REPORT NO. R-36

PILOT PROJECT FOR FARMER-MANAGED IRRIGATED AGRICULTURE UNDER THE LEFT BANK OUTFALL DRAIN STAGE I PROJECT, PAKISTAN

SOCIO-ECONOMIC BASELINE SURVEY FOR THREE PILOT DISTRIBUTARIES IN SINDH PROVINCE, PAKISTAN

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FOREWORD

"The Farmer-Managed Irrigated Agriculture under the Lefl Bank Outfall Drain (LBOD) Stage-I Project Area" is a pilot project on testing the social and economic viability of distributary level water users organizations. For the purpose of comparing "before project" and "afler project" situations in a subsequent impact evaluation, it was necessary to have some organized baseline information of the Pilot Project area.

The socio-economic baseline survey for the three selected sites of distributary commands of the Pilot Project was conducted during February-April 1996. Data entry and data analysis work of the survey consumed several months, as for the cleaning **of** data, the field teams and the supervisors had to go back to some of the respondents.

A summary of findings *of* this survey was reported in the August 1996 Monthly Progress Report and the January 1997 Phase-II Report of the Pilot Project . This information was used in planning and implementing the social organization action research for establishing water users organizations in the three pilot areas.

The publishing of this report in a comprehensive form at this stage is to add **to** the Pilot Project's documentation process, *so* that a more complete picture **of** the baseline situation is available for future evaluation purposes.

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The authors are grateful to the three Supervisory Social Organizers and the members of the three Social Organization Field Teams at Mirpurkhas, Nawabshah and Sanghar for their excellent effort in collecting the data for this survey. The names of staff members who contributed in various ways to make this survey a success are mentioned in Annex-6 of this report. The contribution by Ahsan Kazi and Ayaz Solangi in data entry and initial data analysis work is specially appreciated.

Special mention should be made of the 530 water users who responded with great patience to a long questionnaire so that all of the interviews could be held in a very friendly and supportive atmosphere.

The authors are indebted to Prof. Gaylord V. Skogerboe, Director IIMI Pakistan, for spending his valuable time in providing detailed comments on the first draft of this report and editing it for publication.

Finally, the authors acknowledge the arduous work done by Manzoor Hussain in all the secretarial work for printing this report.

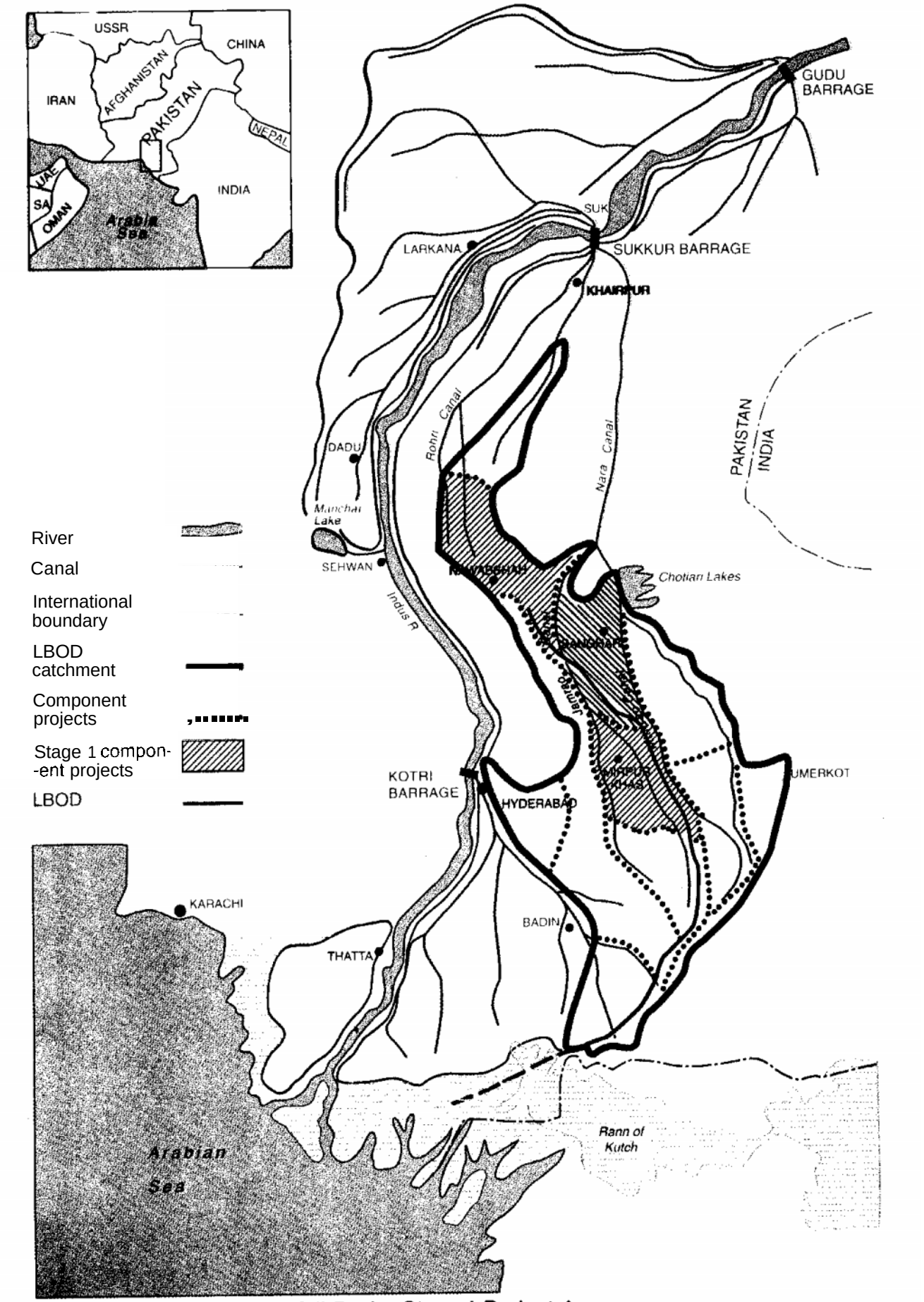

Figure 1.1: Left Bank Outfall Drain, Stage I Project Area

The scheme covers areas of Nawabshah, Sanghar and Mirpurkhas districts. Major components of the project are:

- A network of surface drains discharging to the sea via a spinal drain and tidal link;
- Deep tubewells to intercept seepage water and control the groundwater table by pumping groundwater into the surface drainage network;
- Special wells to scavenge fresh water lenses for use in irrigation;
- Buried interceptor drains beside canals to recover fresh water seepage for use in irrigation;
- Buried tile drains to control groundwater tables where drainage tubewells are not feasible;
- Additional power capacity at seven existing grid stations;
- A network of power supplies to tubewells and drainage pumping stations;
- Remodelling canals to increase capacity and stability;
- Construction of Chotiari Reservoir to provide system storage allowing secure supplies to the Lower Nara Canal system;
- On-farm Water Management to improve watercourses and water use practices;
- The provision of plant, equipment and workshop for maintenance of the drainage system;
- The establishment of sustainable operation and maintenance arrangements; and
- Studies of the impact of the project on groundwater levels, agricultural performance, social development and distribution of benefits.

1.2 Pilot Project for Farmers Organizations

In July 1995, the International Irrigation Management Institute (IIMI) started an action research program in collaboration with the Department of Agricultural Engineering and Water Management of the Government of Sindh to launch three pilot projects on water users organizations in the LBOD project area.

The broad purpose of these pilot projects is two-fold: (1) to test the viability of farmers' managing parts of the irrigation system so that more efficient and equitable allocation of water can be achieved: and (2) to make recommendations on future extensions from the results of the pilot projects.

More specifically, these pilot projects aim to help organize farmers into Water Users Organizations (WUOs) in three selected distributarylminor canal command areas, one in each of the three LBOD districts: Mirpurkhas, Nawabshah, and Sanghar. Another specific objective is to promote the maximum involvement *of* the water users and the WUOs in the operation and maintenance of distributary/minor canals, with adequate institutional support from the relevant governmental agencies. Also, the legislative requirements and institutional processes would be identified for effectively organizing and strengthening Water Users Organizations (WUOs) on a wider scale.

The broad concept underlying these pilot projects is that the WUOs would eventually be accountable for the water received at the head of distributarylminor canals, responsible for distribution of water among the member Water Users Associations (WUAs) at the watercourse level according to their own agreed upon allocation rules, and also responsible for managing groundwater levels in their respective command areas. The WUOs would reach an agreement with their members, as well as with the agencies, for appropriate water charges and operation and maintenance (O&M) costs of irrigation and drainage facilities in their distributarylminor command areas. They will undertake the collection of water/drainage charges, improve water management practices, and undertake other activities related to water, including the maintenance practices for irrigation and drainage facilities.

1.3 Selection Criteria for Pilot Distributaries

During the month of November *1995,* three distributaries in the project area were selected. A map of the project area is presented in Figure 1.2. The following criteria had been adopted in short-listing the distributarieslminors:

- Number of landholders and their distribution according lo size *of* landholding;
- Extent of influence by a few landlords:
- Availability of drainage system;
- Number of lined watercourses;
- General law and order situation: and
- Distance of head and tail of distributarylminor from the field station.

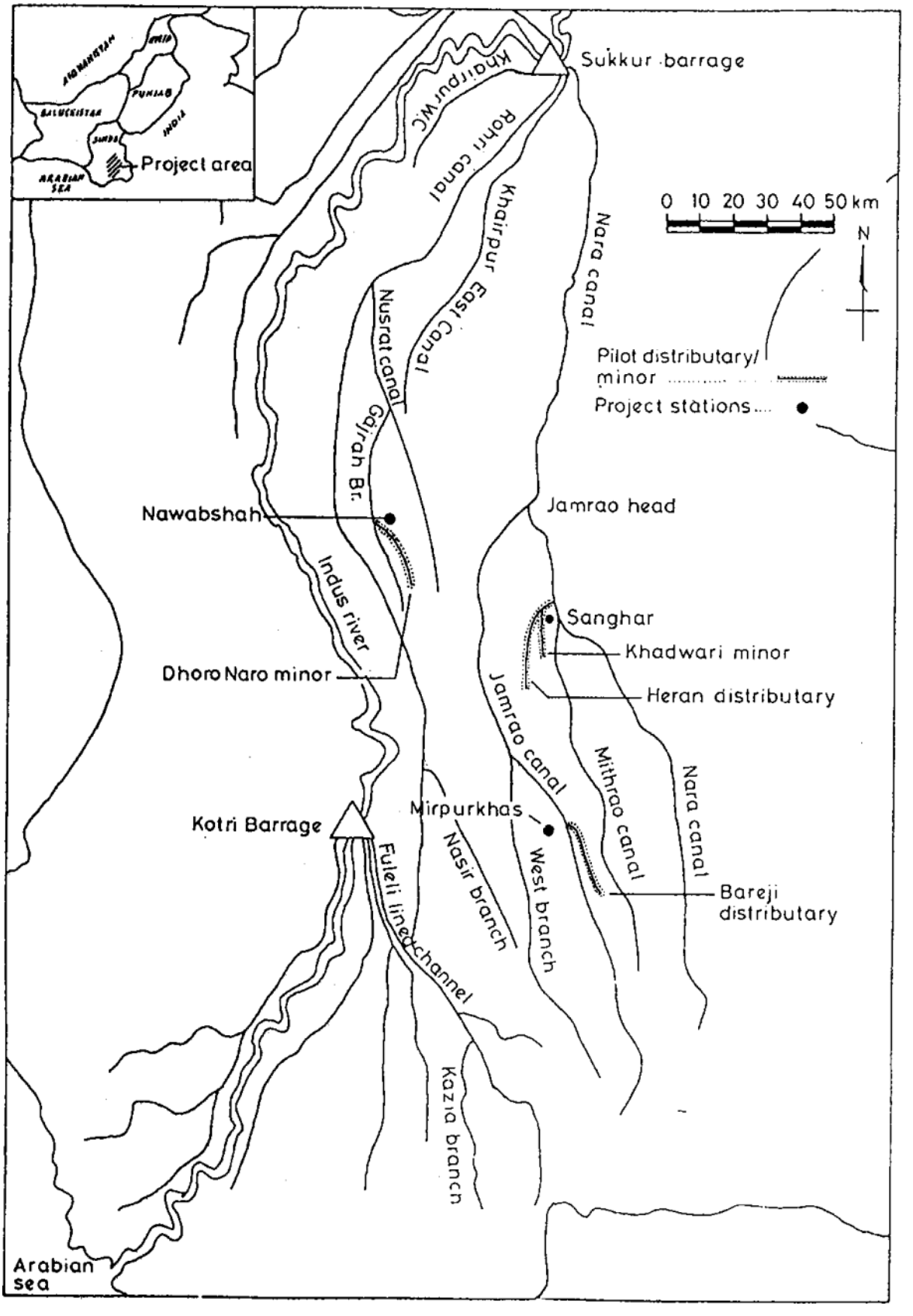

Figure 1.2. Location Map of IIMI Project Area

ributaries.

Name of Distributary/ Minor	No. of Outlets	CCA Acres	No. of Land Owners			No. of Village	No. of H.H.	Population
			Total	>100				
Bareji Distributary (Mirpurkhas)	24	14318	197	20	109	79	1703	10580
Dhoro Naro Minor (Nawabshah)	25	13382	421	17	336	147	2468	19822
Heran Distributary (Sanghar)	24	12336	435				2053	15687
Khadwari Minor (Sanghar)	7	3074	104				1097	11130

and Nawabwshah.

Each of the three pilot sites was of intermediate size, comprising 20 to 30 watercourses and a command area of about 5,500 hectares (ha), with a manageable number of people, the total population in each pilot command area ranging from 10,000 to 25.000. The Heran Distributary in Sanghar District, which has one minor (Khadwari)', offlakes from the Nara Canal at RD[2] 129. The Bareji Distributary in Mirpurkhas District offlakes from Jamrao Canal at RD 408, with Jamrao Canal offtaking from Nara Canal at RD 575. The arrangements under way to remodel the Nara Canal system supported the decision to select these distributaries as pilot sites. The Dhoro Naro Minor[3] in Nawabshah District offtakes from a different canal system, the Gajrah Branch of the Rohri Canal, at RD 91. A schematic diagram of each distributary/minor is given in Figures 1.3, **1.4** and 1.5.

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[1] For data collection purposes. the Khadwari Minor is treated as a separate site

[2] Reduced distance is the distance in measures of 1000 feet of any point on the center line of a canal from the head of the canal (RD 24 = 24,000 ft from the head of the canal).

