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IN SEARCH OF WATER USERS' PERSPECTIVES OF IRRIGATION PERFORMANCE

a participatory research approach

International Irrigation Management

by

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Table of Contents

Summary and conclusions

Involvement of water users in irrigation management research results in an understanding of the importance they give to irrigation management issues. Water users themselves take management decisions about operation and maintenance of farm irrigation systems and about the farming system as a whole. To understand their meanings and perceptions and to include those in the identification of actions for effective improvements, water users' knowledge and expertise can no longer be neglected in irrigation management research.

A participatory approach was applied to achieve understanding of water users' perspectives of irrigation performance. The fundamental principles of the Participatory Rural Appraisal (PRA) methodology were essential in this study. This methodology provided the means to involve water users as experts of their own situation and to enable them to share their perceptions about how they manage the water supply. The water users who participated in this study possess detailed knowledge and a broad perspective about irrigation management issues at farm and watercourse levels, but also at higher levels of the irrigation system. Water users as well as researchers from IIMI took part in a communicative process in which they discussed ideas, concepts and understanding.

Water users' involvement resulted in the identification of indicators, their measurements, factors influencing performance and various local responses implemented to rectify changes in performance. Water users' perspectives are grouped into indicators which they apply to judge the performance of irrigation water supply. In addition to performance indicators, water users have developed several measurements to facilitate their decision-making process on seasonal or daily basis. They also have knowledge about technical and socio-political factors that influence these indicators. The combination of indicators, measurements and influencing factors lead to a specific response of the water user adapted to the local situation. The local response is a way to compensate for poor performance and to improve the actual situation.

The application of the participatory approach resulted in an understanding of water users' perspectives of irrigation performance by the research participants. However, a participatory approach was only applied during the implementation of the research phase of the present study. It is assumed that the results of the participatory approach would have been more effective had it been applied from the very beginning, through all phases of the performance study, including the research phase. This participatory study would also have been more effective if other stakeholders such as representatives of government departments, non-governmental organizations, water user associations, universities, etc, would have been involved at different stages of the research process.

1. Problem definition, research approach and purpose

1.1 Introduction: water users' participation

Since a few years there is a tendency to regard irrigation not merely as a domain of engineers, where technical data are all that is needed to construct and manage irrigation systems. It has been more and more recognized that irrigation management is a socio-technical process in which human and physical elements are combined for sustainable irrigated agriculture (Kalshoven et.al. 1989).

The role of water users in this process is gradually being appreciated and considered to be a vital component in irrigation management research. To involve water users in irrigation research leads to an understanding of the meaning water users attach to their life-worlds (Seur 1992). To accomplish this, the researcher and the researched should take part in a communicative process in which they exchange and discuss ideas, concepts and theories. Not knowing water users' priorities and not including their agendas in irrigation management research mean that professionals are likely to address the wrong problems in their research (Chambers et al. 1989). Water user participation in irrigation management is often desirable, as stated in a World Bank document:

> *"Concern with the limited effectiveness of irrigation bureaucracies overburdened by the rapid expansion of the irrigated area has let many to conclude that the users of irrigation water must play a larger role in the operation and maintenance of both small and large irrigation systems* (Korten 1982:5, cited in Uphoff et. al. 1990)."

Although water user involvement in this quotation sounds as an unavoidable and forced choice, water user involvement is seen as a necessary ingredient to enhance the effectiveness of irrigation management. As stated in this quotation, water users should be involved in operation and maintenance, they have a vital role to play as well in research, planning, implementation, monitoring and evaluation of irrigation related activities.

Water users make management decisions about production inputs, operation and maintenance of farm irrigation systems, and about improvements to be made in the farming system as a whole. To improve their abilities to make these decisions, water users should be involved in the whole process of irrigation management research. In this way it is also more likely that they understand why certain activities, introduced by outsiders, take place and why certain changes are to be made in the irrigation system (Lowdermilk 1981). On the other hand, irrigation system managers, researchers, policy makers and other actors, will better understand why water users take certain decisions and why they prefer certain irrigation practices.

1.2 Irrigation system performance and water user perspective

The International Irrigation Management Institute (IIMI) in Pakistan also acknowledged the relevance to involve water users in their programs. The Performance Assessment Program has been the first program in IIMI-Pakistan in which active water user participation was experienced for the first time (IIMI 1994b). This program is designed as a process in which the performance of irrigated agriculture is assessed and improved, based on indicators derived from several groups with different perspectives.

Three groups can be distinguished according to their objectives: water users, system managers and policy makers (IIMI 1994c). Small and Svendsen (1990) argue that 'significant differences often exist between the typical perspectives of each group'. This implies that good performance as perceived by one group could mean poor performance to another group. Several indicators have been developed for policy makers and system managers[1] (IIMI 1994a). However, little attention has been paid to assess irrigation performance from a water user's perspective.[2]

One reason for IIMI-Pakistan to include water users' values in the Performance Assessment Program is that it is likely that their perspectives differ from those of system managers. Small and Svendsen (1990) give three fields on which their perspectives may differ: concerns of system managers tend to be geographically broad, impersonal and short term; water users' concerns are more local, intensely personal and long-term. Based on these differences, the way they judge irrigation performance will differ as well. Therefore, it is of ultimate importance to know how the actual users judge the system.

Another reason is that performance of the irrigation system in technical and social sense, can not be assessed and optimally improved, as long as the water users' perspectives are not taken into account. IIMI's Performance Assessment Program therefore compares and evaluates the perspectives of several interest groups of irrigation performance.

The final reason is that research on water users' perspectives could be the first (exploratory) step towards a more participatory form of communication in which partnership and collaboration between researchers, water users and eventually other actors, will be established for future activities.

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[1] Indicators for policy makers are: (1) maximization of irrigated area, (2) maximization of productivity, (3) self-sufficiency, (4) equity, (5) water users' profitability and (6) environmental sustainability. For system managers the indicators are: (1) provision of targeted water supply, (2) adequacy of water supply, (3) predictability, (4) equity of water distribution between head and tail-end water users, and (5) productivity, financial viability.

[2] Known examples are Chambers (1988), Baars and Van Logchem (1991), Small and Svendsen (1990).

1.3 Objectives and methodology

The following research questions have been formulated:

(i) ***By which values do water users judge the quality of their irrigation water supply?***

(ii) ***How does this influence the decisions and actions the water users take to compensate for poor performance?***

(iii) ***How useful is a participatory approach for irrigation management research?***

The methodology considered most suitable to serve as a basis to include water users' perspectives in irrigation management research is Participatory Rural Appraisal (PRA). This participatory approach, which differs from IIMI-Pakistan's conventional way of doing research (i.e. questionnaires, empirical and statistical analyses based on primary data collection), was considered fundamental to enable water users to express their ideas on irrigation performance in an open and flexible manner. Emphasis lies on a multi-way flow communication process among the participants. The relevance to involve water users in a different way can no longer be neglected, not for qualitative studies, but neither for long-term quantitative data collection.

This participatory research is to be considered exploratory, as the present research is a first experience in IIMI-Pakistan with water users' perspectives as a key research issue and with water users as active participants in the research process, and represents a first step towards a larger use of participatory approaches at IIMI Pakistan.

1.4 Research site

The irrigation system in Pakistan (14.6 million ha.) is the largest continuous irrigation system in the world (Bhatti and Kijne 1990). The Indus Basin is a huge plain crossed by five rivers: Indus, Jhelum, Chenab, Ravi and Sutlej. The Indus Basin Irrigation System is a large scale irrigation system and covers some parts of the North West Frontier Province (NWFP) and Balochistan and large parts of Sindh and the Punjab (the latter meaning 'land of five rivers' in Urdu). Construction of the system was initiated by the British in 1859 with the Upper Bari Doab Channel in the north of the Punjab. The system comprises 3 major storage reservoirs (Tarbela, Chashma and Mangla), 19 barrages/headworks, 43 canal commands and about 63,000 kilometers of canals and distributaries carry water to about 90,000 *chaks* (watercourse command area), (Bhatti and Kijne 1990). Water flows continuously from canals into distributaries, then through ungated concrete outlets (*moghas*) into watercourses, and finally through the inlet (*nakka*) into water users' ditches and fields (Merrey 1986).

Irrigation water allocation is regulated by rules developed by the British more than a century

ago. Under these rules the Irrigation Department delivers a specific amount of water based on a predetermined 'water allowance' and on the size of the culturable command area of the watercourse. Each water user has the right to a quantity of water proportional to the size of his landholding, for which he is allotted a period of time on a weekly rotation basis, regardless of crop water requirements (Merrey 1986). During his turn, the water user is entitled to all the water flowing in the watercourse. The present water allocation system within chaks is known as '*warabandi*' (*wara* means turn and *bandi* fixation). The warabandi system can either be fixed for each water user by the Irrigation Department and can not be altered. This system is called '*pacca*' (official) warabandi. Another possibility is the '*kacha*' (temporary) warabandi system, in which the turns for each water user are agreed upon by all shareholders of the watercourse. The Irrigation Department does not interfere unless a complaint is lodged (Bhatti and Kijne 1990).

