has a water stage recorder for measuring the discharge at the minors. In addition, there are measuring structures like 'V' and rectangular notches to measure the discharges. The readings at these minors were taken by both society patkaris and ID permanent laborers. These lower level officials do not take water readings regularly at every two hour intervals. They record the discharges three to four times each day. The ID fixed the water quota for each season for these WUAs and did not impose any restriction on the crops grown. Because of the assured supply of water, farmers started growing crops like sugarcane.

The fluctuation of water level at the entry point of the minor has a very disturbing effect on maintaining discipline among farmers. This was amply demonstrated during the 1994 first and second rabi rotation in Jay Jogeswar Society. The unstable flow constraint was overcome by the skilled operation of the patkari. One of the lessons learnt from this rotation is that patkaris must be adequately trained for the operation of the outlets and as to how much water should be allowed in each outlet when the discharge in the minor is at a particular level or fluctuating.

Free crop choice is very important for the farmers to innovate. Once, the farmers are convince of the assured supply of water, then they begin to grow low level water consumption high value crops like vegetables and onions. They have also grown crops like grapes even in shallow soils. They have installed drip system and provided watering every other day from their wells. Because of the close supervision and dynamic leadership, there was equity in water distribution from head to tail. WUAs collaborated closely with the ID and worked jointly with the ID to solve field channel problems. NGOs in these societies plays a helpful and facilitating role. The WUA patkaris receive good training from WALMI, Aurangabad which helped them to carry out their task more confidently.

Water distribution within these minors has to follow tail to head rule. Because of this rule, tail farmers have more assurance of getting canal water during each rotation of various seasons. However, in actual practice tail to head rule cannot be practiced all the time due to receipt of fluctuating discharge received in the minor. Depending on the quantity of discharge received in the minor, the outlet gates are to be adjusted so that no overflow within the minor takes place. Also, opening and closing of outlets depends on the design, capacity and length of minor.

During the 4th rotation of rabi 1994, these societies distributed water on a fixed time basis. This time was limited to 10 hours/ha for irrigation of Phule and Jay Jogeshwar Societies while 12 hrs/ha of Ban Ganga Society. This has some beneficial effects

The beneficiary farmers started cleaning their field channel before receiving the 4th rotation water supply. Seepage from minor and field channels were reduced because of less time was used in irrigation the field. There was more discipline in distribution of water.

The main canal is maintained by the agency. They clean it only once before the rabi season. The turned over system is maintained by the WUAs. The ID gives maintenance grant to the society at Rs 20/ha. Minor channels are maintained well by the society. The field channel cleaning is looked after by the outlet committees. Farmers have to carry out the field channel cleaning.

The following changes have been introduced after turnover of irrigation systems to farmers:

* Taking water on volumetric basis and distributing among farmers on area and crop basis.

* Collection of a water fee of 15% for late submission of water charges.

* Increased penalty for breaking rules.

* Storing water in Bandharas and charging a fee for Bandhara water use.

* A compulsory fee is charged for 50 percent of area from those who do not take water in kharif.

* For those who take water out of turn, the society does not give water for that rotation.

* For those who take water twice in a rotation, an additional fee is charged for the second watering.

* At fixed time rotations (10 hr/ha in Phule and 12 hr/ha in Ban Ganga) better field channel cleaning and less seepage and wastage is observed.

6. PERFORMANCE OF WATER DISTRIBUTION IN TURNED OVER SYSTEMS

Ten typical case studies under lift, tanks and gravity irrigation systems were selected and compared for their performance using the following indicators: flexibility, reliability, farmers' satisfaction, equity, adequate water supply, production of high value crops, less trouble in getting water (easy access) and political mileage (meeting agency officials). (Table 6.1).

As can be seen, most of these indicators are qualitative in nature; however, they point towards the following conclusions:

i. In all the systems, the WUAs have gained political power, able to meet with high level officials and bring pressure in getting things done to their systems; before the turnover, this is not the case.

ii. After the turnover, all farmers had easy access to solve their problems through their WUAs.

iii. In nine of the ten systems, farmers have switched over to high value crops. The one in which farmers have not switched over to high value crops is a very water short system.

iv. Approximately 80 percent of the systems receive adequate supply of water for crop production.

v. In both lift and tank irrigation systems equity of water supply was good whereas in gravity irrigation systems it was good only in 50% of the systems.

vi. In all the systems, farmers have augmented their water resources by pumping groundwater and introduced flexibility in their water supply.

vii. Reliability of water supply in gravity irrigation system was not very good compared to tank and lift irrigation systems (except water short Dusi-Mamandur System).

viii. Farmers Satisfaction is not upto the mark in large gravity irrigation systems compared to small tank and lift irrigation systems.