[3] Small distributaries in the Province of Sindh are often designated as a minor, but strictly speaking, they are more appropriately defined as a distributary. whereas a minor offtakes from a distributary

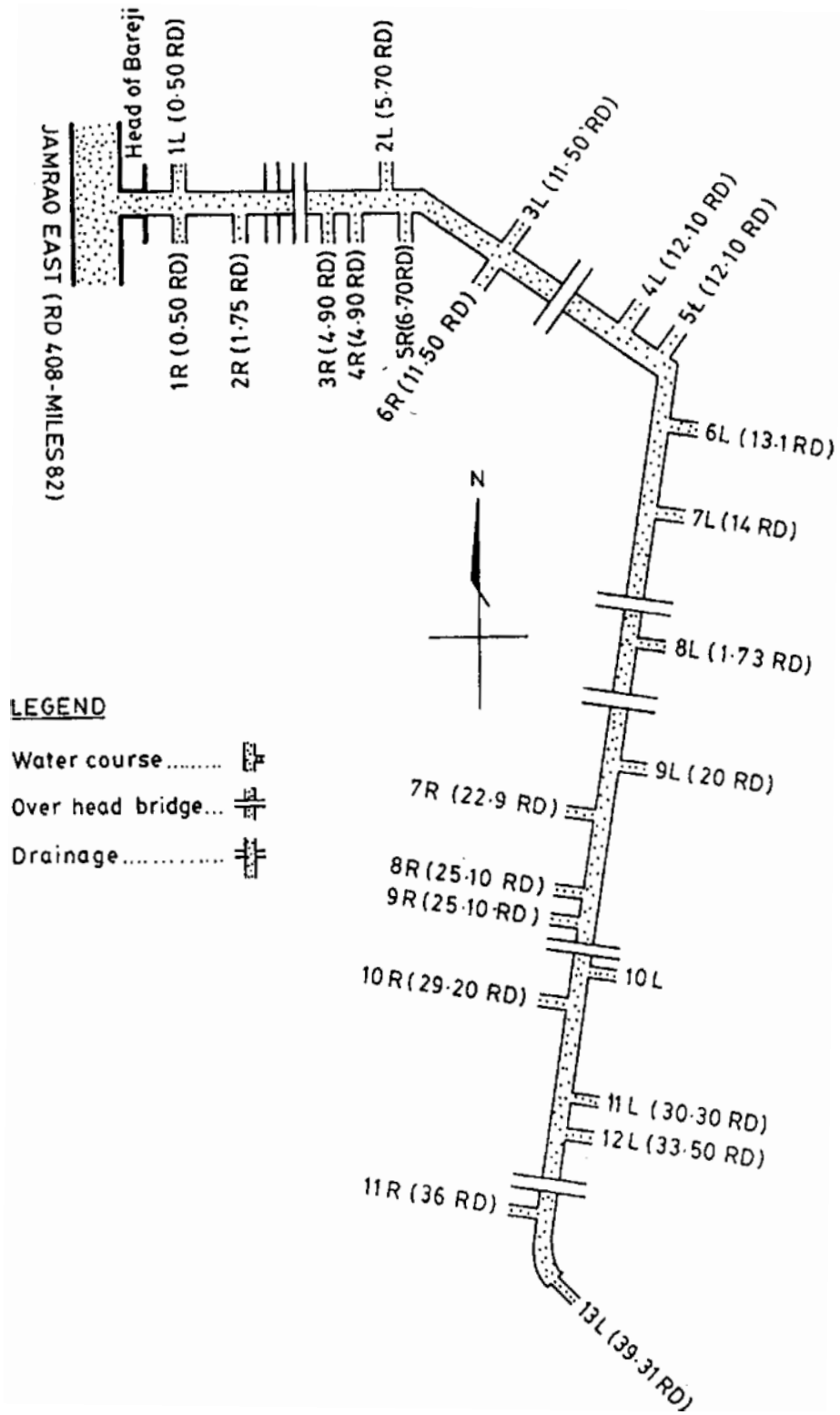

Figure 1.3. Schematic Diagram of Bareji Distributary

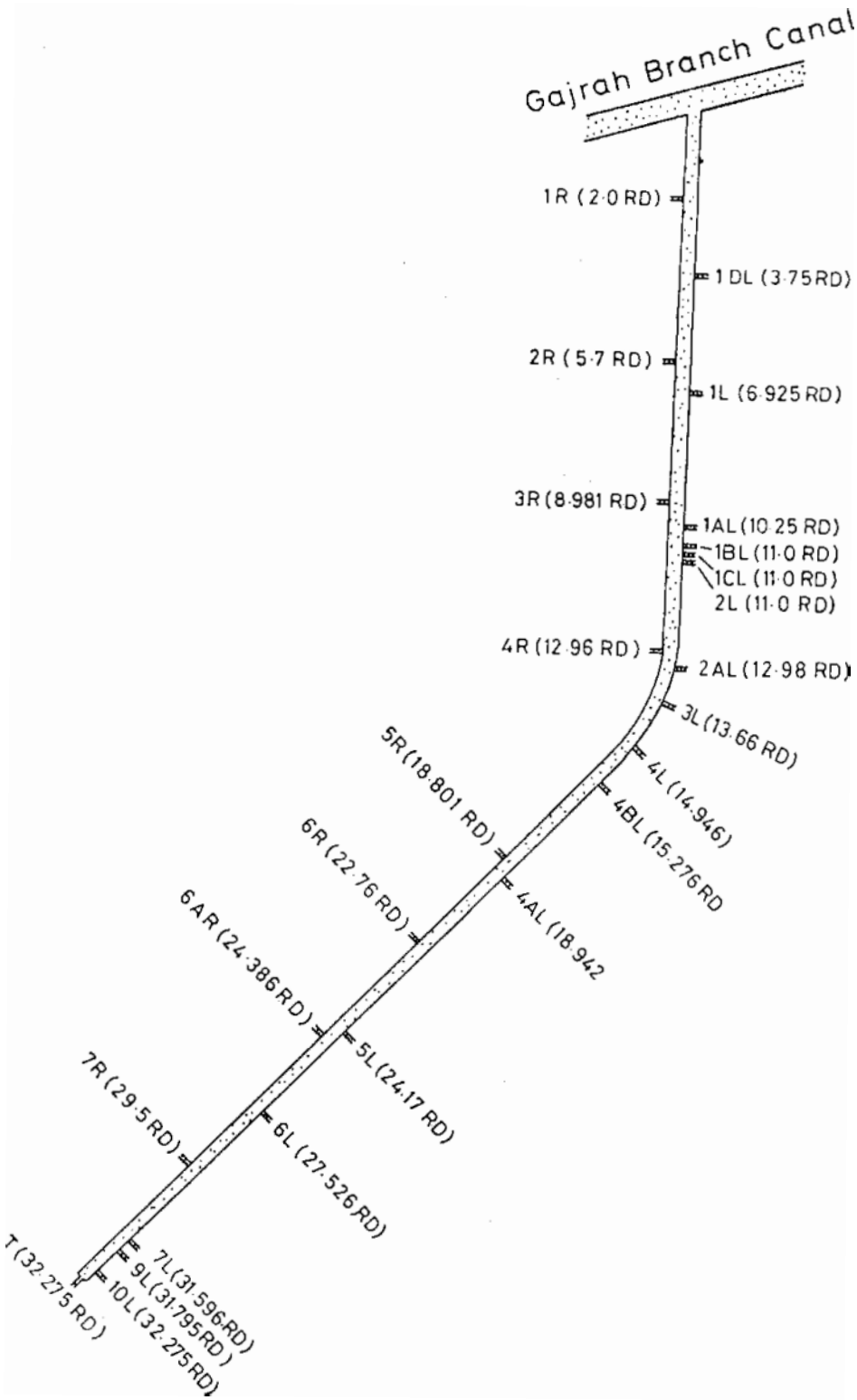

Figure 1.4. Schematic Diagram of Doro Naro Minor

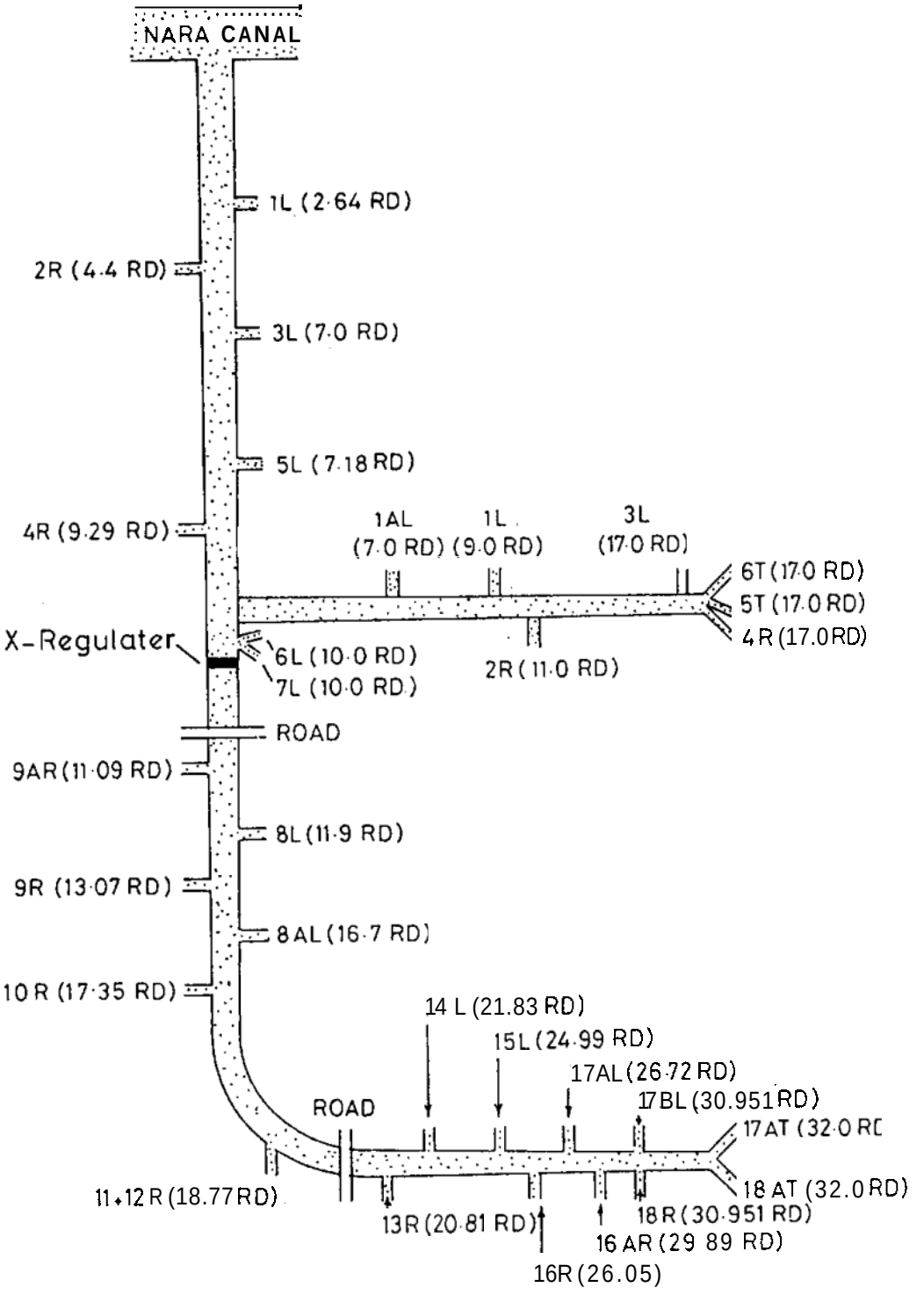

Figure 1.5. Schematic Diagram of Heran Distributary

Besides the irrigation canal systems, the project also places emphasis on the surface drainage component of the pilot areas. Therefore, information on the available drainage facilities was also gathered for pilot distributary command areas.

1.4 Drainage Facilities Available in Pilot Area

The project has conceptualized the idea to mobilize the water users of the project area to take care of the drainage facilities available in the command area. Therefore, it was necessary to gather the information on the drainage facilities available in the area. Tables 1.2, 1.3 and 1.4 present the drainage facilities available in the pilot project command areas.

Information	Bareji Distributary (Mirpurkhas)			Dhoro Naro Minor (Nawabshah)		Heran Distributary and Khadwari Minor (Sanghar)			
	Number of Surface Drains *								
	1	2	3	1	2	1	2	3	4
Length of Drain in the Pilot Command area (km)	7.06	5.08	NA	5.18	8.53	9.75	3.66	3.76	11.3
Design Discharge for Total Length of Drain (cfs)	108.4	52.2	NA	7.90	132	96.6	79.5	17.60	43.9

Note: The total length of a drain is from RD 00 + 00 (source) to the last disposal point flowing through the pilot project command area.

* Details of Surface Drains
At Bareji: 1 = 4L Sub Drain; 2 = 4LA Sub Drain; 3 = Spinal Drain.
At Dhoro Naro: 1 = WN 1AR Sub Drain; 2 = Gajra Branch Drain.
At Heran: 1 = Makhi Branch Drain; 2 = M 1R Sub Drain; 3 = S 1R Sub Drain.

Tab E 3. T i j : Command Areas.

	Dhoro Naro I (Nswabshah)	Heran Distributary n wari Minor (Sanghar
Type	Drainage/saline	16 drainage and 15 scavenger
Number of tubewells	9	31
Range of Discharge (cfs)	1.5 - 2.00 (each)	2.00 (each)
CCA	320 acres (each)	250 acres (each)
Source: LBOD. WAPDA		

Note: Bareji Distributary does not have saline tubewell facilities.

Information	Bareji Distributary (Mirpurkhas)
Number of Tile Drains	13
Design Discharge (cfs) of each Drain ranging from	1.5 to 2.5
Running Hours of Sump House	Automatic
CCA (Acres)	NA
Source: LBOD. WAPDA; NA = Not Available	

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project.

2. DESIGN OF SOCIO-ECONOMIC BASELINE SURVEY

This section covers the design methodology used for the baseline survey, including the selection of watercourses, respondents for the survey, preparation of questionnaire and its pre-testing, training of field staff, problems faced in the field, data entry and analysis.

2.1 Purpose of Socio-Economic Baseline Survey

Baseline or benchmark surveys are carried out to serve two broad purposes. First, these surveys can provide some first hand general field information on physical, social and institutional conditions in the pilot area that can be used in designing the (action research) programs. Secondly, these surveys can also provide some benchmark information for developing and monitoring some testable performance and evaluation indicators that can be used for monitoring during the project gestation periods, or for post-project evaluations.

The current socio-economic baseline survey was, therefore, designed as a starting point for the action research program on farmer-managed irrigated agriculture under the LBOD Stage 1 Project in Pakistan. The results of the survey can help during the action research program because of a better understanding of the project area, its problems and constraints, and possible solutions thereof.

2.2 Selection of Watercourses for the Survey

For collection of the information, two methods are used in general; namely, census and sample surveys. Given the advantages and disadvantages associated with each of these methods, sample surveys have been found fairly efficient and cost-effective for such purposes. It was thus decided that the baseline information for the current project would be collected through a sample survey.

Designing sample surveys is quite a technical and sophisticated job and a lot of background information is required to work out the scientific sample design. The professionals generally use measures of dispersion, such as variance, to arrive at scientifically appropriate and well-specified sample sizes.

Since there was no known variance of any attribute related to the pilot sites, no statistical technique could be employed to determine statistically appropriate sample sizes. The concept of a purposive sample is not unknown under such circumstances. Therefore, the decision was taken to design a purposive sample that should consider all necessary aspects of the pilot area.

Each of the three pilot distributaries irrigates farmers' fields in its command area through a number of tertiary irrigation channels, that are popularly called watercourses. There are a number of farms being irrigated by each of these watercourses. **A** sampling was required for first selecting the sample watercourses from each of the pilot distributaries and then selecting a number of water users from within each of the selected watercourses.