Aside from surface water irrigation there is a large contribution from ground water irrigation to the irrigation water supply. Due to severe waterlogging and salinity problems in the Punjab and Sindh provinces public tubewells were introduced. The first large-scale Salinity Control and Reclamation Project (SCARP) was completed in 1963. In addition to 13,000 public tubewells, there are more than 300,000 private tubewells (Vander Velde and Johnson, 1992). Annual production is based on two cropping seasons: '*kharif*' (summer season from mid-April to mid-October) and '*rabi*' (winter season from mid-October to mid-April). The major crops in the Indus Basin Irrigation System are cotton and rice (kharif), wheat (rabi), maize, and sugarcane.

The area where the research on water users' perspectives was carried out is the Fordwah-Eastern Sadiqia (FES) irrigation system in the Fordwah Division of the Bahawalnagar Circle in the Bahawalpur Irrigation Zone, South Punjab. The Fordwah Main Canal and the Eastern Sadiqia Canal off-take from the Sutlej River at Suleimanki Headworks (see map in Appendix 1). Approximately 175 km downstream, three distributaries follow from the Fordwah Branch: Azim, Fordwah and Mahmood distributaries, situated at the tail of the Chishtian sub-division. The Fordwah and Azim distributaries were selected for this research, to enable comparisons between information collected through participatory approaches and daily water level monitoring data collected by IIMI field staff at the head of eight watercourses along these two distributaries. The major crops in this area are cotton (kharif), wheat (rabi), maize, sugarcane and fodder.

The total Culturable Command Area (CCA) of the perennial Fordwah distributary is 14,844 hectares. The design discharge of the Fordwah distributary is 4.47 cubic meter per second (158 cusecs). Most of the water users cultivating land within the Fordwah distributary command area have small or average land holdings. The people in the area are called '*riasty*' and have migrated from India after partition in 1947. Their language is Punjabi.

The Azim distributary, which is non-perennial (receiving canal water during the kharif season only) has a CCA of 12,870 hectares. The design discharge of the Azim distributary is equal to 6.9 cubic meter per second (244 cusecs). Along the Azim distributary, especially in the head and middle portions of the distributary, many big landlords along with small tenants can be found. The people along Azim are the original inhabitants of the area and speak Punjabi and Siraiki.

1.4 Outline of the report

Aside from the introduction and the conclusion, this report is divided into three parts. The first part, chapter 2, begins with a theoretical background of participatory approaches and then discusses, through the principles, tools and research process, how the Participatory Rural Appraisal methodology has been put into practice.

The second part, chapter 3, includes an evaluation of the methodology applied in this research and assesses the suitability of PRA (or participatory approaches in general) for performance analysis related to irrigation management research.

The third part, chapter 4 and chapter 5, presents research findings related to water users' indicators and local responses developed to mitigate the negative effects of poor canal water supply performance.

2. A participatory approach: theory and practice

2.1 A participatory approach: theoretical framework

The need for a different approach in IIMI-Pakistan was clearly illustrated recently in a watercourse command area where IIMI has been collecting quantitative data for the last three years. The water users who live there revolted against IIMI's presence in their area and did not allow IIMI field staff to come to their village any longer or to ask them any more questions. The water users explained that they suspected IIMI of reducing the water level in the distributary to test to which extent they were still able to survive. Lack of an explanation and openness from IIMI's side about their activities in that area and lack of understanding from the water users' side about IIMI's intentions, were part of the problem. To prevent that such a problem happens again, a different approach towards research should be taken in which water user involvement and participatory communication for decision-making are a natural ingredient.

This chapter first presents a theoretical framework concerning participatory approaches, which is followed by an explanation concerning the application of the PRA methodology in this research.

PRA, a participatory methodology, was chosen to enable water users to participate in the research process and to share their visions and solutions. The word 'participation' however, has become popular and knows many distinctions. Pretty (1995) distinguishes seven types of participation. Table 1 is based on that typology.

Although all these types are forms of participation, only the last three types of participation are expected to have a sustainable impact. It is relevant to realize which type is possible or desired for application within the actual context. The first four forms of participation belong more or less to the conventional paradigm[3], and it can be said that they have no sustainable impact on the community. The last three forms are more or less present in the so called 'alternative systems of inquiry' (Pretty 1994). Numerous participatory approaches have been implemented, mainly as a reaction to the shortcomings of the conventional research paradigm. PRA is one of these so called 'alternative systems of inquiry'. One of the key strengths of PRA compared to other methodologies is the emphasis on visualization (Cornwall et. al. 1993). This requires a reversal of roles between researchers and water users and emphasizes the water users' knowledge and ability to analyze their own situation. Visualization facilitates, rather than replaces, the discussion which follows.

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[3] Under the conventional paradigm, technology is generated from science at universities, laboratories or research institutes. This technology is then transferred by extension agencies to the 'passive' rural community. This linear and top-down process of transfer of technology (TOT) is regarded as a black-box: when the input for the process is known, the outcome can be exactly predicted.

Table 1 Seven types of participation

Type of participation	Role of target people	Role of external agent	Sustainable	Flow of communication	Method used
1 Manipulative participation	'people's' representatives on official boards who are non-elected and have no power	use participation as a 'pretense'	no	one-way; down-stream	
2 Passive participation	listen to what is going to happen	tell what is going to happen	no	one-way; downstream	
3 Participation by consultation	answer questions, being consulted	control analysis and listen to people's views without any obligation	no	two-way; down-stream	questionnaires
4 Participation for material incentives	contribute resources (fields, labor)	return food, cash or other material incentives	no	two-way; down-stream	on-farm research
5 Functional participation	groups meet predetermined objectives (may be interactive)	achieve project goals; determine objectives and make major decisions	maybe	multi-way; down-stream	group dynamics
6 Interactive participation	join in analysis, development of action plans or strengthening local institutions	share decision-making with people, because participation is seen as a right	yes	multi-way	alternative systems of inquiry
7 Self-mobilization	take initiatives independently of external institutions	provide an enabling framework of support	yes	multi-way; up-stream	

2.2 *Putting the approach into practice: principles, tools and process*

The PRA methodology was adapted for irrigation management research and was applied as a research instrument. Six principles of participatory methodologies were considered when adapting PRA to the actual context. Pretty (1995) describes these six principles. How these were applied in this research is described below.

Principles

The first three principles relate to behavior and attitude of the team members who implement the PRA methodology. The fourth and fifth principle relate to the methods or 'tools' of PRA, and the last principle relates to the impact of the participatory process on the participants.

The first principle is that systems of participatory inquiry have a *defined methodology and focus on systemic learning processes*. In the present study, the use of PRA resembled more or less 'functional participation' (type 5) as explained in table 1, although at times water users participated by consultation (type 3). The learning process was most obvious when water users and team members took part in discussions and exchanged ideas.

The second principle, *the approach should be context specific*, means that the approach should be flexible enough to be adapted to suit each new set of conditions and actors. PRA is used in an irrigation management research context and adapted as a research instrument. New tools were developed to suit the local situation. During the course of activities a change of plans was often made when water users came up with suggestions for further activities. Pretty (1995) emphasizes that because of this flexibility there can be multiple variants of an approach. This depends on who implements it, who are the participants, what are the research objectives and what is the time span.

Facilitating experts and stakeholders is the last principle which relates to behavior. As Pretty (1995) explains, the role of an 'expert' is best thought of as helping people to carry out their own study and so try to bring about changes which people regard as improvements. However, IIMI is not a change agent but a research institute, and does not have the means to bring about changes. The team members therefore guided the discussions and the research process and analyzed the outcome which was then discussed and improved by the water users.

The fourth principle states that all participatory approaches seek *multiple perspectives* on a problem situation. To seek diversity is a central objective because individuals with different characteristics will understand and evaluate a situation differently. This study sought the diversity in perspectives between different types of water users, like head, middle and tail water users, and tubewell- and non-tubewell owners. Different meanings between team members were also taken into account when discussing the information.

Making use of the group inquiry process is the fifth principle of a participatory approach. Focus- and organized group meetings provided the opportunity to bring together water users with different characteristics. This revealed the complexity of the problems related to irrigation performance and the differences in perceptions between water users. This implied that the team (all social scientists) was usually extended with people from different disciplines to be able to

discuss the various problems in detail.

The last principle, *the process should lead to sustained action*, is in this study not applied in the sense that the process leads to direct improvements at farm level. This could have been possible if local institutions who have the ability to implement changes at this level were involved in the study. However, IIMI did not yet want to make commitments to the outcome of this research because of its exploratory nature. The process did initiate an internal debate in IIMI about an additional participatory research approach which may influence the perceptions of the actors involved in irrigation performance about how to identify and implement improvements.