7. LESSONS LEARNED

Based on the field studies undertaken and analysis of data obtained from the field studies, the following lessons are learned; based on the lessons learned certain suggestions are made for improving the system related issues and turned over system performance.

i. **The observations made in the field studies indicate that a fully functional system with adequate control to regulate both discharge and level performs better after the turnover; therefore, any system turned over to WUAs must be made fully functional for meeting the objectives of turnover. Incidentally, a functional system is the one in which physical integrity of the system is maintained and is capable of meeting the operational needs and targets of the turned over system.**

System integrity is necessary to pass the desired flow and maintain the required depth of flow through proper control and regulating structures.

Table 6.1 Performance of Water Distribution in Turned Over Systems

Type of System	Name of System/ Indicators	Flexibility	Reliability	Farmers Satisfaction	Equity	Adequate Water Supply	Production of High Value Crops	Less Trouble in Getting Water	Political Mileage Empowerment
Lift	Bhima	Fair	Fair	Fair	Good	Fair	Yes	Yes	Yes
	Phulewadi	Good	Good	Good	Good	Good	Yes	Yes	Yes
Tanks	Parunde	Good	Good	Good	Good	Fair	Yes	Yes	Yes
	Baldeva	Good	Good	Fair	Fair	Good	Yes	Yes	Yes
	Dusi-Mamandur	Fair	Poor	Poor	Fair	Poor	No	Yes	Yes
	Kedar	Good	Good	Good	Good	Fair	Yes	Yes	Yes
Gravity Irrigation System	Anklev	Good	Fair	Poor	Poor	Good	Yes	Yes	Yes
	Mohini	Fair	Poor	Fair	Poor	Good	Yes	Yes	Yes
	Ohjar	Good	Fair	Fair	Good	Good	Yes	Yes	Yes
	LBP	Good	Poor	Fair	Good	Poor	Yes	Yes	Yes

In this regard, maintaining the designed cross-section and longitudinal slope of the canal, limiting the velocity of flow to prevent scour and silt deposition, limiting the seepage and percolation losses, provision of suitable free board to prevent overtopping and provision of appropriate flow regulating and control structures are part of maintaining system integrity.

ii. **Much of the field channels in the turned over system are earthen channels. In view of their large seepage, percolation and operational losses, some of the long earthen canals are not performing well; it would be ideal to limit earthen field channel length to not more than 500 to 600 m. Moreover, the density of field water courses per unit area must be sufficiently high to avoid field to field irrigation. Selective lining of field channels is to be undertaken where there is necessity to push water to the tail-end section as well as to reduce high seepage losses thus preventing waterlogging.**

iii. In most systems studied, maintenance is one activity which was given the least importance while the system operation entirely hinges upon the level of maintenance. **The case studies results indicate that both maintenance and operation should be turned over to Water Users Associations with adequate resources to carry out repairs and maintenance.** The practice of turning over only operational aspects to WUAs while the agency is retaining the maintenance aspects of turned over system is not functioning properly. Even when both operation and maintenance are transferred to WUAs, effective supervision, close monitoring and well-defined norms are to be formulated and put in place.

An effective monitoring of not only the discharge entering into the system at the point of transfer but also monitoring the tail water depth of turned over system is to be introduced.

iv. In most turned over systems, some sort of rehabilitation is being attempted before turning over the system. Performance results of these turned over systems indicate that rehabilitation carried out with full involvement of WUAs right from the beginning of planning and implementation of rehabilitation performs better than those systems where rehabilitation is carried out only by the agency and handed over the system to the WUAs for operation and maintenance. **Therefore, a participatory approach with full involvement of WUAs right from the planning stage is suggested for rehabilitating turned over systems.**

v. **Water allowance to many of the turned over system is more than adequate to meet the crop water needs; this more than** adequate supply increases the groundwater recharge and builds up the groundwater table providing a potential source to farmers to tap this source.