The secondary level irrigation systems (distributaries and minors) are usually divided into head, middle and tail reaches because of the variations in hydraulic behavior of these reaches. Thus, consideration had to be given to these physical aspects as well. It was decided to have an equal number of watercourses from each of these strata in the sample from each of these distributaries. Thus, three watercourses were randomly selected from each of the head, middle and tail reaches of the three pilot distributaries using a lottery method. **At** Heran Distributary, Khadwari Minor also offtakes from the distributary and comprises seven watercourses. To give equal weight to different reaches of the minor, one watercourse from each of the abovementioned strata was randomly selected with a total sub-sample comprising 3 watercourses on this minor. In total, the sample comprised 30 watercourses out of a total of 80 for the three pilot distributaries. The selected sample watercourses for each distributary is presented in Table 2.1,

Distributary/ minor	Randomly Selected Watercourses
Bareji Distributary (Mirpurkhas)	2L (228/1L), 3R (239/2R), 5R (240/2R), 6R (240/3R), 7L (226/1L), 6L (227/1L), 8R (238/2R), 13L (224/2L), AND 11L (225/2L)
Dhoro Naro Minor (Nawabshah)	2R, 1L, 1AL, 6R, 2AL, 4AL, 7R. 5L. AND 10L
Heran Distributary	1L, 6L. 4R. 11&12R, 9R, 14L 15L. 17AL AND 18AT
Khadwari Minor (Sanghar)	1L, 2R AND 6T

2.3 Selection of Respondents from the Selected Watercourses

Afler random selection of the watercourses at each distributary/ minor during the first stage, the water users were enlisted on all of the selected watercourses on a pre-designed form meant to record the schedule of effective water turns of the water users.

This schedule is usually referred to as a warabandi proforma. A majority of watercourses have an official warabandi established by the Provincial Irrigation Department (PID) at the request of the farmers, which prescribes the time allocation among each of the landholdings for the water supply entering the watercourse command area. This official warabandi is the only record of a "water right" held by each landowner. It also has importance for settling disputes by arbitration[4]. The official warabandis were not sufficient for the purpose of the current survey as these contain the names and water entitlement right of the land owners only and there is no information on actual water users. Thus, these warabandis needed to be prepared afresh considering the situation on the ground at that time.

For preparation of these lists, the team members walked along each of the selected sample watercourses. The team members went to each watercourse to meet with the person who was available in the field irrigating his land and to collect the information about himself and his neighboring water users. This information provided the exact total number of the water users at each watercourse, including owner operators, tenants and lessees, or a combination of these categories. Considering the enormous number of total water users, it was decided to cover half of them.

During this second stage, every alternate water user was included in the sample with a random start at each watercourse. There had been 1,060 water users in total, out of which 530 water users were selected for data collection. The number of respondents in the sample from various study sites are shown in Figure 2.1. Tables 2.2a and 2.2b present the total number of water users on each of the selected watercourses with tenancy breakup, and the number of selected water users for each of these watercourses on the three pilot distributaries/minor.

[4] Bandaragoda and Rehman (1995). Warabandi in Pakistan's Canal Irrigation Systems - Widening Gap between Theory and Practice. IIMI Country Paper- Pakistan No.7

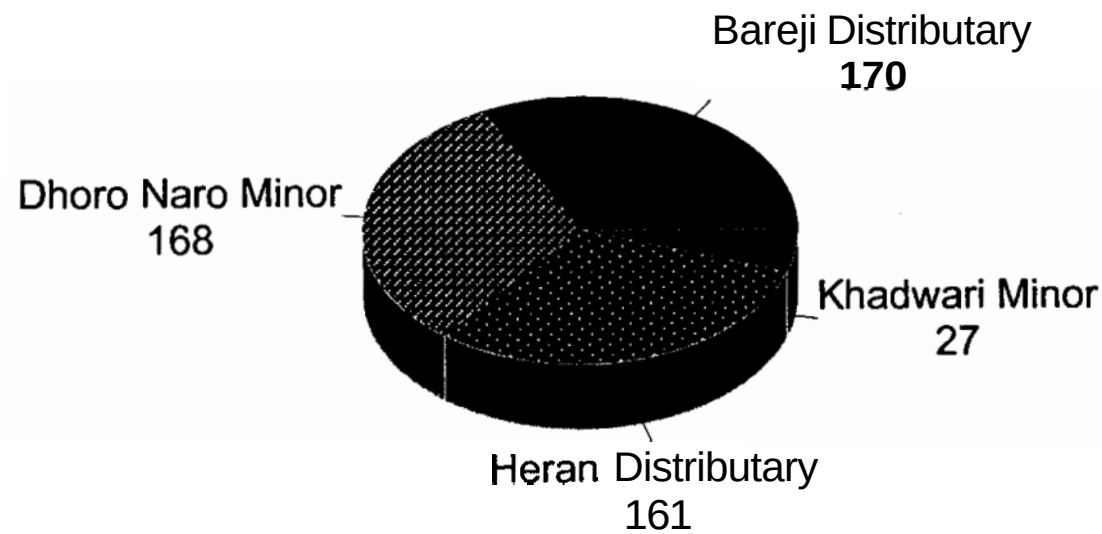

Figure 2.1. Sample Composition By Pilot Site.

S#	Watercourse No	Tenurial Status of the Water Users				Total No of Respondents selected randomly
		Tenant	Owner Cultivator	Lessee	Total	
Dhoro Naro Minor (Nawabshal						
1.	1-L	32	09		41	20
2.	1-AL	26	03	2	31	16
	2-AL	42	21	-	63	32
4.	4-BL	11		1	12	06
5.	5-L	27	09	-	36	18
	10-L		03	-	37	18
7.	2-R	21	22	1	44	22
8.	6-R	10	14	-	24	12
9.	7-R	29	21		50	25
	TOTAL	232	102	4	338	169
Bareji Distributary (Mirpurkha						
1.	2-L	09	10		19	10
2.	3-R	28		01	29	18
3.	5-R	36	08	01	45	23
4.	6-R	42	03		45	22
5.	6-L	54	02		56	28
6.	7-L	60	01	01	62	31
7.	8-R	28	03	-	31	16
8.	11-L	26			26	13
9.	13-L	31		01	32	16
	TOTAL	314	27	04	345	172

S#	Watercourse No	Tenurial Status of the Water Users				Total No of Respondents selected randomly
		Tenant	Owner Cultivator	Lessee	Total	
1.	14-L	03	12	06	21	10
2.	14-AL	06	10	04	20	10
3.	18-AT	29	05	-	34	17
4.	1-L	12	01	01	14	07
5.	4-R	44	-	17	61	31
6.	6-L	09	16	07	32	16
7.	9-R	33	11	08	52	26
8.	11R+12R	38	24	01	63	32
9.	15-L	20	03	01	24	12
TOTAL		194	a2	45	321	161
1	1 AL	12	01		13	07
2	2-R	01	25	04	30	15
3	6-T	07	06		13	06
TOTAL		20	32	04	56	28
GRAND TOTAL		760	243	57	1060	530

2.4 Preparation of Questionnaire and Pre-Testing

A questionnaire was already developed for such a survey conducted by the International Irrigation Management institute (IIMI) at Hakra 4-R Distributary in the Fordwah Eastern Sadiqia (South) Irrigation and Drainage Project area in south eastern Punjab. This questionnaire was adopted with some modifications suggested in a peer review within the organization. The pretesting of this questionnaire was undertaken on all of the three pilot distributaries/minors with the different water users. The suggestions and the feedback by the field staff provided useful inputs for its amendment, which were

incorporated in the questionnaire and the contents were finalized for launching the baseline survey in the field.

2.5 Training of Field Staff on Survey

The training of the field staff regarding the purpose of the survey, and the concepts used, is an important area to address as conceptual controversies are the main source of bias in the data. Three full days of training workshops were organized at the three field stations for the field staff who had to act as enumerators for the survey before launching the actual survey. The training was focused on the concepts employed in the sample survey, sample design, basic principles of research methodology, organization of field work, collecting information using the questionnaire through interviews, checking the contents of the filled-in questionnaires, accuracy of the data, organization and supervision of the data collection work, etc. The output of the training was that the enumerators and their supervisors were coordinated.

2.6 Problems Faced in the Field During Data Collection

Several problems were faced during the actual conduct of the survey. Non-availability of the respondents at the time of visit by the field staff was one of the major problems. The solution was sought in paying two to three visits at the site for interviewing the respondents. Yet, four of the respondents could not be traced and interviewed till the end of the survey and were discarded for inclusion in the survey.

Another problem was the engagement of water users in cultivation of the cotton crop during the day-time. This problem was resolved by paying visits in the evening to the water users who were unavailable during the day-time.

Another problem encountered was due to the cultural set-up of the pilot area. A number of absentee landlords and other landowners, who were not the water users, objected to having their tenants interviewed. Some of the tenants could not respond to questions on crop yields as the production was taken away by the landlord and was weighed by him. Such tenants were informed by the landlords about their own shares only.

Being an interview on a recall basis, the responses to some questions were difficult to remember for the water users. They only responded in hunches and crude estimates to such questions.

The duration of the interview was recorded as being almost two hours initially, which was boring for the water users. Sometimes, the water users had the tendency to respond indirectly with a story as a pretext. Later, however, the enumerators gained experience and the duration was reduced.

2.7 Data Entry and Analysis

Data gathered by the field teams, through personal interviews on the questionnaire, were fed to the computer using the spreadsheet package, LOTUS 123, which were processed and analyzed using SPSSPC soflware. During data entry, some problems were faced regarding the units of measurements, which were not uniform for all of the field teams. These were later converted to the same units while editing. Some of the water users did not respond to some of the questions. These were regarded as no response. There had been some entries that were found surprisingly high or low. These were checked through follow-ups with the enumerators, who had been asked to record important points in their notebooks. Some of the questionnaires had to be rechecked/reconfirmed by paying another visit to the actual respondent.

2.8 Coverage of the Survey

The target group for the current survey were the water users engaged in the actual use of irrigation water at various farms of the watercourse. This included the owner operators, lessees and tenants.

Although there are only three pilot sites, Bareji Distributary in Mirpurkhas. Dhoro Naro Minor in Nawabshah, and Heran Distributary in Sanghar. the analysis has been done in terms of four sites by considering the Khadwari Minor as a separate unit, which offtakes from the Heran Distributary, for the purpose of this survey. In total, 526 water users were interviewed personally, 170 at Bareji Distributary, 168 at Dhoro Naro Minor, 161 at Heran Distributary and 27 at Khadwari Minor. The number of respondents with respect to location of the farm on the watercourse is presented in Table 2.4 for the respective distributaries/ minors.

Reach	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Head	39	22.9	51	30.4	26	16.1	4	14.8
Middle	65	38.2	48	28.6	85	52.8	12	44.4
Tail	66	38.8	69	41.1	50	31 1	11	40 7

3. GENERAL CHARACTERISTICS OF THE RESPONDENTS

In this section, the results are presented regarding the general characteristics of the sampled water users, such as age, experience in farming, marital status, father's occupation, educational attainments, religion, family size, on-farm family employment, tenancy status, farm size, etc. Such characteristics help in knowing the community for planning an intended intervention. These characteristics also determine the extent to which the community will accept the intervention and can be helpful in devising a strategy for entering into the community.

3.1 Age Distribution of the Respondents

Age is one of the important characteristics of the community. It reflects on the productivity of the population as it has a bearing on the overall health situation within the community. In developing countries, aged members are more prone to diseases and thus are less productive. It has a bearing on the employment pattern, spatial mobility and quality of work done. Age plays a significant role in any kind of business, particularly in agriculture, because the use of child labor on the farms is quite high.

The respondents are divided into three age groups (i.e. upto 30, 31 to 60, and above 60 years of age). The idea behind these classes is that the middle group (31-60 years) is the most productive age group in farming. The distribution of respondents with respect to these age groups is presented in Table 3.1.

The mean age of sample water users is about 37, 43, 47 and 43 years at Bareji Distributary, Dhoro Naro Minor, Heran Distributary and Khadwari Minor, respectively. The standard deviations are quite low, indicating that the means are quite reliable. The difference in the mean age among the four sites is negligible. It can thus be asserted that the age is well distributed among the respondents in all of the project sites.

Within each pilot site, a maximum proportion of the water users falls into the age group 31-60 years of age. This proportion is highest in case of Dhoro Naro Minor compared to the other three sites. In Heran Distributary, the proportion of relatively young and old classes is almost equal, while at other sites, the proportion of relatively young water users exceeded almost 2 *to* 8 times than those of the old water users. This points out that with growing age, there is a tendency among the water users to retire from the business.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
< 30 years	69	40.6	33	19.6	26	16.1	7	25.9
31-60 years	92	54.1	120	71.4	108	67.1	18	66.7
> 60 years	9	5.3	15	8.9	27	16.8	2	7.4
Mean (STD)	37 (12.8)		42.8 (13.3)		46.9 (15.2)		42.5 (13.8)	

3.2 Experience in Irrigated Agriculture

Experience is positively associated with earnings. Conceptually, it is measured in years as a continuous variable as reported by Haque (1988). In Pakistan, the agricultural community uses their family members in the field directly or indirectly from quite a young age. Regardless of the type of work done, as an offspring of an agricultural family, there is a general tendency among people involved in agriculture to claim that they are in the field since birth, or at least from early childhood. The difference between age and experience can thus be reported as low as 5 years.

The mean number of years of experience in irrigated agriculture of the sample water users varies between 20, 27, 30 and 26 years for Bareji Distributary, Dhoro Naro Minor, Heran Distributary and Khadwari Minor, respectively. The values of standard errors are quite reasonable for pilot sites other than Bareji Distributary. While there are differences among water users belonging to different distributaries/ minors, a majority of the respondents had experience upto 40 years.

Comparing the means of age and experience in irrigated agriculture of the respondents, it appears that they have started their agriculture job at an early age of around 10 to 15 years of age.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
< 20 years	105	61.8	70	41.7	56	34.8	12	44.4
21-40 years	56	32.9	71	42.3	74	46.0	12	44.4
Mean (STD)	20 (12.3)		27.1 (13.9)		30.2 (15)		26.2 (13.2)	

3.3 Marital Status and Occupation

Table 3.3 shows that an overwhelming majority of the respondents are married at all of the pilot sites. Unmarried singles and widower respondents form less than 5 per cent in case of Heran Distributary and 11 per cent in case of Khadwari Minor. The results are not surprising, because still in rural areas, the marriages take place at early ages so that they have children at an early age, who are considered an addition to the family human capital. Besides, the males usually are encouraged to be married even at a much later stage, so there is only a meager chance that a water user, who ought to be a male, is unmarried or widower.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Married	159	93 5	160	95 2	154	95 7	24	88 9
Single	2	5 9	a	4.8	4	2 5	2	7 4
Widower/Widow	1	0 6	-		3	1 9	1	3 7

3.4 Occupation of the Respondents' Fathers

In Table 3.4. an attempt is made to present information on the father's occupation of the water users. It is clear that almost 90 per cent of the respondents have adopted farming merely because of being a farmer's son. This may be ascribed *to* several reasons. The lack of availability of acquirable non-farm skills in rural communities precludes the possibility of moving outside agriculture. Besides, once someone becomes educated. his first preference would be not to become a successful farmer, but a well groomed white collar urban dweller. Thus, those in farming are usually not there by choice, but are forced to stay in their ancestral occupation.