Tools

Another important component of PRA is the tools (or methods) (Chambers 1992) developed for its implementation. The application of PRA in irrigation management research led to the development of new PRA tools and modification of existing ones.

Tools applied to facilitate the discussions

- un- or semi-structured interviews
- field walks
- field maps indicating problem areas
- pie diagrams to visualize the share of tubewell and canal water applied to the field
- trend lines to visualize irrigation water supply throughout the year
- chapatti figures and chick peas to indicate canal water availability in relation to the needs of the water users
- chance-exercise to explore predictability
- problem ranking and ranking of indicators
- cropping calendar in combination with water needs
- flow diagrams for causes and effects of problems

Examples of tools are provided when the results of this research are discussed in chapter 4. Drawings were made by using various color pencils. For this report, the colors used in the drawings which are explained in chapter four are replaced by signs.

Process

PRA was applied throughout the whole research process. The process can be distinguished into an exploratory phase, an in-depth phase, and a validation phase.

The exploratory phase mainly comprised of problem identification and analysis, information selection and a first understanding of water users' performance indicators. The team members, who by now got a first impression of the area and the people, sought as much diversity as possible in the range of problems related to irrigation water supply and irrigated agriculture. At the start, a large number of watercourses were investigated to cover the largest possible heterogeneity in terms of irrigation water supply and physical, social and economic environment. Seeking for diversity resulted in a large range of information which provided useful explanations for information obtained at more advanced phases of the research process.

The objectives for the second phase, the in-depth phase, were to finalize the definition of indicators through cross-checks and discussions with water user groups (using sheets and cards which could be shuffled). One watercourse was selected (Fordwah 46-R) where a group meeting was followed by twelve meetings with individuals to explore how water users with different characteristics apply the indicators to compensate for felt constraints, and to reveal differences between water users from the head, middle and tail part of the watercourse.

During the validation phase, the knowledge which was gained from the previous meetings was discussed in a group meeting. Differences which were found were explained, resulting in very lively discussions. Based on the information exchanged, suggestions for follow-up activities (between the water users and IIMI) were raised. However, there seemed to be a gap between the water users' expectations and IIMI's potential to take action accordingly.

The information provided above can be summarized as in table 2. The focus during each phase of the research process is given for each principle.

Table 2 Overview of the different principles and phases of the applied participatory research process

Principles of a participatory approach	Phases of the research process		
	Exploratory phase	**In-depth phase**	**Validation phase**
Learning process	Learning about broad problems related to irrigation	Learning about detailed water users perspectives of irrigation performance	Learning about explanations for differences between all types of water users
Context specific	PRA for research; tools for general problem identification and analysis	PRA and tools for specific information	Tools for validation
Facilitation	Little facilitation in meetings with individuals	Focused facilitation with individuals and groups	Facilitation of group discussions to explore differences and discuss remaining issues
Multiple perspectives	Seeking as much diversity as possible among water users and among team members	Seeking diversity between water users of a watercourse with different characteristics	Seeking diversity in explanations for differences
Group inquiry process	Random group meetings with several type of water users	Focused group meetings with water users of one watercourse	Organized group meetings in one watercourse

2.3 Selection of sample sites and implementation of field activities

A number of watercourses was selected for this research. The field activities were implemented in each watercourse with a certain number of water users during group or individual meetings (table 3).

Table 3 Overview of watercourses and number of water users involved in the research

Watercourse	Sites visited in the watercourse	IIMI	NON-IIMI	Number of water users visited	
				individual	groups
Azim 20-L	Head, tail	X		6	10
Azim 30-R	Head, tail		X	5	
Azim 65-L	Head, tail		X	5	
Azim 94-L	Head, middle, tail		X	7	
Fordwah 14-R	Head, middle	X		4	
Fordwah 46-R	Head, middle, tail	X		15	18, 8, 18, 25
Fordwah 90-R	Head, tail		X	5	
Fordwah 106-R	Head, middle, tail		X	6	6
Fordwah 125-R	Head, middle, tail		X	6	

The sampling procedure was based on two selection criteria. The first criterion emphasizes that the selected watercourses should not be (close to) IIMI's watercourses. This was done to avoid bias from water users who are often visited by IIMI field staff or who are aware of IIMI's activities in their area. Water users could have the attitude that IIMI already knows everything (as experienced during a training period in December 1994 in another research site) and that they do not see the usefulness to be involved in a participatory research. One exception has been made for the in-depth phase of the process where an IIMI watercourse has been chosen (Fordwah 46-R) to enable comparison between results collected by IIMI through quantitative methods and those emanating from this participatory research.

The second criterion relates to a distinction between perspectives from water users of head, middle and tail watercourses along a distributary. To obtain as much diversity as possible, selected watercourses must show a diversity in characteristics. This means that watercourses with good and poor water supply, with intensive use and no use of tubewell water, with and without salinity problems, with big and small landowners, have been included in the sample.

3 *Application of PRA to achieve understanding of water users' perspectives.*

3.1 The role of the water users

The application of PRA resulted in a set of broad and detailed water users' perspectives of irrigation performance, which reflect social, economic and technical dimensions. This was possible because water users were involved as:

- *providers of relevant knowledge and information*
  we were there to learn from their experience.

- *analysts of their problems related to irrigated agriculture*
  the water users identified and ranked problems related to irrigated agriculture, with the help of cards and flow charts, they visualized causes, effects and possible solutions.

- *actors influencing the research agenda during the research process*
  issues which they identified as important (i.e. great influence of big landlords and politicians on unequal water distribution) were taken up for further investigation.

- *participants in the identification of performance indicators*
  through group meetings and sub-groups, information received from water users was cross-checked with other water users. Water users corrected each other and finally agreed upon a framework.

- *experts of their own situation when they explained how to use indicators to take actions and decisions to compensate for poor performance*
  based on several PRA tools (map, trend lines, cropping calendars and water need periods, ranking, chapatti diagrams), IIMI learned from water users how they use the indicators to cope with problems related to poor irrigation performance.

3.2 Constraints of the participatory methodology

The broad perspective of the water users and their detailed knowledge about and experience with irrigation makes assessing irrigation performance a complex task. Some of the constraints encountered during the study and implementation of participatory activities are detailed in the

following paragraphs.

Experience of team members

The experience of team members who facilitate the participatory process highly influences the quality of the study (Engel 1992). Initially, the team members had only limited experience with the application of the PRA principles and techniques, which resulted in too much emphasis on 'tool skills' and less on substantive issues. However, the course of activities proved to be a learning process in which the team members gained significant experience in working with PRA. The PRA methodology was adapted to the local situation as a research instrument, which led to the creation of new tools and to new insights into specific aspects of irrigation.

Selection of information

The use of PRA resulted in a holistic perspective of irrigation performance in which diversity was embraced and multiple perspectives were sought. This provided clear background information to put different views into perspective. On the other hand, a selection and clear definition of the information relevant to the specific objectives of this study were needed. This may have led to the exclusion of other information relevant to water users.

PRA for large samples

A third constraint is that PRA is difficult to use for large samples, especially in order to make general statements and to identify the representativeness of the information. The PRA study would have become very time-consuming if overlaps and differences in perspectives between different types of water users along the two distributaries had to be identified. Therefore, this study could only account for a few differences between water users (like head, middle and tail water users and tubewell and non-tubewell owners). The question: how representative the information is for the total Chishtian sub-division (70,000 hectares)? still is to be answered.

Water users' expectations and lack of potential for action

A fourth and last constraint is that expectations of the water users were raised as a result of their active involvement in this study and of the attitude of the team members, which differed from the attitude of visiting officials. Like one water user remarked: *this is the first time that I am approached in such a practical way. You should be up to something!* The water users' expectations resulting from this participatory approach were reflected in their suggestions for possible improvements. There was a gap between their suggestions and the potential of IIMI to translate these into action. This friction may be due to lack of transparency from the side of the team, but also to the fact that no other actors were involved who could actually consider these suggestions for implementation.

3.3 A participatory approach for irrigation management research

This study focuses attention on issues which are relevant for water users and may be a start to discuss improvements in which their problems and solutions are taken into account. PRA emphasizes the water users' ability to investigate and analyze the irrigation situation from their perspective. In a flexible and structured way, PRA provides an opportunity to express and elaborate upon views and priorities in an open manner. Issues are revealed which complement, strengthen and explain results generated from quantitative studies.

When all actors who have a stake in improved irrigation performance take part in a communicative process, their efforts may eventually lead to improved performance. Each of the participants contributes from it's own field of experience. Awareness of each others' constraints, opportunities and priorities to implement improvements may create more sustainable and effective relationships. Although the contribution of the water users in this process is crucial, their expertise is quite often neglected because researchers are not aware of a possible right way to deal with their ability. Participatory research methodologies provide opportunities to include the water users' knowledge in research and may involve water users as equal partners in research and development. The following chapters reflect the detailed perspectives of the water users on irrigation performance.