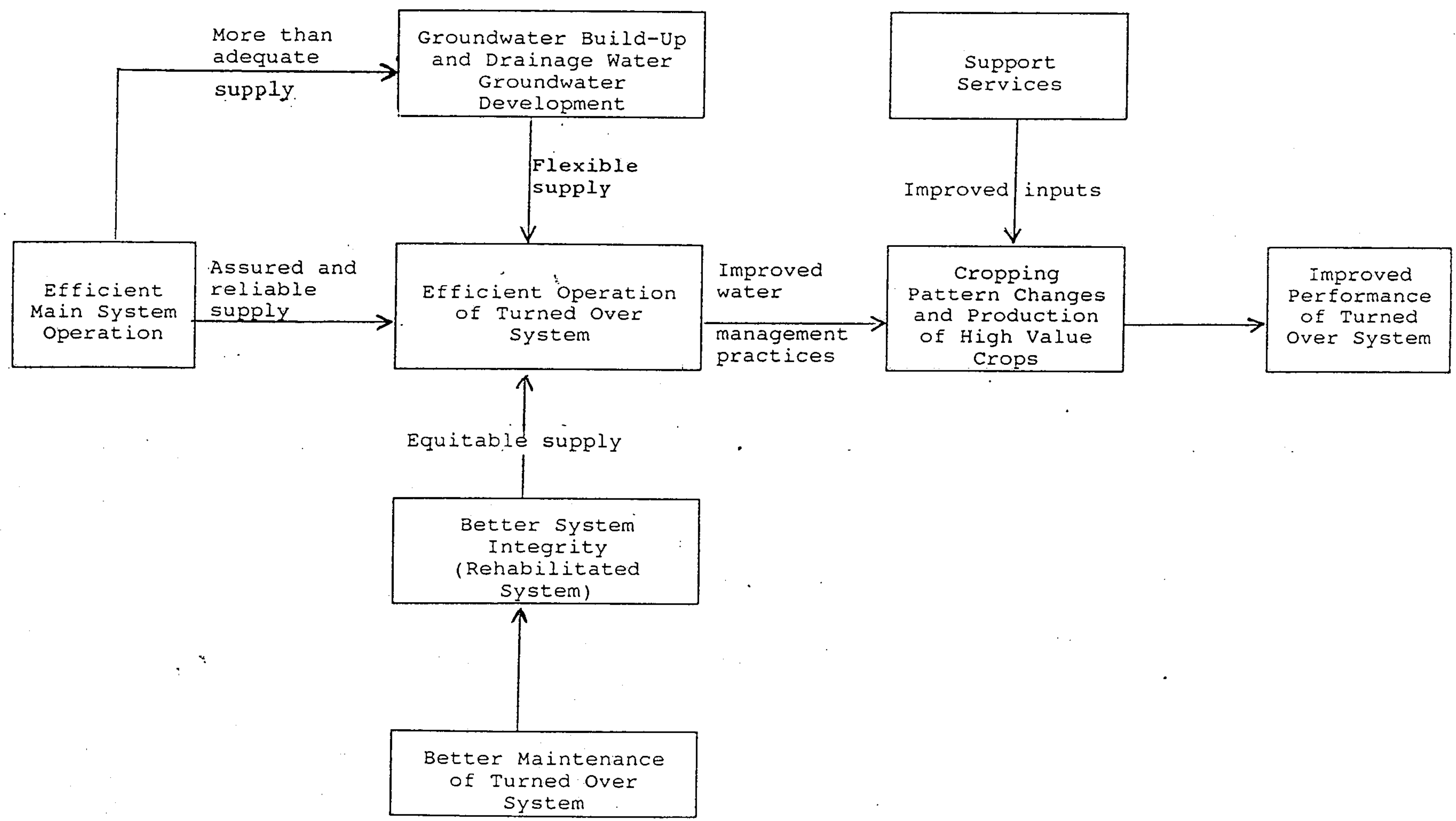
Farmers when they are assured of reliable surface water supplies go in for groundwater development to create the necessary flexibility in water supplies which is instrumental for introducing the production of high value crops. Therefore, the two important parameters that are very conducive for improving the performance of turned over system are: i) reliable main system water supply, and ii) adequate water supply for farmers to conserve and use it in an integrated manner to provide the necessary flexibility for raising high value crops (Table 6.2).

The argument then leads to us to answer an important question: what should be the level of water supply from the main system to the turned over system which is sustainable and yet produces sufficient incentive for WUAs to go in for high value crops.

vi. With the existing infrastructure and system control and regulating structures and unreliability of main system delivery supply, introduction of a rigid rotational water supply appears to be somewhat difficult unless we improve the on-farm works considerably, improve the reliability of main system supply, put in place an efficient maintenance management practice and introduce an effective monitoring and supervision mechanism.

vii. System turnover essentially entails switching over from agency management to WUAs management on the turned over part of the system. Field study results indicate that presently, there is an abrupt withdrawal by the agency from the turned over system; the process of this transfer should involve a transition period of joint management both by the agency and the WUAs with some external help from NGOs'. Systems in which these joint management is put in place with NGO effort, performed better. It is suggested that a period of 2 to 3 seasons should be allocated for joint management and subsequently effect phased withdrawal by the agency and NGOs for the WUAs to equip themselves with technical and organizational management capabilities.

Table 6.2. The Process of Change Introduced by the System Related Factors



8. CONCLUDING REMARKS

The following system related issues have implications for policy formulations:

* Level of water supply to turned over system (productivity and sustainability).

* The process of rehabilitation (participatory approach).

* Components to be turned over (operation, maintenance, rehabilitation, etc.).

* Water rights (with regard to surface, ground and drainage water).

* Joint management between agency and WUAs (during the period of transition).