Another way of looking at the situation is that the relation between land and man is socially seen as that of mother and son. This strong bond is also an important reason for helping farmers' sons to become future farmers.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Same as Respondent	153	900	158	940	146	907	24	889
Olher	17	100	10	6 0	15	9 3	3	11 1

3.5 Educational Status of Sampled Water Users

The educational breakdown of the respondents is presented in Table 3.5. It can be seen that the majority of water users at all of the pilot sites were illiterate, except for Khadwari Minor. The literacy was found at a minimum among the respondents of Bareji Distributary and at maximum among the respondents belonging to Heran Distributary and Khadwari Minor. One important reason could be the high proportion of settlers at Heran Distributary and Khadwari Minor.

As can be seen at the bottom row of Table 3.5, the mean number of school-going children is very low. The standard deviation is very high, indicating a high variation within each pilot site.

The rural population in the regressive culture of Sindh involves their children in the field at an early age as family labor. Educating of children is considered a double **loss.** On the one hand, the family loses part of the income accruing *to* child labour and, on the other hand, there are additional expenditures *to* be incurred on fees, books, etc. In general, the responses to the question on reasons for not sending children *to* school were:

- non-availability of schools in the area;
- since poor people do not get jobs in the government sector for merely being poor, it is therefore, of no use *to* send children *to* schools;
- the children will adopt farming as a career and that does not need an education as declared by the respondents; and
- the family cannot afford *to* pay for hired labour **so** they can not afford to part with their children's cost-free services.

Table 3.5. Educational Status of the Respondents.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji *Distributary* N=170		Dhoro Naro *Minor* N=168		Heran *Distributary* N=161		Khadwari *Minor* N=27	
	No	%	No	%	No	%	No	%
Illiterate	123	72.4	113	67.3	94	58.4	8	29.6
Primary	31	18.2	44	26.2	27	16.8	11	40.7
Secondary	9	5.3	7	4.2	25	15.5	5	18.5
College	7	4.1	4	2.4	15	9.3	3	11.1
No. of Male Children going to school	0.7 (1.3)		1.3 (1.4)		1.5 (1.5)		1.9 (2.0)	
No. of Female Children going to school	0.1 (0.5)		0.4 (1.0)		1.0 (1.5)		0.7 (1.3)	
Mean No of Children in School	0.8 (1.5)		1.7 (1.9)		2.5 (2.3)		2.6 (2.5)	

Note: Figures in parenthesis are standard deviations.

In Mirpurkhas and Nawabshah sites, only a very small proportion of the family size were the school-going children, the mean number per family being 0.8 at Bareji Distributary, 1.7 at Dhoro Naro Minor, 2.5 at Heran Distributary and 2.6 at Khadwari Minor, which forms 11%, 13%, 26% and 20%, respectively, of all children of school age. It can be noticed that the proportion of female children going to school is much lower than that of male children at Bareji and Dhoro Naro; the relatively higher proportion at Sanghar district can be attributed to the community structure, which is more or less composed of settlers.

3.6 Family Size

In Table 3.6. the average family size for the respondents is presented for the different pilot sites. The joint family system is quite popular in the rural areas of Sindh Province. In only a few cases are nuclear families found. Grandparents, parents and children (even if married) share the same household. In some cases, it was found that they had one kitchen with more than 20 family members.

The mean number of family members per household was found to be 7.5 at Bareji Distributary, 12.8 at Dhoro Naro Minor, 9.5 at Heran Distributary and 12.9 at Khadwari Minor.

Mirpurkhas			Nawabshah			Sanghar					
Bareji Distributary N=170			Dhoro Naro Minor N=168			Heran Distribulary N=161			Khadwari Minor N=27		
Tolal	Male	Female	Total	Male	Female	Tolal	Male	Female	Tolal	Male	Female
7.5	4.1	3.4	12.8	6.5	6.3	9.5	5.1	4.4	12.9	6.2	6.7

The value of the standard deviation indicates that, except for the Khadwari Minor, the estimates for mean family size are reliable.

The sex composition for the family size is almost equal for Dhoro Naro and Khadwari minors, but it is slightly unequal for the two distributaries.

3.7. Religion of the Sampled Respondents

In Nawabshah and Sanghar sites, almost all of the water users are Muslims, but at Bareji Distributary in Mirpurkhas. 56 percent are Non-Muslims (these are mostly the Hindu tenants).

Table 3.7. Religion of the Respondents.

	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Disty N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Muslim	75	44.0	162	97.0	156	97.0	24	89.0
Non-Muslim	95	56.0	6	3.0	5	3.0	3	11.0

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Full Time employed	2.3 (1.5)		4.1 (3.3)		2.0 (1.7)		2.7 (2.4)	
Males	**1.5**		2.7		1.6		2.3	
Females	0.8		1.4		0.4		0.4	
Part Time employed	1.5 **(1.9)**		**1.6 (2.5)**		1.8 (2.1)		**0.8 (1.2)**	
Males	0.7		0.5		**0.9**		0.5	
Females	0.8		1.1		0.8		0.3	

The mean number of family members involved in full-time farming were 2.3 at Bareji Distributary, 4.1 at Dhoro Naro Minor, 2.0 at Heran Distributary and 2.7 at Khadwari Minor, whereas the mean number of family members involved in part-time farming was 1.5 at Bareji Distributary, 1.6 at Dhoro Naro Minor, **1.8** at Heran Distributary and 0.8 at Khadwari Minor. The values of the standard deviations suggest that the data is highly variable and the estimates obtained are not reliable in this regard. Also, in most of the cases, the full-time employment consists more of males, while for the part-time employment, the converse is true.

3.9 Tenancy Status of Water Users

As regards the tenancy status, three contrasting tenancy relationships can be discerned among the actual tillers of land; owner operators, tenants and lessees. The owner operator is defined as a person who (or whose family) owns as well as operates the farm himself. An owner operator is usually also the sole decision-maker regarding all agricultural activities to be conducted at his/ her farm and consequently bears the **loss** or enjoys the profit. A tenant is a person who cultivates the land belonging to someone else on a crop-share basis; usually the decisions are jointly taken by both the tenant and the (absentee) landlord, and both of them share the profit or **loss** jointly. Some decisions are, nevertheless, under the sole jurisdiction of one of the parties. **A** lessee is a person who operates a rented farm on cash. He is independent in taking decisions regarding planning the crops to be cultivated and is fully entitled to the farm earnings from the crop enterprise.

Besides the abovementioned categories, there are a number of other tenurial categories that comprise a combination of the above categories. It is generally believed that a person holds one of the abovementioned categories when referred to a specific farm, but when talking to a water user, he may hold more than one piece of land on the same watercourse, thus being a single water user but holding more than one tenurial status. Such categories include owner-operator-cum-tenant, owner-operator-cum-lessee, owner-operator-cum-lessor, tenant-cum-lessee, landowner-cum-tenant, landowner and owner-operator-cum-tenant-cum-lessor. All of these categories are grouped under "others".

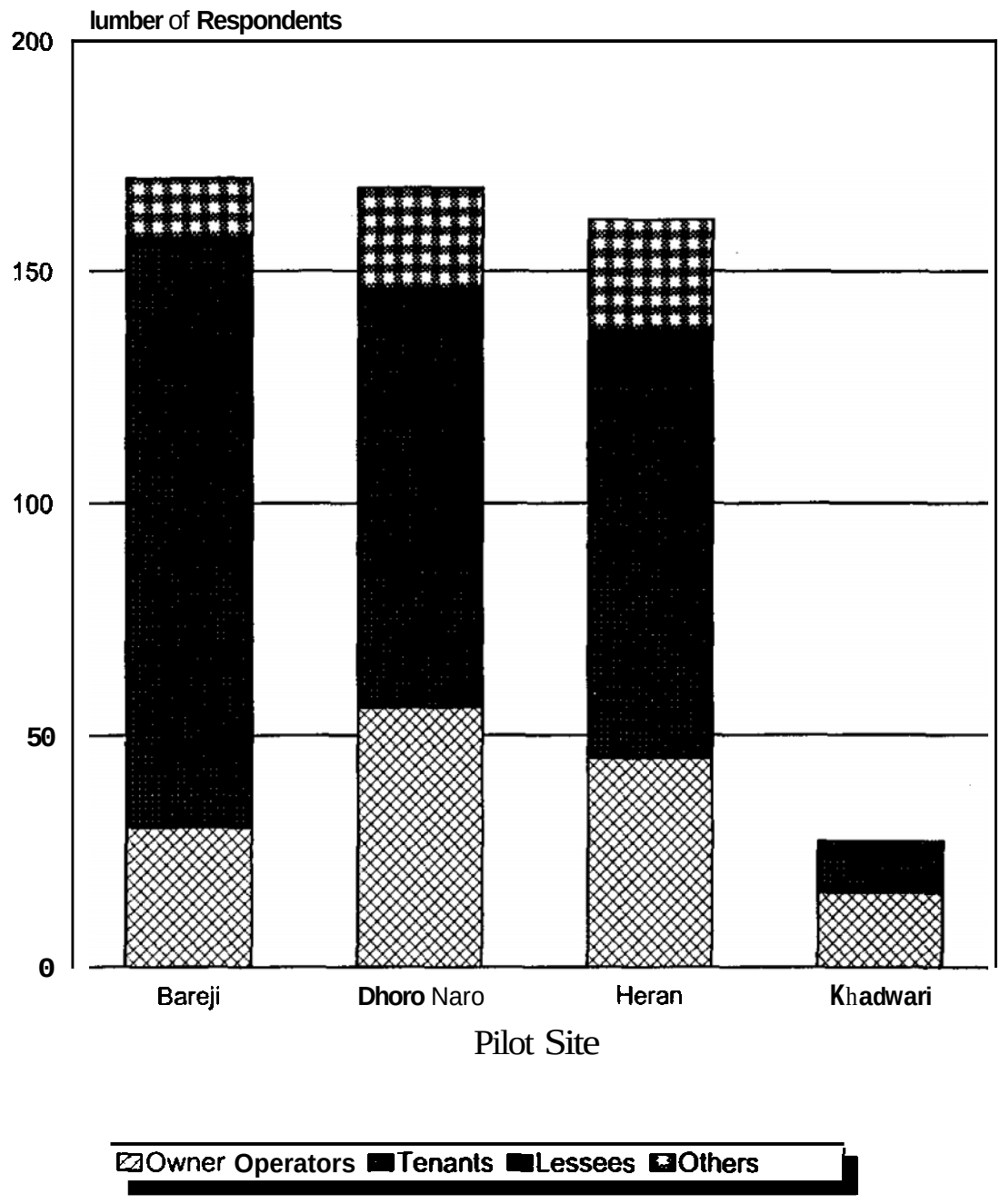

Figure 3.1. Tenurial Distribution of Respondents.

Table 3.9. Tenurial Classification of the Respondents.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Owner-Operator	30	17.6	56	33.3	45	28.0	16	59.3
Tenant	126	74.1	89	53.0	81	50.3	8	29.6
Lessee	1	0.6	1	0.6	11	6.8	2	7.4
Other	13	7.6	22	13.1	24	14.9	1	3.7

Table 3.9 shows that at Bareji Distributary, Dhoro Naro Minor and Heran Distributary, the majority of the sample water users are tenants, whereas at Khadwari Minor, the majority are owner operators. Other categories form a small proportion of the total and range between roughly **4** per cent at Khadwari Minor to 15 percent at Heran Distributary. Figure 3.1 shows the significance of this differentiation.

3.10 Size of Landholding of Sampled Water Users

Size of land holding is one of the important determinants of social status and economic well-being and also has a bearing on the power relations and social interactions among water users. Size of holding here **is** defined as the area operated by a water user at the particular watercourse and includes the area owned plus area leasedlrented in minus area leasedlrented out. The picture is reflected in Table 3.10, and Figure 3.2.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	Mean	Std	Mean	STD	Mean	STD	Mean	Std
Area Operated	7.41	9.3	12.78	11.5	18.09	13.23	20.06	10.5
Area Owned	4.71	10.6	8.95	21.8	9.11	14.8	15.24	13.7
Area Ooerated as Tenant	5.52	5.3	7.53	10.3	8.90	10.4	4.52	8.7
Area Operate as Lessee	0.08	0.7	0.99	8.1	2.84	9.7	1.93	6.4
Area Given Out to Tenant	0.26	1.5	4.02	18.9	2.23	9.1	1.18	4.8
Area given out to Lessee	0.22	.9	0.66	7.7	0.53	3.4	0.44	2.3

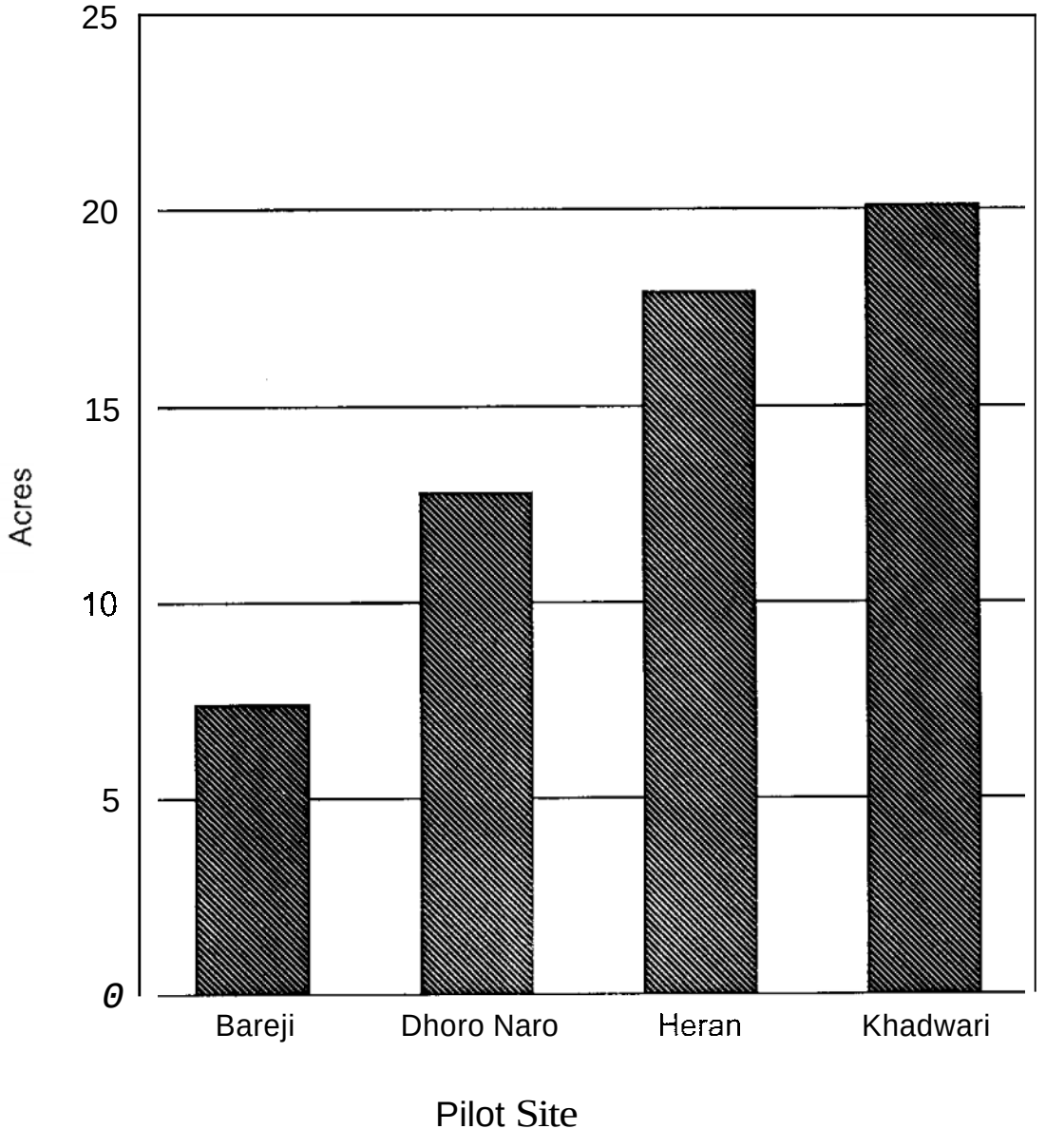

Figure 3.2. Average Area Operated By Respondents.