4 *Water users' perspectives of irrigation performance*

4.1 Water users' perceptions of the actual irrigation situation

The first issue put forward by many water users during discussions is that they perceive a shortage of canal water to irrigate their fields. The main reasons given are that since fifteen years, more land has been brought under cultivation, especially by big landlords who used to raise buffaloes and other cattle. Moreover, the practice of cultivating land for only six months a year and leave it fallow for the next six months could no longer be maintained because of land pressure. Land pressure occurred due to a high increase in the rural population and a more complex life which requires more resources. Many water users had to shift production from water-intensive crops like rice and sugarcane to wheat and cotton. The need to produce for household needs only has made way to produce for profits in order to purchase machines and fertilizers. This 'new' way of cultivating for profits, which has made water a scarce resource, has increased suspicions and competition among water users and some noticed that even fraternity is diminishing. Many water users no longer see the need to share their knowledge about water related issues with others.

Water users in this area have little trust in government institutions to solve their problems. For example, water users at the tail of Fordwah distributary remarked that the water in the canal is flowing full when officials of the Irrigation Department visit the area, whereas the next day it is empty again.

Water users from Fordwah as well as from Azim distributary also mentioned a survey which was carried out by foreigners to explore the opportunities to divert water from the Qaim minor to their area. Water users got very suspicious about this activity, because they never received any water. Some say it was a survey to search the area for petroleum, others say it was an attempt of the Member of the National Assembly (MNA) to win support for the elections. There is also little sympathy and a lot of distrust towards the big landlords who may divert canal water to their fields whenever they need it. The small farmers do not rely on the officials of the Irrigation Department for help because as one water user mentioned, *'they are the tools of the MNA's and the big landlords and act according to what they get from them'*.

Water users feel that illegal practices in the irrigation system are increasing since the last fifteen years because water has become a scarce resource. Bribing officials from the Irrigation Department has become a habit to secure the water supply. One water user mentioned that bribing officials seems to be the only way to get water. He illustrated this with the following story: "*One day I am going to the market. When the women notice this they ask me to bring some toys for their children. My answer will be that 'only the children from the woman who pays, will play'*". In other words, only the people who give bribes to officials will receive water.

4.2 Water users' indicators of irrigation performance

With help of the application of the PRA methodology several indicators of irrigation water supply have been defined by the water users. This study managed to take into account the broader and much more detailed perspectives of the water users in comparison with the two indicators for irrigated agriculture (predictability and profitability) proposed by IIMI (1994c). The defined indicators approach the ones in the literature mentioned by Small and Svendsen (1990) and Chambers (1988). A total of seven indicators has been defined in this study: *adequacy, timeliness, water quality, tractability, predictability, equity* and *hassle*. The indicators represent a diverse range of water users' values and preferences based on which they have developed a local response to compensate for poor irrigation performance.

Indicators

At first it was assumed that these indicators were only applicable to canal water supply, but it appeared that water users use some of these indicators as well when they talk about tubewell water supply. This is maybe not so remarkable when taking into account the relative share of tubewell water for irrigation in the Punjab, which is 28% (APO, 1991:186). Tubewells have become a source on which more and more water users have to rely for irrigation. When water users talk about adequacy, timeliness, equity and predictability, they only refer to canal water supply, whereas water quality, tractability and hassle do include an obvious tubewell component. It appeared that water users consider the use of tubewell water for irrigation as one of the necessary actions to compensate for poor canal water performance. The use of tubewell water will therefore be discussed in detail in the next chapter.

The indicators will be discussed below. First, a definition of each indicator is provided as agreed upon by the research participants. This definition is followed by an explanation of specific tools used and applied to facilitate the discussion. Then, measurements are explained which are used by water users to facilitate their management decisions, and, finally, factors which influence the indicator are discussed.

(1) Adequacy

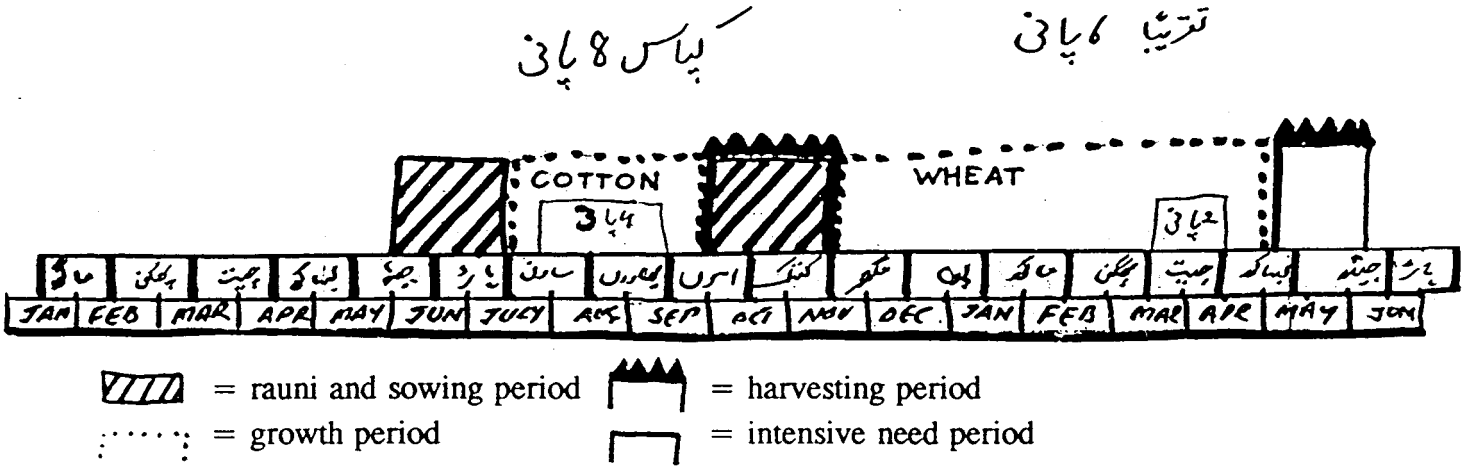
Definition

Adequacy is the ratio between the number of turns which has been received and the number which is required, with a correction for the water depth at particular turns during a cropping season. This definition also includes water which water users with saline fields need to leach out salts and to water needed during *rauni* (land preparation).

Tools used

To ease remembering exactly when water users received a certain water supply, specific tools were developed in which the water users' terminology was used. The result was a cropping calendar in combination with water requirements which proved to be a useful tool (figure 1).

Figure 1 Cropping calendar to facilitate discussions on adequacy related issues (tail water user of Fordwah 46-R)



The months are indicated in such a way that the team members as well as the water users understand the figure. The months with which the water users are familiar are the 'desi' months. For example, the desi month 'po' starts mid-December and ends mid-January. In this tool the water user has indicated that he needs 8 irrigations during the cotton season, of which 4 are needed from August till mid-September. In the wheat season he needs 2 out of 6 irrigations from mid-March till mid-April. This figure also visualizes that the harvesting period of cotton is overlapped by the land preparation and sowing period for wheat. Based on what the water user has illustrated about his needs, questions came up about what was actually received during the whole cropping season and during the intensive need period and what has been done in case of shortage.

Measurements

Adequacy is a quantity-related measure. Water users measure water quantity in the distributary and in the watercourse in various ways, using water depth measures and a time measure. Water users measure water quantity between 2 hours till 15 minutes before the start of their turn.

Water depth measures consist of the following rules of thumb:

- hand, arm or leg (distance between bottom and surface)
- 'balisjt', the distance between thumb and pink (distance between the surface and the mark which has been left on the bank)
- a stick (distance between bottom and surface)
- referring to the mark the water has left on the bank (distance between surface and mark)

The time measure is:

- the assessment of the time which is required to irrigate a certain amount of land

Time required to fill a field as a measurement per se is quite complicated because it is dependent on soil type (water users said that sandy soils need twice as much time to irrigate one acre as clay soils), field size, level of the field, the number of bunded units and the location of the fields.

Influencing factors

Water users have several reasons why water supply is not adequate for their farming practices. First, they complain that the distributaries are not properly cleaned which increases losses. Second, water users who are better off in terms of water supply, are more likely to blame the lack of water to natural circumstances, like an insufficient supply in the river or a spontaneous breach in the main canal. Water users who are often poorly supplied generally tend to blame other water users for their inadequate supply.

(2) Timeliness

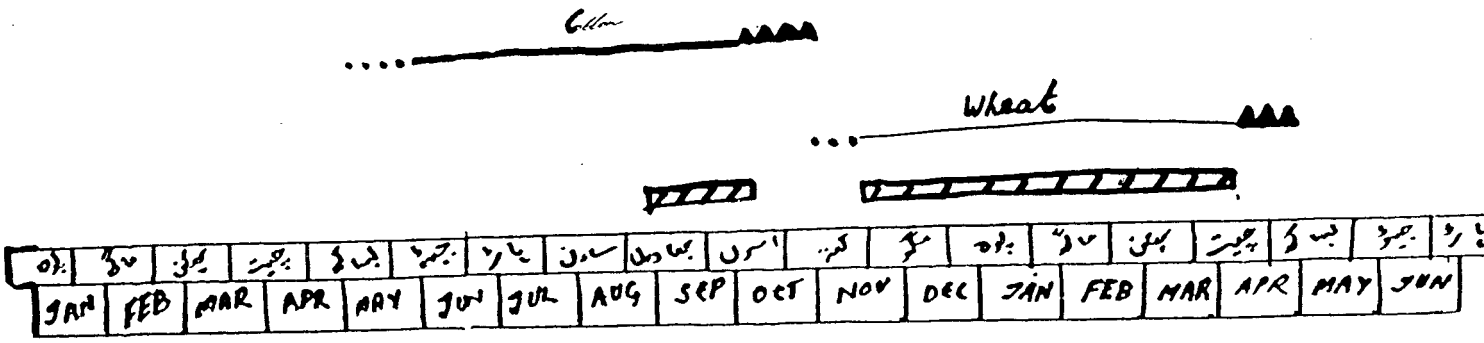
Definition

Timeliness is defined as receiving water at the right time for farming practices. Timeliness implies that there are some specific requirements to be fulfilled: during land-preparation, after a specific period of time for each crop after sowing, and during grain-filling periods or periods when the cotton flowers are growing. During these three periods the timeliness indicator is relevant and should preferably be adequate.

Tools used

To facilitate the discussions on timeliness related issues, a tool was developed using the cropping calendar and an indication of the three periods (figure 2). The discussion which followed focused on the timely application of water in these periods.

Figure 2 Cropping calendar to facilitate discussions on timeliness related issues (middle water user from Fordwah 46-R)



• • • • • = rauni and sowing period ▲▲▲ = harvesting period
——— = growth period ▨ = intensive need period

The same indication of the months is used as with adequacy. This water user indicated that the intensive need period for cotton is only from September till mid-October whereas the timeliness indicator should be optimal for the whole growth period of wheat.

Measurements

Water users establish the timeliness of their water supply by assessing how many turns they received at the right time when they needed it for farming practices. During the three specific periods in the cropping season it is really important that the timeliness indicator is optimal.

Influencing factors

Water users realize that if they do not receive a timely water supply it may depend, like adequacy, on natural causes or on the influence of other water users upstream who take water. Some water users mentioned that due to cultivation of cotton, sowing of wheat gets delayed, which causes problems during annual canal closure in January. This means that even if the water supply is not modified, the competition between crops can lead to a change in the assessment of timeliness.

(3) Water quality

"Canal water is as sugar for my crops, I have such happy crops that sometimes my onions may dance!" (expression of Muhammad Ali, to indicate the good effects of canal water as opposed to tubewell water).

Definition

Water quality is indicated by the presence of mud, sediments, nutrients and minerals, or salts. The presence of the first four is seen as a favorable quality factor whereas the presence of salts is regarded unfavorable.

Tools used

Use was made of field walks to discuss the soil quality and the condition of crops.

Measurements

Water users measure canal water quality by assessing whether a layer of silt has been left on the soil surface after infiltration. This layer keeps the soil humid for a longer time because it prevents quick evaporation. Canal water is said to make the soil soft and fertile. With the application of canal water some water users mentioned that they need less fertilizer and the risk of crop diseases is lower than when they have to rely on tubewell water. Water users mentioned that tubewell water infiltrates slower than canal water and evaporates more quickly because it is 'dry' in nature (without mud and sediments).

Tubewell water quality is assessed by various subjective methods:

- taste the water (salty or not)
- determine after drinking the water whether there is quickly a feeling of satiation. In case there is, tubewell water quality is considered poor.
- check whether 'white sands', an indication of salinity, appear on the soil surface after infiltration
- judge whether it makes an easy foam while washing clothes: the more foam, the better the water quality
- establish the hardness of the soil.

Influencing factors

Water users mentioned that tubewell water quality depends on the site of the tubewell. Due to a higher rate of infiltration because canal water is better available, tubewell water at the head of the distributary is of much better quality than at the tail. Also, tubewells placed close to the canal bank also seem to have a better water quality than tubewells installed far from the canal bank.

(4) Tractability

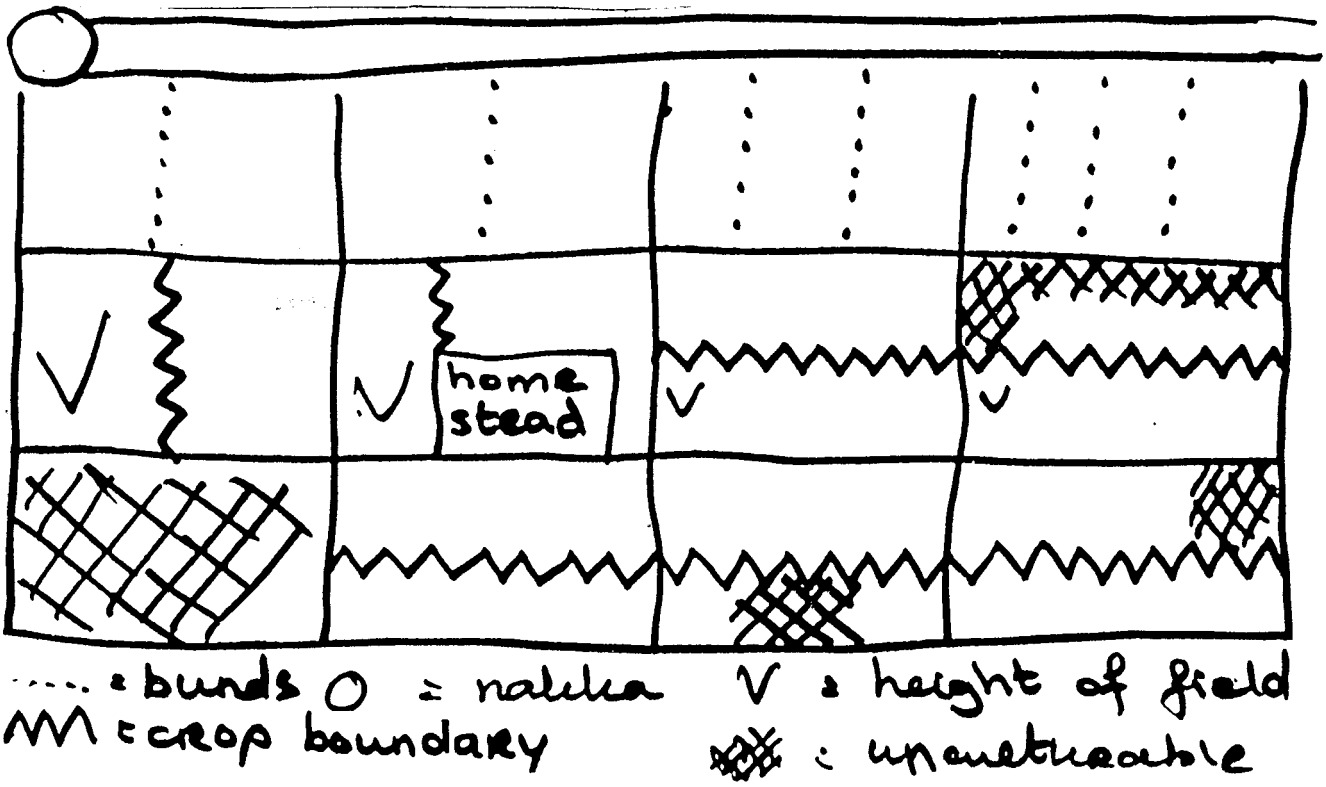
Definition

Tractability can be defined as the ease with which the water user can manage the water from mogha to nakka and from the nakka along his fields. Whether this is easy or difficult depends on stream size and flow velocity.

Tools used

The starting point for discussions on tractability was a field map drawn by the water user. Based on what the water user indicated the discussion evolved, referring to the map when something was not clear, or making a field walk to examine a certain problem area. An example of a field map is shown with indications which the water user felt necessary to discuss.

Figure 3 Field map used to facilitate discussions on tractability related issues (middle water user of Fordwah 46-R)



Measurements

Water users determine tractability by using time measurements. They establish how long it takes for the water to reach their nakka and how fast the water level in the watercourse rises at the nakka. Time is an important measure because it may tell them if irrigating will be easy or difficult, in other words, if they can do it alone or if they have to ask for help. Based on the time which the water needs to travel over a certain distance in combination with a certain stream size, the water users determine how many acres they can irrigate, in which sequence they will irrigate their crops, and how they will manage the water. This requires quite some flexibility from their side.