The mean total area operated by the respondents was **7.4** acres at Bareji Distributary, **12.8** at Dhoro Naro Minor, **17.9** at Heran Distributary, and 20.1 at Khadwari Minor.

Mean area owned by respondents stood as **4.7** acres at Bareji Distributary. 8.8 at Dhoro Naro Minor, **9.1** at Heran Distributary, and 15.2 at Khadwari Minor.

Except in the case of respondents at Heran Distributary and its Khadwari Minor, more than half of the operated area is comprised of shared/leased in area. The area shared/leased out is comparatively low at all the sites.

3.11 Farm Size Classification of the Respondents

The farm size here reflects the area operated by a respondent and/ or his family. It can be seen from Table **3.11** that a majority of the respondents operate farms between 5 to 16 acres. The subsistence holding in Sindh is considered to be **16** acres. This means that in the pilot distributaries, most of the farmers are small farmers. At Heran Distributary and its Khadwari Minor, a sizeable proportion (22 and 33 per cent, respectively) of the respondents were operating farms above 25 acres to 100 acres. It can thus be asserted that *at* Bareji and Dhoro Naro, most of the farmers are small farmers, whereas at Heran Distributary and its Khadwari Minor, more large land owners are present. This is further supported by the fact that a majority *of* the respondents at Bareji and Dhoro Naro are tenants, who usually operate subsistence farms.

Farm Size	Number and proportion of farms			
	Mirpurkhas	Nawabshah	Sanghar	
	Bareji Disty	Dhoro Naro Minor	Heran Disty	Khadwari Minor
<= 5 acres	82 (48.2)	27 (16.1)	9 (5.6)	2 (7.4)
> 5 to <= 16 acres	75 (44.1)	108 **(64.3)**	105 (65.2)	11 **(40.7)**
> 16 to <= 25 acres	10 (5.9)	25 (14.9)	11 (6.8)	5 (18.5)
>5 to <= 100 acres	3 (1.8)	8 (4.8)	**35** (21.7)	**9** (33.3)
Above 100 acres	0 (-)	0 (-)	1 (0.6)	0 (-)
Overall	170 (100)	168 (100)	161 (100)	27 (100)

4. IRRIGATION PRACTICES AND WATER MANAGEMENT

Irrigation water, being the most scarce resource afler land, is very important for agriculture. Efficiency of the farmers regarding the use of canal supplies for irrigation purposes can be evaluated by studying their irrigation and water management practices.

In this section, an attempt is made **to** identify the main sources **of** irrigation, methods employed *to* irrigate fields, sufficiency of the supplies to meet the crop requirements, arrangements for water distribution, and satisfaction of the end users regarding the system and its performance.

4.1 Sources of Irrigation

The physical environment of the area limits the choices for irrigation water to canal supplies and a few of privately owned tubewells to extract ground water. There were no public tubewells at the time of conducting this survey. Sometimes, farmers opt for a conjunctive use of tubewell and canal water to meet irrigation requirements of the crops. Use of different sources for irrigation in the pilot sites is presented in Table **4.1.**

Table 4.1. Sources of Irrigation Water.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Canal	170	100	155	92.3	161	100	2	100
Tubewells	-	-	1	0.60	-	-	-	-
Canal + Private Tubewells	-	-	12	7.1	-	-	-	-

The source exploited for irrigation water supply in all of the pilot sites was almost limited to canal water only. The conjunctive use of canal and groundwater was reported by the water users of Dhoro Naro Minor in Nawabshah, but that too, to a very limited extent. Only 7 percent *of* the total respondents in that area reported using canal and tubewells together.

The low exploitation of the groundwater is understandable as a major proportion **of** the LBOD project area is characterized by high water table and the quality of ground water is bad or marginal, in general, in terms of salinity. Augmenting the rather static canal supplies by using groundwater conjunctively is only feasible to the extent that it does not

cause crop loss. Besides, spatial location of the tubewells also limits the choice to purchasing and conveying groundwater at the farm at the hour of need.

4.2 Extent of Fulfillment of Crop Water Requirements

The adequacy of irrigation supplies to meet crop water requirements is one of the areas that is to be addressed for managing irrigation for sustainable agriculture. Although a more technical way of studying the situation would be to launch on-farm field trails, but the results thus obtained would be difficult to generalize for the entire pilot site as the soil characteristics. conveyance losses, and other factors in the agricultural environment may differ.

Similar results can also be obtained by analyzing the general feelings of the farmers regarding this matter as they know their area and crops better. Their perceptions were obtained regarding the extent of sufficiency of present irrigation supplies for fulfillment of crop water requirements and the results are presented in Table 4.2.

At Khadwari Minor in Sanghar District, a majority of the respondents thought that the present water supplies from all sources were not sufficient to meet crop water requirements. Respondents from Dhoro Naro Minor in Nawabshah and Heran Distributary in Sanghar were more or less satisfied with their water supplies. Conversely, ***45*** per cent of the respondents from Bareji Distributary were, in general, of the view that the current supplies were sufficient to meet crop water requirements to a large extent.

Particulars	**Mirpurkhas**		**Nawabshah**		**Sanghar**			
	Bareji Distributary N=170		**Dhoro Naro Minor N=168**		**Heran Distributary N=161**		**Khadwari Minor N=27**	
	No	%	**No**	**%**	**No**	%	**No**	**%**
Not at **all**	**18**	10 6	29	17.3	27	16.8	15	55.6
To some extent	76	44.7	121	72.0	96	59.6	5	18.5
To large extent	76	44.7	18	10.7	38	23.6	7	25 9

4.3 Sufficiency of Canal Water

Since canal water is the main source of irrigation, it was also studied whether canal water was sufficient or not. The pattern of the canal supplies differs during the two major cropping seasons (i.e. kharif and rabi). Being an interview on a recall basis, the most recent two cropping seasons were the reference period for the question on sufficiency of canal water.

The majority of the water users at all pilot site command areas were of the opinion that canal water was not sufficient for crops during the last kharif season. It was sufficient during the last rabi season for the water users, except those at Khadwari Minor.

Table **4.3.** Sufficiency of Canal Water for Crops During **Last** Two Cropping Seasons.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		NO	%	No	%	No	%	No	%
During Last Kharif Season (1995)	Yes	67	39.4	23 .	13.7	65	40.4	6	22.2
	No	92	54.1	144	857	96	59 6	20	74.1
	Did *not* Cultivate	11	6 5	1	0 6			1	3 7
During Last Rabi **Season** (1995)	Yes	125	735	99	58.9	127	78.9	10	37.0
	No	35	206	63	37 *5*	31	19.3	16	59.3
	Did not Cultivate	10	5 9	6	3 6	3	1.9	1	3.7

4.4 Satisfaction with Present Water Distribution

Water distribution among the watercourses results into water disputes among the water users of the watercourse. Responses regarding satisfaction of the respondents from present water distribution at the watercourses are presented in Table **4.4.**

The evidence is that the water users at Bareji Distributary and Dhoro Naro Minor were satisfied with the distribution among the watercourses, but the water users of Heran Distributary and its Khadwari Minor had mixed feelings.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Extent of Satisfaction with the Present Distribution of Water	Not at all	16	9.4	33	20.2	19	11.8		7.4
	To some extent	18	10.6	26	15.5	88	54.7	13	48.1
	To large extenl	136	80.0	108	43	54	33.5	13	44.4
Agency Able to Improve Water Distribution	Government agency	14	8.2	30	22.6	8	6.22	-	
	Farmers organizalion	2	1.2	3	2.4	4	2.5	-	
	Both					7	5.6		

4.5 Irrigation Methods Used

In general, farmers use three irrigation methods; namely, basin irrigation, furrow irrigation and wild flooding. Sometimes, they use two or more methods for different fields or crops. Each of these methods has advantages and disadvantages in terms of application efficiency, impact on crop yield, etc.

The choice of the farmer is determined by the soil type, labour intensity of the method, labour availability, availability of equiprneht. resource endowment, etc. The results regarding irrigation methods employed are presented in Table 4.5.

It is evident from Table 4.5 that most of the water users of the Dhoro Naro Minor, Heran Distributary and Khadwari Minor used the basin method for irrigation, whereas those at

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Basin	5	2.9	120	71.4	98	60.9	21	77.8
Furrow	10	5.9			4	2.5	3	11.1
Wild Flooding	1	0.6						
Basin+ Furrow	154	90.6	48	28.6	59	36.6	3	11.1

4.6 Type of Warabandi

Warabandi is the local name for the irrigation water turn schedule for the shareholders of a particular watercourse. There are two arrangements for water distribution; formal or pakka warabandi (officially fixed), which is fixed by the Irrigation Department, and informal or kachcha warabandi. which is managed by farmers with mutual agreement.

At most of the watercourses, an official warabandi has been notified and 'is being followed, but the gaps between the official warabandis and their actual implementation are increasing (Bandaragoda and Rehman, 1995). The informal or kachcha warabandi is disappearing from the scene.

Table 4.6 shows that pucca warabandi was found to be predominant at Nawabshah and Sanghar sites, whereas at the Bareji Distributary command in the Mirpurkhas area, most of the respondents believed that there was no warabandi in practice. The reason is that at this distributary, many of the farms are operated by the tenants and servants. Since the water right is established for a farm belonging to the *zamindar* in the warabandi and he is entitled to use his turn at his farm, but he arranges the distribution among various tenants and servants operating parts of his farm with his own consent. Sometimes, this duty is performed by his manager, called *kamdaar*, who is authorized to do so by the zamindar. Thus, the arrangement becomes adhoc and no tenant or servant knows exactly when he will be allowed *to* irrigate during the zamindar's irrigation turn.

Table **4.6.** Warabandi in the Pilot Distributaries.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Katcha	14	8.2	66	39.3	13	8.1	7	25.9
Pacca	29	17.1	99	58.9	148	91.9	20	74.1
No Warabandi	127	74.7	3	1.8	-	-	-	-
Irrigation Department	24	14.1	94	56.0	145	90.1	20	74.1
Mutual arrangement by Farmers	24	14.1	64	38.1	16	9.9	7	25.9
Any other	122	71.8	10	6.0	-	-	-	-

4.7 Time Allocated and Required to Irrigate an Acre

Each shareholder of a watercourse has an irrigation turn on the specific watercourse. The length of the turn, in general, is proportionate to the size of the culturable command area of the plot of land to be irrigated. Some allowance and adjustments are made in the water turn for compensation of the conveyance loss to tail areas. The time needed to fill and empty the watercourse for different locations are also adjusted in the warabandi.

Time required to irrigate an acre depends on the type *of* soil, location *of* the farm on the watercourse, route and physical condition of the watercourse, actual discharge drawn by the outlet, etc. In Table **4.7.** an attempt is made to present the picture regarding mean allocated time and mean time required to irrigate an acre, as perceived by the water users.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	Mean	STD	Mean	STD	Mean	STD	Mean	STD
Time Allocated	14 9	2 5	25 8	17 8	17 1	9 3	21 2	8 5
Time Required	98 1	43 5	100	58 4	91 6	47 6	170 5	112.8

4.8 Satisfaction with Maintenance of the Irrigation System

The dissatisfaction regarding distribution of irrigation water results generally from the faulty operations of the system. Even if the system is operated efficiently, poor maintenance will cause mal-distribution. Similarly, faulty operations cause maintenance problems. Thus, operations and maintenance are interdependent to some extent.

The respondents were enquired about their satisfaction regarding maintenance of their channels. The results are presented in Table 4.8.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Not at all	27	15.9	82	48.8	70	43.5	22	81.5
To some extent	66	38.8	70	41.7	82	50.9	2	7.4
To large extent	75	44.1	13	7.7	9	5.6	3	11.1
No comment	2	1.2	3	1.8				

Regarding the maintenance of the irrigation system, the respondents had mixed feelings. The majority of the respondents from Dhoro Naro and Khadwari minors were not satisfied with the present maintenance condition of the system. About 44 percent of the water users of the Bareji Distributary were satisfied to a large extent and the majority of the Heran Distributary were satisfied to some extent with the maintenance of the irrigation system.

4.9 Perceptions on Importance of Proper Water Management on Yields

The respondents were questioned on their perceptions regarding the role of proper irrigation management on crop yields (Table 4.9). Almost all of the respondent were affirmative to the statement" due to proper management of irrigation at your field, the yields of crops would increase". Only 2 and 3 per cent disagreed, respectively, at Dhoro Naro and Bareji.

Most of the respondents also claimed that they were aware of the proper requirement of irrigation water for different crops. The proportion of people who were unaware was the same as for the respondents who did not agree to the impact of proper water management on crop yield. They were either really ignorant, or were not serious, in their responses.

Table 4.9. Perceptions of Respondents on Impact of Proper Management of Irrigation on Crops and knowledge About Crop Water Requirements.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Proper Management of Irrigation Increase Yield of Crops	Yes	165	97.1	165	98.2	160	99.4	27	100
	No	5	2.9	3	1.8	1	0.6		
Knowledge of Requirement of Proper Irrigation Water for Different Crops	Yes	163	95.9	165	98.2	160	99.4	27	100
	No	7	42	3	1 8	1	0 6		

5. PERCEPTIONS **ON** IRRIGATION SYSTEM PERFORMANCE

An important aspect studied during the survey **is** the perceptions of the water users regarding the performance of the irrigation system. Irrigation system performance can be evaluated by examining it in terms of equitable distribution, reliability of water supplies and adequacy of water etc.

This section intends to briefly present the results on the perceptions of the water users on the abovementioned topics. Section 5.1 deals with equity in water distribution. Section 5.2 discusses reliability of water supplies, while Section 5.3 presents perceptions on adequacy of irrigation water supplies.

5.1 Equity in Water Distribution

5.1.1 Equity Within the Watercourse Command Areas

At the tertiary level of an irrigation system, a number of water users irrigate their farms from the same watercourse. With the introduction of a pucca warabandi irrigation timings for each farm were fixed, and a semblance of water rights was established. This helped in diminishing the number of water related disputes arising out of mal-distribution of water within the commend areas of watercourses.

The respondents were asked about their perceptions on distribution of water at the watercourse. It is evident from Table 5.1 that an overwhelming majority of the respondents regarded water distribution at the watercourse level as equitable. At the Khadwari Minor, however, more than one-third of the respondents regarded water distribution to be inequitable.