Influencing factors

The difference in stream size and flow velocity between tubewell and canal water influences the ease with which a water user irrigates his fields. In general, tubewell water has a smaller stream size and lower flow velocity than canal water which requires more efforts to irrigate.

(5) Predictability

Definition

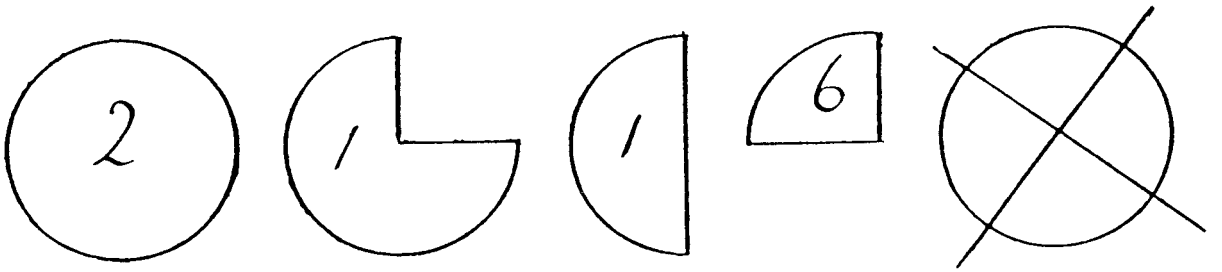
Predictability means knowledge obtained in advance on a certain pattern of water supply. Based on this, a water user can predict *how much* water will arrive *when* and for *how long* it will remain in the distributary or watercourse. Water users can make predictions about quantity, moment and duration. Their predictions can either be short term (e.g. for the next warabandi) or long term (e.g. for the next season).

Tools used

After several difficult attempts to discuss water users' predictions about future water supply (they always said the water supply was unpredictable), a tool was developed to facilitate these discussions. Use was made of a 'game of chance', using chick peas and a sheet of paper with so called chapatti figures (figure 4).

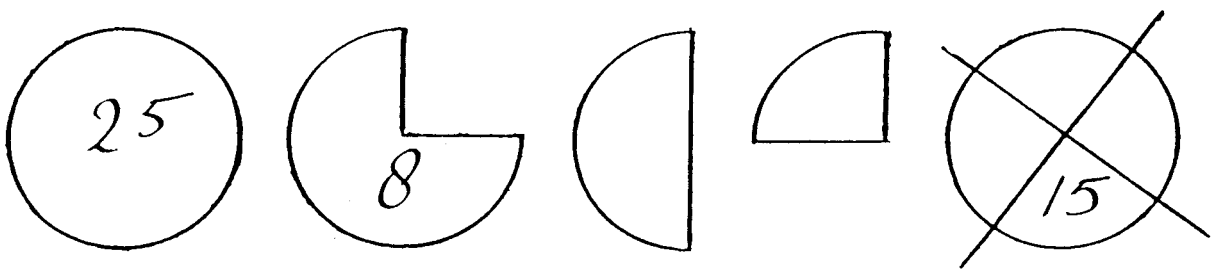
To visualize predictions about the next turn the water users distributed 10 peas over the five chapattis to indicate the chance that there would be a certain water level in the distributary at the start of their turn. This distribution means that for the next turn they predict that there is no chance on an empty distributary, 60% on a quarter, 10% on half, 10% on 3/4 and 20% on full supply.

Figure 4 Chapattis and 10 peas used to facilitate discussions on predictability related issues (group meeting in Fordwah 106-R)



For predictions about the next year a group of water users in Fordwah 125-R distributed 48 peas (signifying 52 turns per year minus 4 during canal closure in January) over the chapattis (figure 5).

Figure 5 Chapattis and 48 peas for predictions about water supply for 1995 (group meeting in Fordwah 125-R)



The water users agreed that they expect 15 of the 48 turns to be empty, 8 turns to be 3/4 and 25 to be full. The final results were brought about through discussions and agreement among the water users, which generated a lot of additional information.

Measurements

Water users' predictions are based on past experiences and on their knowledge about future

events. Water users find predictions about water supply for the next warabandi more difficult to make and more uncertain than about the average water supply for next year. Water users gain knowledge by measuring the water quantity in the distributary, by asking people who have been upstream or by contacting the gate keeper at the head of the distributary.

Influencing factors

Whenever there is a big landlord present in the watercourse, it is quite likely that his water supply meets his predictions and the water users in his vicinity or upstream are also largely assured of this. Water users, for example, at the tail of Azim distributary can predict with certainty that even next year they will receive no significant water quantity because the water users at the head will quite certainly use that much water that nothing will reach the tail.

(6) Equity

Equity is a complex indicator because if water would be in abundance, water users would not concern themselves with equity issues. However, in the actual situation where water is a scarce resource, unequal water distribution becomes an obvious and important problem.

Definition

Water users define equity as a fair distribution of the water available between distributaries, between watercourses and within a watercourse. This also includes that at times it is accepted to a certain extent that powerful water users receive more water, because it is beyond the power of the small water user to exert influence upon it.

Tools used

No specific tools were developed to facilitate discussions on equity related issues, because this issue urged water users to elaborate upon it in depth spontaneously.

Measurements

Measurements are based on observations about who receives more water than he is supposed to receive.

Influencing factors

Several factors were identified which influence the distribution of water between distributaries, between watercourses and within a watercourse, which is discussed below.

Equity between distributaries

Equal water distribution between distributaries is disturbed by water users giving bribes (in cash or kind) to the gate keeper. The more resources and the higher one's social status, the more power one has to impose his decisions to other water users. The gatekeeper will then deliver an

amount of water for a specific time period to a certain distributary, whether or not at the cost of other distributaries.

Equity between watercourses

Unequal water distribution between watercourses is influenced by several factors. One factor is the presence of powerful water users in a watercourse who can raise with their tractors a small sand wall in the distributary to block the water and divert it to their own fields. These water users may also breach the distributary bank and take water. These actions have a negative impact for watercourses downstream of that point and a positive impact for upstream watercourses. Water users also observed that water only flows in abundance when the MNA of that area has his turn.

Another action is that water users have their mogha widened. This involves large sums of bribes which differ greatly between watercourses. For example, a watercourse had to pay 25,000 Rupees ($830) to have their mogha widened, whereas the adjacent watercourse, whose relationship with the official in charge is very good, paid 8,000 Rupees ($270).

Equity within a watercourse

Unequal distribution within a watercourse is limited because control and social pressure at this level are much sharper. However, water users may bribe officials of the Revenue Department and the Irrigation Department so that they note down more acres in their books than a water user actually possesses or that a water user still has an orchard (for which more water is designed) whereas in fact he has changed to other crops. Another possibility is that water users may breach the watercourse bank while a water user downstream is irrigating, and divert water to their own fields.

(7) Hassle

Definition

Two dimensions of irrigation management are included in 'hassle': to obtain and use tubewell water, and costs/expenses related to those activities.

Obtain and use tubewell water

With regard to obtain tubewell water, water users may have to face the following situations:

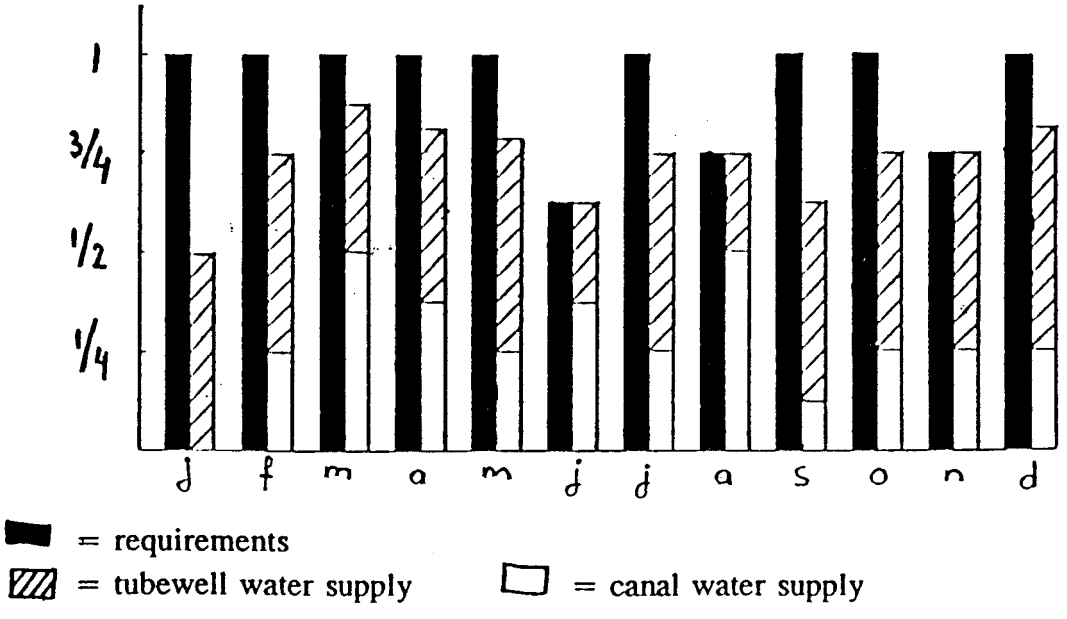
- the tubewell owner is not present at the time that the water user requires tubewell water
- the tubewell owner or another water user is irrigating his own fields
- the watercourse is not free
- lack of resources to use tubewell water (this involves money for tubewell water, for hiring a tractor or engine or buying one's own engine)

Considering the use of tubewell water, an electric tubewell causes more hassle than a diesel tubewell because it is disturbed by load-shedding. Due to load-shedding it may happen that the intake stops suddenly during irrigation which means that water users have to start over and over again. In addition, for non-tubewell owners it is hardly possible to mix canal water with tubewell water at night because night operation goes beyond a tubewell owners' control.