Table **5.1.** Perceptions ***of*** Water Users **on** Equity Within the Watercourse Command Area.

Particulars	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Yes	154	90.6	159	94.6	140	87.0	17	63.0
No	16	9.4	9	5.4	21	13.0	10	37.0

Bareji. one-fifth of the respondents believed that there was no equity, while more than two-fifths believed that irrigation water was equitably distributed among different watercourses. Almost one-third of the respondents were those who perhaps were unsure, or did not want to respond.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Equal Distribution of Irrigation **Water Between the** Distributaries/Minors	**Yes**	32	18.8	19	11.3	82	50.9	6	22.2
	No	24	14.1	125	74.4	51	31.7	18	66.7
	Don't **know**	114	67.1	24	14.3	28	1 7 . 4 3		11.1
Equity Within Distributary/Minor Command Area	Yes	78	45.9	25	14.9	124	77.0	11	40.7
	No	35	20.6	133	79.2	33	20.5	15	55.6
	Don't know	57	33.5	10	6.0	4	2.5	1	3.7

In general, the respondents saw an increasing equity in water distribution as their evaluation shifted from the branch canal through the distributary/minor to the watercourse. Many did not know much about the situation within the branch canal (between the distributaries), but generally acknowledged the inequity within the distributary (between the watercourses).

5.2 Reliability in Water Supply

Like equity, reliability of irrigation supplies is also assessed from the perceptions/ experiences of the water users. If a water user receives irrigation water when he is expecting it, the supply can be regarded as reliable and the converse is also true.

5.2.1 Missed Water Turns

There can be two important indicators for determining whether the canal supplies are reliable or not. Firstly, due to an unexpected absence of water from the canal and, therefore, the water users miss their irrigation turn as a consequence. Secondly, it is quite possible that the canal/ distributary is discharging water, but it is not reaching the farmers fields because somebody might have stolen water upstream in the watercourse. The data presented in Table 5.3 show that a majority of the sampled water users missed some of their water turns, both during the last kharif, as well as rabi, seasons.

Table **5.3.** Missed Water Turns by Respondents.

Particulars		**Mirpurkhas**		**Nawabshah**		**Sanghar**			
		Bareji Distributary N=170		**Dhoro Naro Minor N=168**		**Heran Distributary N=161**		**Khadwari Minor N=27**	
		No	**%**	**No**	**%**	**No**	%	**No**	**%**
Missed **Water** Turn(s) during last **Kharif** 1995	**Yes**	138	81 2	151	899	114	708	20	741
	No	16	9 4	15	8 9	46	286	6	222
	Not Applicable	16	9 4	2	1 2	1	0 6	1	3 7
Missed **Water** Turn(s) During **Last** Rabi 1995	**Yes**	155	91.2'	98	58.3	96	59.6	17	63.0
	No	**4**	2.4	59	35.1	64	39.8	**9**	33.3
	Not Applicable	11	6.5	11	6.6	1	0.6	1	3.7

Clearly, during the kharif season, more water users missed their irrigation turns. The proportion of such water users varied between 71 per cent at Heran Distributary to 90 per cent at Dhoro Naro Minor. Similarly, during rabi. the proportion of those water users who missed their turn ranged between 58 per cent at Dhoro Naro Minor to 91 per cent at Bareji Distributary.

Those who did not respond are water users who are tenants and had not leased/ shared in land until recently at that watercourse; thus, they were not aware of the situation during the reference period.

The conclusion can be made that for a majority of the respondents, water availability was unreliable during the reference period.

5.2.2. Water Turns Stolen

The information regarding the incidents reported by the water users about their stolen water turns is presented in Table 5.4. It can be witnessed from Table 5.4 that the incidents of water stealing are only far and few between. Only 5 to 52 per cent of the water users reported water stealing during their turn in Dhoro Naro and Khadwari minors, respectively, during the 1995 kharif season.

The proportion of the respondents who reported water stealing for the 1994-1995 rabi season ranged between 3 to 33 percent at the same locations (i.e. Dhoro Naro and Khadwari minors). Moreover, it can be seen that the proportion of water users reporting water stealing is higher in the case of kharif compared to the rabi season because the water shortage problem is more acute during the kharif season.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Stolen Water During Kharif Season 1995	Yes	11	6 5	8	4 8	19	118	14	519
	No	146	85.9	159	946	144	876	13	48 1
	Not Applicable	13	7 6	1	0 6	1	0 6		
Stolen Water During 1994-95 Rabi Season	Yes	10	5 9	5	3 0	12	7 5	9	33 3
	No	149	876	152	905	146	907	18	667
	Not Applicable	11	6 5	11	6 6	3	1 8		

5.3 Adequacy of Canal Water for Irrigation

The adequacy of the canal water for irrigation purposes can be assessed by water transactions among water users. In this section, an attempt is made to analyze water turns purchased, sold and exchanged by the water users of the pilot sites.

5.3.1. Purchase of Canal Irrigation Turns

Table 5.5 presents the situation regarding the purchase of irrigation water turns. It can be seen that while nobody purchased an irrigation turn at Bareji Distributary and Khadwari Minor, some water users reported purchases of irrigation turns at Dhoro Naro Minor and Heran Distributary. The proportion of such water users is as low as 8 per cent at Heran Distributary and around 4 per cent at the Dhoro naro Minor.

The canal water is a scarce input as the tubewell water in this area cannot be regarded a close substitute. This points to the fact that, though a lot of water users would be interested to buy irrigation turns from someone else as a potential buyer, but not many water users would be ready to sell their water turns and ruin their own crops.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Purchased Water During Last Kharif 1995	Yes			6	3.6	13	8.1		
	No .	157	92.4	161	95.8	147	91.3	26	96.3
	Not Applicable	13	7.6	1	0.6	1	0.6	1	3.7
Purchased Water During Last Rabi 1994-95	Yes			3	1.8	8	5.0		
	No	159	93.5	155	92.3	152	94.4	26	96.3
	Not Applicable	11	6 5	10	6 0	1	0 6	1	3 7

5.3.2. Sale of Canal Irrigation Turns

As indicated above, not many water users would be ready to sell their irrigation turn. The situation is reflected in Table 5.6, which reflects that almost no one sold an irrigation turn during the last two cropping seasons. This looks somewhat surprising as the question arises that how did those water users manage to buy a water turn who reported so. This can, in part, be attributed to the fact that the sale of an irrigation turn is legally prohibited, so those who actually sold water might have not responded truthfully to the enumerator because of the'fear of information leakage and consequent punishment.

Table 5.6. Sold Canal Irrigation Water Turns.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
						Heran Distributary N=161		Khadwari Minor N=27	
						No	%	No	%
Sold Water During Last Kharif Season 1995	Yes					1	0.6		
	No	157	92.4	167	99.4	159	98.8	26	96.3
	Not Applicable	13	7 6	1	0 6	1	0 6	1	3 7
Sold Water During Last						1	0 6		
		159	9 3 5	150	9 4 0	159	98.8	26	9 6 3
	Applicable	11	6 5	10	6 0	1	0 6	1	3 7

5.3.3. Exchange of Canal Water Turns

Unlike canal water transactions, the mutual exchange of irrigation turns is quite common among the water users. The situation is reflected in Table 5.7. Many water users mutually exchanged their irrigation turns. The extent of involvement in exchanging irrigation turns varies among the pilot sites and among the seasons as well.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Exchanged Irrigation Turn During Last Kharif 1995	Yes	96	56 5	28	167	72	447	6	22 2
	No	61	359	139	827	88	54 7	20	74 1
	Not Applicable	13	7 6	1	0 6	1	0 6	1	3 7
Exchanged Irrigalion Turn During Last Rabi 1994/95	Yes	83	48.8	13	7.7	45	28.0	6	22.2
	No	76	44.7	145	86.3	115	71.4	20	74.1
	Not Applicable	11	6.5	10	6.0	1	0.6	1	3.7

During the 1995 Kharif season, more than half of the respondents at Bareji exchanged turns, while slightly less than half of the respondents at Heran were involved in exchanging irrigation turns. This tendency was comparatively low at both the minors to the extent of 17 and 22 per cent at Dhoro Naro and Khadwari minors, respectively.

During the 1994-1995 Rabi season, this tendency of exchanging water turns declined among the water users **of** Bareji, Dhoro Naro and Heran. but the water users of Khadwari stagnated at the same proportion as that of kharif. The extent **of** decline was highest at the Dhoro Naro Minor, where almost half of the water users who exchanged water turns during kharif abstained from doing so during the rabi season.

6. COLLECTIVE ACTION AND INSTITUTIONAL DEVELOPMENT

When discussing institutional development, there is a need to study the activities that are already being undertaken by the community. While discussing the socio-economic characteristics of a community and potential for institutional development within the community, it is important to look at what collective actions the community is undertaking already. The level of collective action among the community members reflects on the potential for an organized effort for collective solutions of common problems, such as those confronted in irrigation management.

This section intends to discuss the results regarding involvement of the community in collective action, their knowledge about the already formed Water Users Associations (WUAs) and, finally, their experiences and perceptions regarding an organized effort for solution of common oroblems.

This topic is sub-divided into three sections. Section 6.1 reflects the knowledge of the respondents about the existence and membership of the already formed WUAs. In Section 6.2, results regarding the involvement of the respondents in various collective activities are presented. Section 6.3 entails some discussions on the potential for a collective and organized effort for irrigation management.

6.1 Knowledge About the Water Users Associations

The Water Users Associations were formed by the On-Farm Water Management Directorate for watercourse improvements. The results regarding the knowledge of the respondents on existence and membership are presented in Table **6.1.**

A majority of the water users at Heran Distributary knew that a WUA was formed at their watercourse. In all other sites, the water users believed that there was no WUA at their watercourse. This sounds surprising, but there are reasons. When looking into the actual situation regarding the social and physical context of WUA formation, most of the watercourses were lined because of large landowners, who usually are absentee landlords. Their tenants are never aware that a WUA is to be formed before lining is undertaken. On the other hand, small owner operators are less interested as the lining usually takes place in that part of the area that runs through the land belonging to big landlords, so that at the time of WUA formation, such landlords do no consult other farmers, so they remain unaware.

Table'6.1. Knowledge About Existence and its Membership of the Water Users Associations.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Water Users Associations Formed at the Watercourse	Yes	2	1.2	4	2.4	141	87.6	8	29.6
	No	168	98.8	164	97.6	20	12.4	19	70.4
Are you a member *of* the WUA?	Yes	-	-	2	1.2	34	21.1	2	7.4
	No	2	1.2	2	1.2	107	66.5	6	22.2
	N.A.	168	98.8	164	97.6	20	12.4	19	70.4
Is there a WUA in the Village or Outside the Village?	Yes	5	2.9	2	1.2	20	12.4	1	3.7
	No	165	97.1	157	93.5	57	35.4	16	59.3
	N.A.	-	-	9	5.4	84	52.2	10	37.0

N.A. = Not Applicable

Naturally, all of those who responded that there was no WUA on their watercourse, were not the members of the WUA and the question was not applicable to them. The highest proportion *of* WUA member respondents was at Heran Distributary (21%). Others might have not been involved due to tenancy, or farm size considerations, as discussed above.

Only a small proportion of the respondents were aware of a WUA on other watercourses of the village or outside the village.

This surprising response can be ascribed to the fact that the WUAs were initiated some 15 years ago in the ,country for the purpose of effecting physical improvement or lining of the watercourses, and soon afler the physical work was achieved, these WUAs became defunct. Since they did not perform any visible and continuous role aflerwards, the level *of* interest among the farmers declined regarding them.

6.2 Involvement of the Respondents in Collective Action

There are several physical, economic and social activities that collectively involve the water users. The participation of the community in such activities determines the potential of the community to undertake a responsibility jointly and in an organized manner. Table 6.2' and Figure 6.1 entail the details of the participation by the respondents in such activities.,

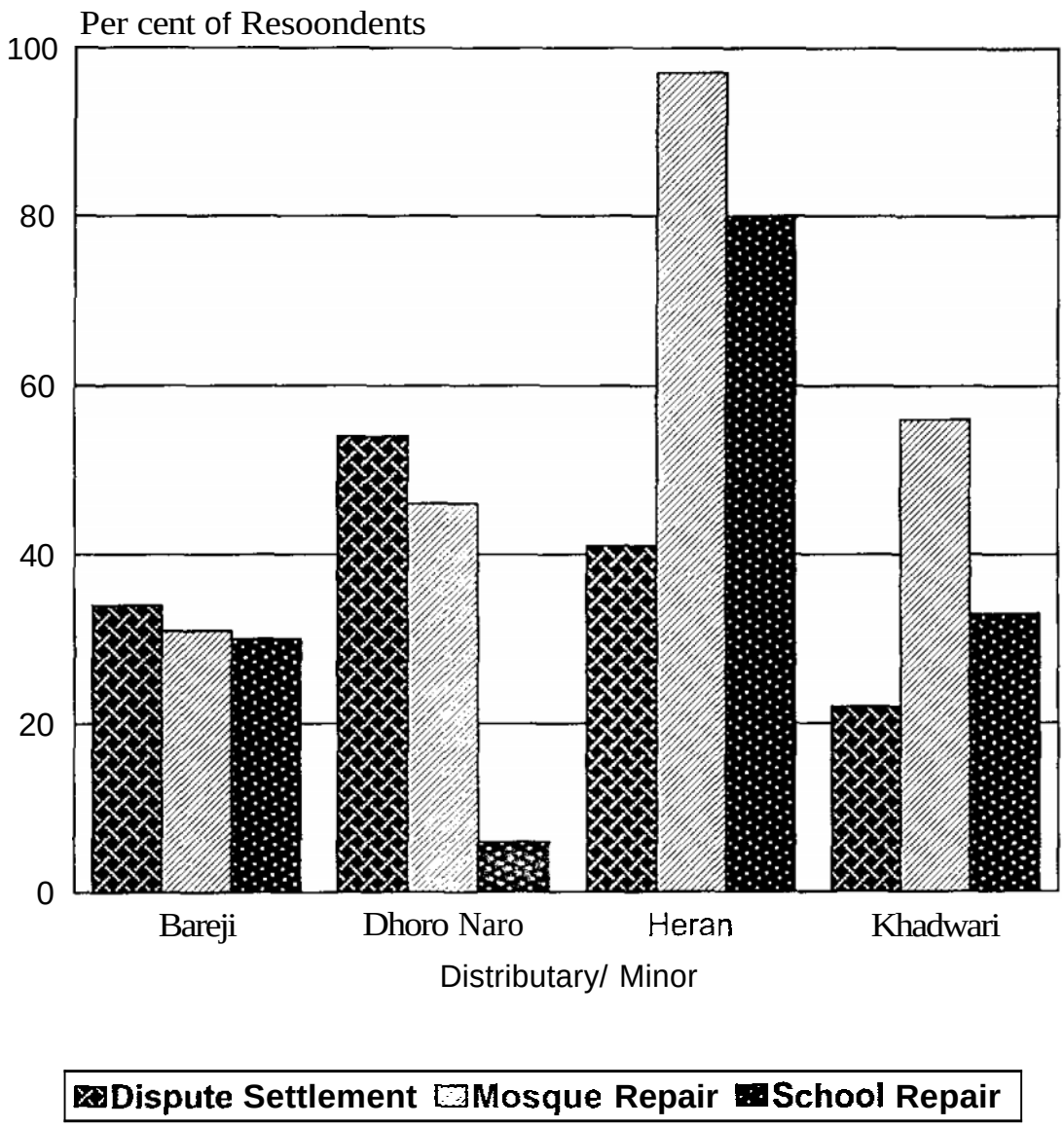

Figure 6.1. Participation in Community-based Social Action Programs.

The level of collective action among the water users is quite high at all of the three pilot sites. particularly as reflected in their contribution towards the maintenance of watercourses. Almost all of the respondents participated in maintenance of the watercourse. The majority of the respondents at Bareji and Heran distributaries, as well as Khadwari Minor, and about half of the respondents at Dhoro Naro Minor were, involved in the maintenance the distributaries/ minor also.

Collective Action		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		NO	%	No	%	No	%	No	%
Maintenance of Watercourse	Yes	169	99.4	167	99.4	161	100	26	96.3
	No	1	0.6	1	0.6	-		1	3.7
Maintenance of Distributary/Minor	Yes	168	98.8	80	47.6	159	98.8	25	92.6
	No	2	1.2	88	52.4	2	1.2	2	7.4
Settlement of Land and Water Disputes	Yes	57	335	90	536	66	41 0	6	22 2
	No	113	665	78	464	95	590	21	778
Purchase of Inputs	Yes	1	0.6	1	0.6	1	0.6	6	22.2
	No	169	99.4	167	99.4	160	99.4	21	77.8
Marketing of Crop Produce	Yes	2	1.2	1	0.6	1	0.6	6	22.2
	No	168	98.8	167	99.4	160	99.4	21	77.8
Maintenance/ Construction of Village Mosque	Yes	53	31.2	78	46.4	156	96.9	15	55.6
	No	117	68.8	90	53.6	5	3.1	12	44.4
Maintenance/ Construction of School	Yes	51	30.0	11	6.5	128	79.5	9	33.3
	No	119	70.0	157	93.5	33	20.5	18	66.7

The involvement of the respondents in collective solution of the disputes related to land and water ranged between one-fifth at Khadwari Minor *to* over half at Dhoro Naro Minor. Since water and land disputes are of different kinds and nature, some can be solved

within the community and many others cannot, so the involvement was low compared to maintenance of the watercourse and distributary.

Maintenance and construction of the village mosque is another collective activity that was performed by the water users of all the three pilot sites. The degree of participation ranged between 31 per cent at Bareji Distributary to 97 per cent at Heran Distributary. Participation in collective maintenance of the village school was also noticeable. This was, nevertheless, lowest at Dhoro Naro where only around 6 per cent of the respondents participated. At Heran Distributary, 4 respondents out of every 5 were involved in collective maintenance of the village school.

The activities that were not, but could be, undertaken by the respondents collectively were collective purchase of agricultural inputs and disposal of the marketing surplus of the produce realized at their farms. The underlying reasons could be differences in resource endowments of the different categories of the respondents with respect to size of their holdings. For instance, big farmers can buy inputs on credit in advance, because they are big customers, but a small tenant cannot because of low credit-worthiness. Similarly, small farmers tend to market the crop produce as early as possible due to weak financial position. while the big land owners can wait for peak demand periods. Due to these differences, there is a clash of interest in these activities and the tendency to undertake these activities is non-existent

6.3 Potential for Organized Efforts for Solving Common Problems

The potential for an organized collective effort for solving joint problems can be assessed with respect to the previous acquaintance of the respondents with some organized effort in development, their involvement in such activities, willingness to work for a common good, and willingness to contribute time and money for such an effort. Table 6.3 entails the details of responses by the water users at the various pilot sites.

Table 6.3. Formation of Water Users *Organizations* and Federations.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Awareness of Organization and Development Work Undertaken by it	Yes	163	95.9	116	69.0	157	97.5	26	96.3
	No	5	2.9	46	27.4	4	2.5	-	-
	Don't know	2	1.2	6	3.6	-	-	1	3.7
Involvement in *membership and* initiation of organization	Yes	45	26.5	79	47	72	44.7	18	66.7
	No	123	72.4	88	52.4	89	55.3	9	33.3
	Don't Know	2	1.2	1	0.6	-	-	-	-
Willingness to Work with the People for Development	Yes	165	97.1	155	92.3	150	93.2	26	96.3
	No	3	1.8	12	7.1	10	6.2	-	-
	Don't know	2	1.2	1	0.6	1	0.6	1	3.7
Willingness to Contribute Labor and Affordable Money to Carry out Development Work	Yes	164	96.5	143	85.1	153	95.0	27	100
	No	5	2 9	24	14 3	8	5 0	-	
	Don't Know	1	0 6	1	0 6				

An overwhelming majority of the respondents were aware of some organization catering to development works in their area. This awareness was lowest at the Dhoro Naro Minor but, still around 70% of the respondents were aware. For rest of the three distributaries/ minors, the awareness was as high as around 97 per cent.

Many of the respondents, themselves, were involved in some kind of organization as initiating members of the organization. The proportion of such respondents ranged between roughly 27 per cent at Bareji to 67 per cent at Khadwari.

An overwhelming majority of the respondents showed their willingness towards working for development with people. The proportion of such respondents was higher than 92 per cent at all of the pilot sites.

A vast majority showed their willingness and readiness to contribute labour and affordable money for such an organization. The level of willingness varied between 85 per cent at Dhoro Naro Minor to 100 per cent at Khadwari Minor.

From the above discussion, it appears that the respondents are very much willing to work in an organized manner for the common good. There is a great potential and scope within the water users community at all of the pilot sites.

6.4 Potential for Organized *Efforts* in Irrigation Management

The potential for organized effort in irrigation management can be determined by three factors: (a) willingness of the water users to form a water users association at the watercourse; (b) willingness to federate these associations; and (c) willingness to contribute towards O&M of the distributary. The results obtained on these areas are presented in Table 6.4.

At Bareji Distributary and Dhoro Naro Minor, an overwhelming majority of the respondents wanted to form a water users association. At Heran Distributary and Khadwari Minor, the response was 38 and 48 per cent respectively. Low response at this distributary can be attributed to the fact that some of them are already members (see Table 6.1) and to the rest of them it is not applicable. On the contrary, there are fewer numbers of already established WUAs at Bareji Distributary and Dhoro Naro Minor.

Table 6.4. Willingness to Form and Federate WUAs and Readiness to Contribute for O&M of the Distributary.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Want to Have a WUAs at their Watercourse	Yes	156	91.8	148	88.1	61	37.9	13	48.1
	No	2	1.2	4	2.4	5	3.1	4	14.8
	Don't know	12	7.0	16	9.5	95	59.0	10	37.0
Members of WUA can form the Water Users' Federation at Distributary/Minor Level	Yes	153	90.0	143	85.1	147	91.3	27	100
	No	5	2.9	22	13.1	14	8.7	-	
	Don't know	12	71	3	1.8	-			
Willing to Contribute for O&M at Distributary Level	Yes	151	88.8	143	85.1	146	90.7	25	92.6
	No	16	9.4	24	14.3	15	9.3	2	7.4
	Don't know	3	3	1.8	1	0.6	-		

The potential to federate these WUAs into a Water Users Federation (WUF) is high as expressed by the perceptions of the respondents. In no case did the proportion of the respondents with a positive answer drop below 85 per cent. At Khadwari Minor, all of the respondents affirmed that the WUAs could be federated.

The water users expressed their willingness to contribute money for meeting the financial outlays on distributary operations and maintenance. The extent of readiness varied between 85 per cent at Dhoro Naro Minor to 93 per cent at Khadwari Minor.

In summary, it can be concluded that though many of the respondents did not have a formal exposure to an organized effort for solving common problems, but they have knowledge and are willing to form, federate and sustain a water users organization as they showed a willingness to even contribute funds for meeting the financial liabilities of the organization.

Level of Organized Behaviour	Illiterate	Literate
0 to 2 activities	135 (40)	41 (22)
3 to 4 activities	171 (51)	116 (62)
more than 4 activities	32 (9)	31 (16)
Total	338 (64)	188 (36)

Table 6.6. Level of Collective Action With Respect To Location of the Farm.

Level of collective action	Head	Middle	Tail
0 to 2 activities	47 (39)	59 (28)	70 (36)
3 to 4 activities	60 (50)	121 (57)	106(54)
5 or more activities	13 (11)	30 (15)	20 (10)
Total	120 (23)	210 (40)	196(37)

Note: The figures in parenthesis are the percentages of the total.

While there seems to be no difference for participating in collective action between the head and the tail respondents, but the middle reach respondents participated more in collective action. The share of respondents of this class who participated in three or more activities is 72 % compared to 61% and **64** % for the head and tail reach respondents, respectively, which is quite high. Nevertheless, this cannot help in concluding that head farmers are less cooperative.

A more important way to look at these responses **could** be to analyze participation in maintenance of watercourses by location. Theocratically, there are more watercourse-related problems at the middle and tail reaches and, therefore, the probability of participation in watercourse maintenance is more for the middle and tail reach farmers. Table 6.7 presents the picture gained from the baseline data.

Location of Farm	Participation in Maintenance of the Watercourse		
	Yes	No	Total
Head Reach	112 **(93)**	8 (7)	**120**
Middle Reach	**179** (85)	**31 (15)**	**210**
Tail Reach	**171** (87)	**25 (13)**	**196**
Total	462 **(88)**	64 **(12)**	**526**

lining is generally undertaken at the head reaches of the watercourses that might have been conceived as maintenance by the respondents.

6.5.3 Effect of Farm Location on Irrigation Time

The farther that the farm is situated along the watercourse, the higher are the conveyance losses: consequently, the time needed to irrigate an acre becomes greater with distance from the outlet. This proposition can be tested by cross-tabulating the time needed to irrigate an acre with location of the farm along the watercourse. In Table ***6.8,*** the time needed to irrigate an acre has been classified into three groups, i.e. one hour or less, between one and two hours, and more than two hours. The situation is presented in Table 6.8.

Time needed to irrigate an acre	Farm location on the watercourse		
	Head	Middle	Tail
<= 1 hour	58 (48)	75 (36)	58 (30)
1 to 2 hours	51 (43)	98 (47)	90 (46)
More than 2 hours	11 (9)	35 (17)	46 (24)
Total	120 (23)	208 (40)	194 (37)

Obviously, from Table 6.8. that the majority of the respondents (91 %) from the head reach reported that the time required to irrigate an acre as being less than 2 hours, while almost half of them reported it to be less than an hour. Contrary to this, most of the respondents from the middle and tail reaches reported this time to be more than an hour. Although the value of the correlation coefficient is low, but this coefficient and the Chi-square test are highly significant, indicating that the difference in time required for irrigation of an acre significantly increases with location of the farm along the watercourse.

7. PERCEPTIONS ON WATERLOGGING AND SALINITY MANAGEMENT

Because of high water tables and brackish groundwater, the soil degradation is quite rapidly increasing in the area. Without proper management practices regarding land, waterlogging and salinity, it is quite probable that in a few years, the fertile lands will refuse to produce anything. **At** the same time, LBOD has been designed and constructed to alleviate these problems. During the survey, the knowledge and management practices of the respondents regarding these areas were also recorded. This section focusses on their perceptions and practices.

Section 7.1 discuss the perceptions and knowledge **of** the respondents regarding relations between land levelling and water utilization and precision land levelling. In Section 7.2, an attempt is made to study their perceptions on quality of groundwater. Section 7.3 is reserved for their knowledge about past and present water table depths and information on land affected by waterlogging and salinity. The last section discusses the management practices used by them to alleviate waterlogging and salinity.

7.1 Perceptions about Land Levelling and Management

If someone does not believe that land levelling is important for optimal use of water, it is unlikely that he will opt for levelling for optimal water use. The responses of the water users regarding this and precision land levelling are presented in Table 7.1.

An overwhelming majority of the respondents believe that land levelling is a crucial factor to optimize the utilization of water. The proportion of the respondents who acknowledged the statement ranged between 96 per cent at Bareji *to* 100 per cent at Khadwari Minor.

On the other hand, almost 9 out of 10 respondents were unaware of precision land levelling, Over 10 per cent of the respondents from Dhoro Naro Minor were familiar with precision land levelling, which was the highest proportion among all of the sites. Precision land levelling is becoming more familiar because of the On-Farm Water Management Directorate, which is employing this technology at demonstration centers in their respective areas. Since there is a low tendency among the general farmers to visit demonstration centers of agriculture-related agencies, they are less familiar with this technology. This also suggests that extension measures are needed to promote and popularize the concept and advantages of precision land levelling.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Level Land Properly to Optimize the Utilization of Water Level	Yes	163	95.9	162	96.4	160	99.4	27	100
	No	7	4.1	6	3.6	1	0.6		
Heard about Precision Land Levelling	Yes	11	6.5	18	10.7	8	5.0	1	3.7
	No	159	93.5	149	89.3	153	95.0	26	96.3

7.2 Perceptions About Quality of Groundwater

Farmers are the best judges to assess the quality of ground water as they are using it since the pre-irrigation period for cultivation of crops. They were enquired about their feelings about the quality of ground water and their responses are presented in Table 7.2

Table 7.2. Quality of Groundwater as Perceived by the Respondents.

Quality of Groundwater for Irrigation Purposes	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
	No	%	No	%	No	%	No	%
Fit	7	4.1	70	41.7	58	36.0	7	25.9
Marginally fit	13	7.6	19	11.3	5	3.1	2	7.4
Unfit	142	83.5	71	42.3	95	59.0	18	66.7
Don't Know	8	4.7	8	4.8	3	1.9	-	-

At Bareji Distributary, as well as Heran Distributary and its Khadwari Minor, the majority (84%. 59% and 67%, respectively) of the respondents perceived that the quality of groundwater was unfit for irrigation purposes. In the case of Dhoro Naro Minor, 42 percent of the respondents felt that it was fit while another 11 percent thought that it was of marginal quality that should be used only during extreme water shortages.

In general, the quality of groundwater was regarded not suitable for irrigation purposes. This should be noted that within each distributary/ minor command area, there is a variation in responses. This may be attributed to the spatial nature of the ground water quality. Even within the same watercourse command area, the quality of groundwater may vary due to the nature of the underlying soil layers.

7.3 Perceptions about Waterlogging

A majority of respondents claimed that they had knowledge about the depth to water table in their respective areas. The proportion of the respondents who responded positively ranged between almost 90 per cent in Dhoro Naro and Khadwari minors to 98 per cent at Heran Distributary.

The average farm area affected by waterlogging and salinity varied between almost 2.5 acres (19 and 12 % of the mean area operated respectively) at Dhoro Naro and Khadwari minors to over 4 acres (52 and 24 per cent of the mean area operated, respectively) at Bareji and Heran distributaries. The high value of standard deviations is higher than the means, indicating that there are high variations among various responses regarding area affected within each of the distributaries/ minor.