Tools used

A very suitable tool to facilitate discussions is a trend line in which tubewell and canal water supply are visualized with regard to the requirements of the water users. Based on this trend line discussions focused on how often tubewell water was applied and how many times non-tubewell owners were unable to apply tubewell water when they needed it.

Figure 6 Trend line of tubewell and canal water requirements and supply for 1994 (group meeting in Fordwah 106-R)



The group of water users explained that they apply tubewell water to an optimum and not to a maximum. They take into account the effects of bad quality tubewell water on their crops and the costs for operation and maintenance of the tubewell. In January for example, the canal is closed because of annual canal cleaning. Sowing of wheat is done in January. These water users could not meet their requirements because of load-shedding, the negative effects of tubewell

water on the soil and the costs for operating the tubewell. In June, their requirements were less because wheat was harvested. In August, the rains contributed to some part of the irrigation water requirements. In September the canal was partially closed due to floods upstream in the rivers which supply the canal. The requirements for November were less because of picking the cotton flowers.

Measurements

Hassle to obtain tubewell is measured by a ratio of the number of times that tubewell water could not be applied (due to the factors described above) and the number of times that tubewell water was required.

Hassle to use tubewell water is measured by defining out of the times that the tubewell was operated, how many times its operation was disturbed by load-shedding.

Influencing factors

There are not many specific factors which influence the obtention and use of tubewell water. One factor identified is that when non-tubewell owners have a bad relationship with the tubewell owner, the latter may prefer other water users to use the tubewell first.

Costs/expenses related to irrigation water

The second part of the hassle indicator relates to costs and expenses made for obtention and use of tubewell and canal water. Water users consider a tubewell a hassle because it costs much more than the *abiana* (fee) for canal water. For example, a water user paid 12,000 Rupees ($400) for the diesel engine and 7,000 Rupees ($230) for boring the hole. To install an electric tubewell a bribe is usually required, like one water user paid 10,000 Rupees ($330) bribe. Big landlords use electric tubewells because electricity costs are based on a flat rate which is attractive. The flat rate is too expensive for small water users, because they pay despite the load-shedding.

Water users at the tail of Azim distributary pay the abiana for canal water despite the very poor supply since four or five years. Tail water users of Fordwah distributary have stopped paying collective bribes, because even through bribes they did not receive water. According to the water users, the officials responded by the installation of steel plates and the use of cement in the mogha to get the water users' attention to pay bribes again.

Tools used

To facilitate discussions on costs and expenses related to canal and tubewell water no specific tools had to be developed, because discussions evolved easily.

Measurements
Costs and expenses made for irrigation water can be measured in terms of money or kind and must be checked with the person who received the reward.

Influencing factors
The relationship between the two parties involved in transactions highly influences the amount to be paid. On the other hand there is still a strong influence of officials on water users to pay official rates when the service is not even provided.

Box 1 ***Note on night irrigation***

Night irrigation is not per definition perceived as a hassle for the water users involved in this study. In kharif as well as in rabi season the water users need less man power because there is less stealing of water at night. On the other hand, breaches made by small animals can not be seen and sometimes sleepiness may cause over-irrigation. However, both seasons have their advantages and disadvantages.

- *advantages of kharif:* at night the temperature is lower than during the day so there is less evaporation.
- *disadvantages of kharif:* in summer there may be more mosquitoes, snakes and other dangerous animals.

- *advantages of rabi:* the fog which is developed at night already makes the soil humid which eases irrigation, so less water may be needed.
- *disadvantages of rabi:* at night it can be unpleasantly cold.

4.3 Discussion of indicators, tools and measurements

The indicators have been defined as a result of a structural application of participatory communication between water users and researchers. The indicators reflect the complex reality of irrigation performance from a water user's perspective. Their perspectives appear to be broad and detailed and reveal more than a technical dimension. Social relationships and power structures have been discussed as well.

A common concern are the actual power structures which determine most of the supplied water quantity, the water distribution and the hassle issues. It is the power of the big landlords over the small water users, the power of influential water users over modest water users, and the power of the MNAs and MPAs over the ID officials which is at the core of most of the

problems related to poor performance. As such it were adequacy and equity issues which received most attention from the water users who participated in the research.

The tools developed in this research proved very useful in focusing on certain topics which made it possible to go into detail and to discuss differences within a group of participating water users. The chapatti diagrams, flow diagram, trend-line, and ranking proved useful tools for group meetings whereas the field map, pie diagram and cropping calendar were more suitable with individuals. The field walks served as 'ice-breakers' and as a means to establish understanding between the participants.

Most water users' measurements lack precision, are not linear and can not measure volume accurately. A comparison of different values with these measurements is therefore impossible. However, the measures are easy to use by the water user and sometimes a comparison over time might be possible (in case of quantity-related measures).

5. *Water users' local response to compensate for poor performance*

5.1 Several options

Water users' local response to poor performance can be divided into five categories:
- adjustments in irrigation practices
- installation of a tubewell and use of tubewell water
- involvement in water markets
- participation in 'illegal' practices
- social pressure

More focused research is required to be able to say something about how general these local responses are. In which way these actions and decisions will improve the indicators mentioned above will be discussed in the next paragraphs.

Adjust irrigation practices

Improving irrigation practices relates mostly to improving water management at field level. This refers to stream size, flow velocity, and water depth. Irrigation practices can be adjusted before the beginning of the cropping season, during the cropping season and during a turn.

Irrigation with small stream size and low flow velocity is difficult because it requires careful management of the water. Water users prefer to irrigate as many fields as possible with low depth on the field surface instead of irrigating one field with high depth.

Before the start of a season land is prepared with a certain expectation in mind. A water user can consider several options or a combination of options to facilitate and improve management of the water in case he expects that managing canal water will become more difficult or that more tubewell water (with smaller stream size and lower flow velocity) will be needed.

The first option is land-leveling, which is done prior to sowing with help of a tractor or oxen.

Second, water users can decide to increase the number of bunded units per acre. They can increase the number of bunded units 1) in kharif, due to more evaporation, 2) in sandy soils because of quick infiltration, 3) in fields far from the nakka because velocity has reduced, and 4) in case of expecting to irrigate most of the time with tubewell water (when the flow has a smaller stream size and lower velocity than canal water).

Third, water users can change the site of crops. For example, crops with high water requirements like fodder, tobacco, rice, and vegetables can be cultivated near the nakka so that even with small stream size and low flow velocity these crops can be irrigated with canal water.

These three options will improve the tractability indicator, because it will become easier for a water user to manage the water at his fields. The fourth option will improve the adequacy indicator.

A fourth action water users can take at the beginning of the season is to reduce the amount of land for crops which require relatively more water. Many water users have already abandoned the cultivation of rice and have shifted to wheat and cotton. A more radical practice would be to leave part of the land fallow but this is rarely undertaken and hardly possible.

The last action identified is that water users preferably postpone sowing (within limits) until they expect that they can irrigate the first time after sowing with canal water. If they succeed to apply canal water at that time, it will improve the timeliness indicator.

During the cropping season, and especially during a warabandi, the water users again have to make several management decisions. A common practice among the participating water users appeared their attempt to irrigate the maximum amount of land with canal water because of the negative impact of tubewell water, thereby taking into account the crops which could not be irrigated during the previous warabandi and the cash crops.

During a turn, water users may have to deal with high or small stream size and high or low flow velocity. In case of a large stream size and high flow velocity the fields far from the nakka or the higher situated fields will be irrigated first when canal water can usually not reach there.

With a small stream size and low flow velocity water users can decide to irrigate the lower situated fields or the fields close to the nakka. However, water users also mentioned that they prefer to irrigate the fields close to the nakka with tubewell water because it saves expenditures, and divert canal water to further situated fields. Canal water can also be mixed with tubewell water to increase stream size and flow velocity.

These decisions will improve the tractability indicator.

Installation of a tubewell and use of tubewell water

When a water user has enough resources (because, as some water users mentioned, boring a hole for an electric tubewell costs 10,000 Rupees ($300) bribe) he can consider to install a private tubewell, either as a member of a cooperation or individually. A private tubewell is an advantage because the water user can always get water whenever he wants, which increases the timeliness

indicator. At the same time with a private tubewell there is no waiting-time for the tubewell to be available or for the owner to be present. As such this decision will improve the hassle indicator as well. At the same time, it has a negative effect on the hassle indicator because of the costs involved for installation, and operation and maintenance.

For tubewell owners as well as for non-tubewell owners, provided that they have the required resources, the use of tubewell water increases the amount of water supply and as such also the adequacy indicator (only if the water user has not decided to grow more high yielding crops). The simultaneous use of tubewell and canal water increases the stream size and flow velocity and makes it easier to manage the water at the field.

Non-tubewell owners who have to rely on tubewell owners for water supply better make sure they have a good relationship with the tubewell owner, although bribing the owner to secure the water supply is also practiced.

Water markets

To engage in water markets is a cheap alternative compared with the installation and use of tubewell water. Various water transactions occur in this area. An in-depth study on water markets is currently carried out by IIMI. Transactions of water markets include to exchange warabandi turns, to borrow (part of) a warabandi, to lend a warabandi, and to buy/sell a warabandi. Sometimes water users just 'give' (part of) a warabandi to another water user without the guarantee that the same amount of water will be returned.

To engage in water markets will increase the adequacy indicator because, for example, a combination of two warabandi increases the water volume at that moment. Water markets can also increase the timeliness indicator. When a water user is in need of water and he did not receive water during his warabandi, he could borrow water from a water user. Lastly, to engage in water markets may also increase the tractability indicator because the combination of canal water turns and tubewell water will increase the stream size and flow velocity.

Illegal practices

Several 'illegal' practices came up during discussions with water users, like bribing and stealing water. As far as it concerned the participating water users, bribing occurs between non-tubewell owners and tubewell owners and between water users and government officials. The small water users are often disadvantaged compared to the big landlords who have more resources to bribe and who in addition can use their political power to achieve what they want. Government officials are bribed to get something done (i.e. to widen the mogha), or to keep silence about something (i.e. about a water user who has the right to less water than he actually receives, because he changed crops). Tubewell owners are bribed by non-tubewell owners to favor them

when tubewell water is needed badly.

Stealing water is done by making breaches in the distributary or watercourse bank or by obstructing the canal water to flow further downstream. Again, the big landlords are in advantage because they have more means to effectuate this.

Social pressure

Water user delegations were often organized to visit offices of the Irrigation Department to request attention for their problems. In Fordwah 125-R there is an active water users' group whose leader has taken a lot of action. He has written to the Prime Minister, President, Chief Minister, Minister for Revenue, Secretary Irrigation, MNA, MPA, and many other officials, and has many times lead a water user delegation to the authorities. Their problems were never responded and so they have stopped visits to officials because they are ineffective and expensive.

Water users at the tail of Azim distributary succeeded to bring officials to the point where a cut was made. However, these officials left as soon as they found out that the cut was made by an influential water user. These water users also experienced that direct social pressure upon big landlords is impossible because of their reprisals (thieves are sent to rob the houses or steal cattle, take the daughters to threaten with the consequences).

Some water users have initiated a legal process against water users who participated in illegal practices, but since it is a long procedure, these water users are enjoying the benefits in the meantime.

Water users differ in opinion about the establishment of a farm union to protect their rights. Some complain that there is a union for everything except for farmers and this could be a way to stand up for their rights. They need a good leader who can tell them who to contact and what to do. Others say that it will be useless because there is no-one to lead it and they would most likely be opposed by the actual influential people. The very pessimists consider a post for detectives and police officers on the banks of the canal the only solution to stealing water.

5.2 Discussion of the local response

The following box (box 2) gives a summary of the characteristics and indicators, along with water users' local response to compensate for poor performance.

Box 2 Indicators and the water users' local response

Indicators	*Local response*
Receiving a sufficient amount of water *(adequacy)*	Adjust irrigation practices, installation and use of tubewell water, engage in water markets, illegal practices, exert social pressure
Receiving water at the right time *(timeliness)*	Adjust irrigation practices, installation and use of tubewell water, engage in water markets
Mud, sediments, minerals and salt contents *(quality)*	None
Difficulty in irrigating with a certain stream size and flow velocity *(tractability)*	Adjust irrigation practices, installation and use of tubewell water, engage in water markets
Uncertainty about how much, when and for how long canal water will flow *(predictability)*	Social relationships and networks
Water distribution between distributaries, between watercourses and within a watercourse *(equity)*	Social pressure
Use and obtain tubewell water, costs/expenses related to tubewell water *(hassle)*	Installation and use of tubewell water

As becomes clear from the possible local responses, some may have direct benefits for the individual water user, like irrigation practices, installation of a tubewell and use of tubewell water, and water markets, without bringing other water users to a disadvantage. Looking for illegal practices as a response to poor performance may improve the situation of an individual or of a watercourse at the cost of other water users. Social pressure is from an individual water user's point of view probably the least effective in improving performance because of the personal reprisals of big landlords and influential water users. The effect of the local response on the indicators can be summarized as in the following table.

Table 4 Influence (+ = positive, - = negative, o = no influence) of the local response on the indicators

Influence of local response on indicators	Irrigation practices	Installation of a tubewell and use of tubewell water	Water markets	Illegal practices	Social pressure
Adequacy	+	+	+	+	+
Timeliness	+	+	+	o	o
Water quality	o	-	o	o	o
Tractability	+	+	+	o	o
Predictability	o	o	o	o	o
Equity	o	o	o	-	+
Hassle	o	+/-	o	-	-

It is obvious that installation of a tubewell and use of tubewell water have an overall success, although it's use is quite expensive and the negative effects of saline water are considerable. Water markets are a cheap way to improve canal water supply performance, although good relationships between the trading water users are at the core of this activity. Illegal practices are more rule than exception and many water users consider this the only solution to improve performance. Social pressure is used at first to improve water quantity but also to ask attention from officials for problems experienced by deprived water users.

6. Conclusion

This participatory study has revealed water users' perspectives and values through the definition of indicators, measurements and local response and therefore provides grounds for a process of effective and more efficient communication between water users, policy makers and system managers. This process of participatory communication should eventually lead to improved irrigation performance and management.

The information which is a result of the application of PRA can best be seen as complementary to quantitative methods can give body to quantitative information. However, the additional strength of participatory studies is that relationships are built between the outsiders (researchers, government officials) and insiders (water users, farm women) from the very beginning of the study. Both parties take part in a communicative process. These relationships can result in detailed insights relevant to the water users which can not be obtained through quantitative studies. It is also more likely that because of this, the research participants create an understanding of each other's potential to innovate. In this way, problems can be addressed more effectively and efficiently.

This last point implies that not only water users should be involved in the study. There is also a need to explore the objectives and values of other stakeholders or 'actors' as well to identify in the end opportunities to improve irrigation performance at all levels of the system.

The potential of PRA to do this has yet to be explored. However, another participatory methodology was used as an experiment in IIMI-Pakistan: Rapid Appraisal of Agricultural Knowledge Systems (RAAKS, developed at the Agricultural University Wageningen, Department of Communication and Innovation Studies). RAAKS provides opportunities to involve all actors who possess relevant knowledge and information which may contribute to improvements in the performance of the irrigation system. A short RAAKS study of two weeks in the Chishtian sub-division was designed.

A first step in the RAAKS part was to identify the actors. A total number of ten actors (representing departments or organizations) was identified[4]. The second step was based on interviews with these people and included an analysis of the differences and similarities related to irrigation performance between their objectives, interests, tasks, linkages, communication and coordination.

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[4] Sub-divisional Officer (SDO) - Water and Power Development Authority; Sub-engineer - Irrigation Department; Station House Officer (SHO) - Police Department; Assistant Commissioner (AC) - Civil Administration; Water Management Specialist - On-Farm Water Management; Team Leader Field Research - IIMI Field Station Hasilpur; Chairman of a water user organization at the tail of Fordwah distributary; Extra Assistant Director of Agriculture - Agriculture Extension Department; Member of the National Assembly (MNA); water users.

A first impression of this RAAKS study is that there appear to be very few interactions and hardly any shared interests among the actors when it comes to irrigation performance. The network pattern can best be described as 'a group of islands with weak or no bridges between them'. The attitude is that: as long as you are not aware of another one's problems, you do not have to bother yourself with them. On the other hand, all actors realize that the only way of improving performance is through collaboration.

A combination of principles, tools and techniques from several participatory methodologies suitable for that specific situation can provide the best opportunities to actually implement changes for irrigation management research.

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Appendix 1

The Fordwah-Eastern Sadiqia irrigation system