Table 7.3. Knowledge About Depth of Water Table and Area Affected by Waterlogging and Salinity.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Knowledge of Depth to Water Table	Yes	161	94.7	150	89.3	158	98.1	24	88.9
	No	9	5.3	18	10.7	3	1.9	3	11.1
Land Affected by Waterlogging and Salinity	Mean Area in Acres (STD)	3.9 (5.0)		2.5 (6.3)		4.3 (5.4)		2.4 (3.9)	
Water Table Now (ft)	Mean (STD)	9.2 (7.5)		20.8 (14.8)		5.7 (4.1)		5.7 (2.9)	
Water Table Two Years Ago (ft)	Mean (STD)	8.1 (8.3)		25.0 (22.9)		3.8 (3.1)		2.5 (1.3)	

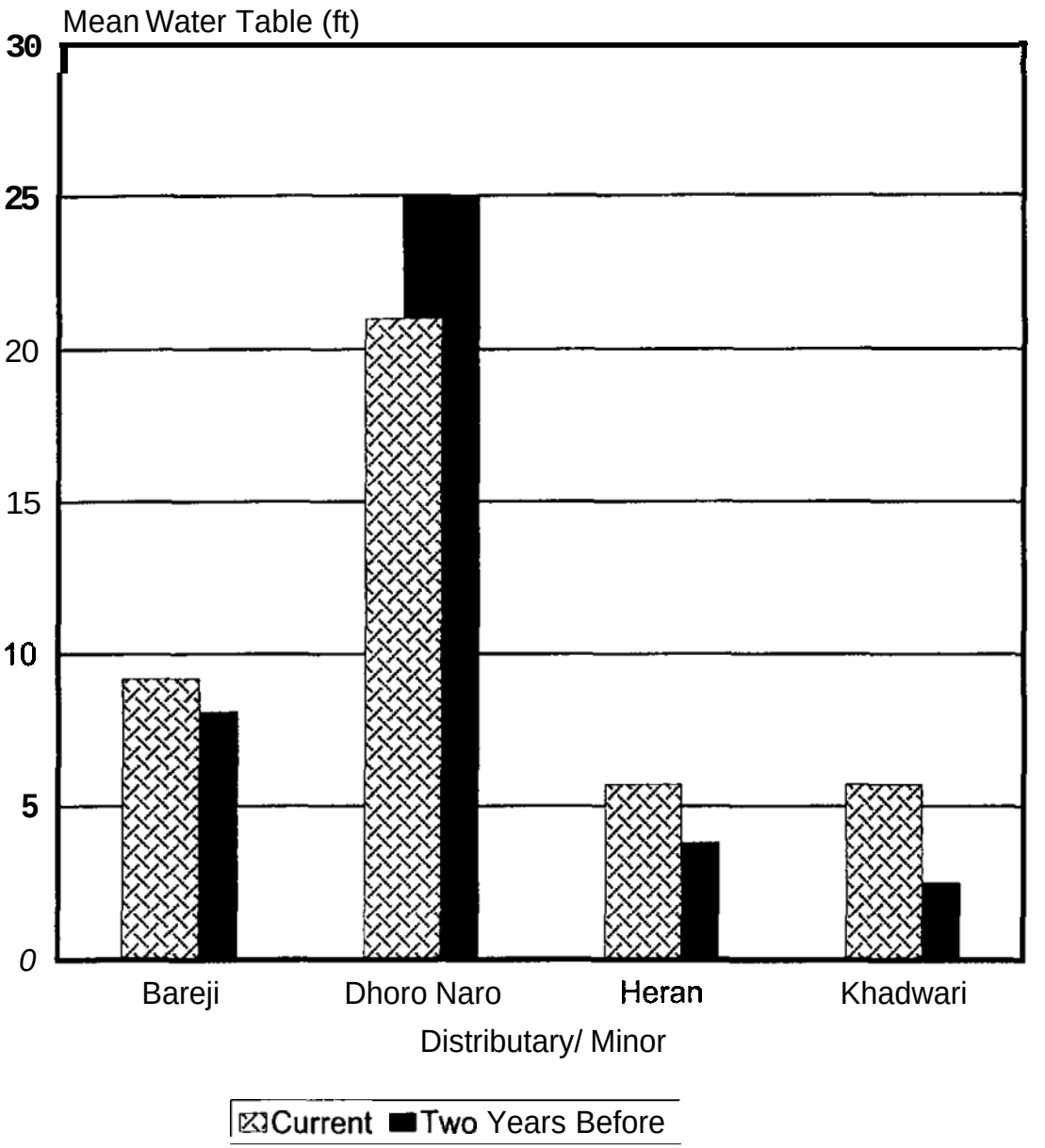

Figure 7.1. Water Table Now and Two Years Before.

To most of the respondents, the ground water table has dropped during the last two years. The extent of reported drop varied between around 1 foot at Bareji Distributary to about 4 feet at Dhoro Naro Minor. The reported figures, nevertheless, varied among different respondents of the same distributary to a great extent as the respective standard deviations are quite high. The responses from Khadwari Minor, however, about reported water depth can be regarded quite consistent as the standard deviations are less than half of the mean.

7.4 Measures Taken to Control Waterlogging and Salinity

Waterlogging and salinity are not caused only by local conditions: rather this twin menace arises from collective human actions over large areas. Although it may not be eliminated altogether locally, but it can be minimized by adopting local solutions in conjunction with large-scale efforts. In Table 7.4, the salinity and waterlogging management practices adopted by the water users are presented.

At the Bareji Distributary in Mirpurkhas, a majority of the respondents *(66%)* used grass to control waterlogging and salinity. Cultivation of rice for leaching salts is another common practice adopted by one-quarter of the respondents. Use of gypsum and plantation of salt resistant trees are, however, not yet so popular.

At the Dhoro Naro Minor in Nawabshah. none of the salinity control measures is frequently practiced as is indicated from Table 7.4. Only 16 per cent *of* the respondents cultivated grass to control salinity.

Among the respondents from Heran Distributary the cultivation of grass, rice and planting trees are somewhat popular as 42 per cent, 32 per cent, and 27 per cent of the water users were using these measures, respectively.

At Khadwari Minor of the Heran distributary, almost every fifth respondent planted trees and/ or cultivated rice for lowering the water table and minimizing salinity, while every ninth respondent was reported using gypsum for reclaiming the land.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Use Gypsum to Control Waterlogging and Salinity	Yes	2	1.2	2	1.2	6	3.7	3	11.1
	No	168	98.8	166	98.8	155	96.2	24	88.9
Grow Grass to Control Waterlogging and Salinity	Yes	112	65.9	27	16.1	67	41.6	6	22.2
	No	58	34.1	144	83.9	94	58.3	21	77.8
Plant Trees lo Control Waterlogging and Salinity	Yes	4	2.4			44	27.4	2	7.4
	No	166	97.6	168	100	117	72.6	25	92.6
Cultivated Rice to Control Waterlogging & Salinity	Yes	45	26.5	3	1.8	51	31.7	5	18.5
	No	125	73.5	165	98.2	110	683	22	81.5

8. PERCEPTIONS ON DRAINAGE SYSTEM

The importance of drainage to irrigated lands cannot be over-emphasized. The prime idea behind the LBOD Project is that afler completion of the drainage system, its O&M should be turned over to farmers because the government cannot subsidize irrigated agriculture any more. This section, therefore, discusses the perceptions of the respondents on various aspects of drainage.

Section 8.1 is focussed on perceptions regarding availability of drainage facilities and its importance and usefulness for crops. Section 8.2 entails farmers' perceptions on their views about O&M responsibilities and willingness to contribute towards O&M.

8.1 Knowledge About and Importance of Drainage System

Table ***8.1*** presents perceptions of the respondents about the existence and importance of drains in the area. Almost all of the respondents were familiar with the drainage system in the project area. Nevertheless, every fourth respondent at Dhoro Naro Minor and every tenth respondent at Bareji was unaware of the drainage system.

At Bareji 96 per cent, at Dhoro Naro 94 per cent, at Heran Distributary 96 per cent and all the respondents at its Khadwari Minor believed that drainage will help in increasing crop yields. Whereas 1, 6 and 4 per cent of the respondents were unsure about this at Bareji distributary, Dhoro Naro Minor and Heran Distributary, respectively.

Almost all of the respondents at all the sites regarded drainage equally important for the land in order to save it from the twin menace of waterlogging and salinity. They also opined that drainage is important for saving the land from waterlogging and salinity and that drainage should be maintained and operated properly and regularly. A great majority shared the view that if properly operated and well maintained, it will be continuously beneficial for the lands in the area.

Table 8.1. Knowledge About Drainage and Its Importance.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Familiarity with the Drainage System	Yes	156	91.8	123	73.2	157	97.5	27	100
	No	14	8.2	45	26.8	4	2.5	-	-
Availability of Drainage will Increase Crop Yields	Yes	163	95.9	157	93.5	155	96.3	27	100
	No	7	4.1	11	6.6	6	3.7	-	-
Drainage is Equally Important for the Land to Save from Waterlogging and Salinity	Yes	169	99.4	161	95.8	161	100	27	100
	No	1	0.6	7	4.2	-	-	-	-
Drainage Give Benefit Continuously if it is Maintained and Operated Properly	Yes	165	97.1	153	91.1	160	99.4	27	
	No	5	3.0	15	8.9	1	0.6		100

8.2 Operations and Maintenance Responsibilities of the Drainage System

The perceptions on responsibility for operations and maintenance of the drainage system, only with the willingness of the respondents towards paying for the outlays, are presented in Table 8.2.

A majority of the sampled water users were of the view that operations and maintenance of the drainage system is the responsibility of the government. Nevertheless, one-third of the respondents at Bareji Distributary and Dhoro Naro Minor, as well as one-fourth of those at Khadwari, believed that it was either the responsibility of the farmers themselves or a joint responsibility of the government and the users.

Roughly three out of four respondents were willing to provide services / money for operations and maintenance of the drainage system. The highest level of willingness was shown by the respondents from Khadwari Minor (89%), followed by those of Heran Distributary (83%), those of Bareji Distributary (79%), and lowest from those of Dhoro Naro Minor (73%).

Table 8.2. Perceptions on Operations and Maintenance of the Drainage System.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Operations and Maintenance of Drainage is the Responsibility	Government Agency	99	58.2	114	67.9	140	87.0	20	74.1
	Farmers' Organizations	7	4.1	14	8.3	4	2.5	4	14.8
	Both	46	27.1	40	23.9	17	10.6	3	11.1
	Don't Know	18	10.6	-	-	-	-	-	-
Willing to Give Services and or Pay Contribution for O&M of Drainage System	Yes	134	78.8	123	73.2	134	83.2	24	88.9
	No	32	18.8	44	26.2	27	16.8	3	11.1
	Don't Know	4	2.4	1	0.6	-	-	-	-
Willingness to Maintain the Drainage System through Formed Organizations	Yes	135	79.4	123	73.2	143	88.8	18	66.7
	No	33	19.4	44	26.2	18	11.2	9	33.3
	Don't Know	2	1.2	1	0.6	-	-	-	-

Furthermore, they were also willing to maintain the drainage system through their organizations. The level of willingness oscillated between 89 per cent *at* Heran Distributary to 67 per cent at its Khadwari Minor.

9. FARM MACHINERY, LIVESTOCK, PRODUCTION PRACTICES, OUTPUT OF MAJOR CROPS AND INCOME

In this section, ownership of farm resources, specifically machinery and livestock, area planted and major crops reaped and income composition of the respondents is discussed.

Section **9.1** entails the details of farm machinery and 9.2 contains the details of livestock held by the respondents. In Section 9.3, the major crops planted and reaped are discussed. Section 9.4 is reserved for income composition of the respondents.

9.1 Farm Machinery Held by the Water Users

The main elements of machinery that were studied are mechanical equipment, such as tractors, threshers, seed drills, rotavators and reapers. The information is presented in Table **9.1.**

At the Bareji Distributary, only 5 respondents owned a tractor and/ or thresher. This forms 3 per cent of the total water users surveyed.

At the Dhoro Naro Minor, 18 respondents were in possession of machinery, 4.2 per cent **of** the respondents had a tractor. 3 per cent had a thresher, around 2 per cent owned a seed drill, and 1 per cent had a rotavator. Only one person owned a reaper.

At Heran Distributary, 20 persons had machinery, but nobody had a seed drill. **At** Khadwari Minor of this distributary. 5 persons owned tractors and no other machinery was owned by any of the respondents.

Among the three pilot sites, respondents from Heran Distributary and its Khadwari Minor had the maximum concentration of tractors and threshers (16 and 7, respectively). Water users of Dhoro Naro Minor at Nawabshah enjoyed a monopoly in possessing seed drills (3 only) and had more rotavators.

Table 9.1. Ownership of Agricultural Machinery and Other Accessories.

Particulars		Mirpurkhas		Nawabshah		Sanghar			
		Bareji Distributary N=170		Dhoro Naro Minor N=168		Heran Distributary N=161		Khadwari Minor N=27	
		No	%	No	%	No	%	No	%
Own Tractor	Yes	4	2.4	7	4.2	11	6.8	5	18.5
	No	166	97.6	161	95.8	150	93.2	22	81.5
Own Thresher	Yes	1	0.6	5	3.0	7	4.3	-	-
	No	169	99.4	163	97.0	154	95.7	27	100
Own Seed Drill	Yes	-	-	3	1.8	-	-	-	-
	No	170	100	165	98.2	161	100	27	100
Own Rotavator	Yes	-	-	2	1.2	1	0.6	-	-
	No	170	100	166	98.8	160	99.4	27	100
Own Reaper	Yes	-	-	1	0.6	1	0.6	-	-
	No	170	100	167	99.4	160	99.4	27	100

9.2 Ownership of Livestock and Poultry

The livestock in the area comprises of bulls, cows. buffaloes, camel. sheep, goats, donkeys, horses and poultry (Table 9.2).

A maximum number of bulls was found with the respondents of Dhoro Naro Minor (309) followed by those of Heran Distributary (268) and Bareji Distributary (187). The minimum number of bulls was found with the water users of Khadwari Minor.

Over one 100 cows were found with the respondents of Bareji, Dhoro Naro and Heran distributaries, with the maximum at Bareji Distributary.

Livestock	Mirpurkhas		Nawabshah		Sanghar			
	Bareji Distributary		Dhoro Naro Minor		Heran Distributary		Khadwari Minor	
	N	No	N	No	N	No	N	No
Bull	79	187	131	309	117	268	16	40
Cows	81	209	81	152	57	116	17	65
Camel	2	6	4	6	-	-	-	-
Buffalo	43	96	119	294	125	482	14	78
Sheep	7	120	16	390	5	83	2	33
Goats	126	805	129	894	127	780	18	134
Donkey	2	7	56	87	35	40	6	8
Horse	1	1	6	9	1	1	1	1
Poultry	17	95	03	539	78	829	5	74

Camels were only found at Bareji Distributary and Dhoro Naro Minor. Buffaloes were more concentrated in Heran Distributary. followed by Dhoro Naro Minor. Sheep herds were concentrated more at Dhoro Naro while goats were almost in equal number at Dhoro Naro. Bareji and Heran. The maximum number of donkeys was found at Dhoro Naro, while at Heran, the number of donkeys was almost half of those at Dhoro Naro. At least one horse was held by respondents of all the sites. The poultry farming seems to be a more popular enterprise at Heran Distributary.

Overall, the respondents from Dhoro Naro Minor had more livestock compared with the other pilot sites.

9.3 Production Practices and Output

In this section, the area planted and destroyed, seed used per acre, total expenditures incurred per acre, and crop yields realized are discussed. Each sub-section is reserved for one of the major crops. In total, three crops were identified as major crops (i.e. cotton, wheat and sugarcane). These were cultivated in all *of* the three pilot sites.

9.3.1. Cotton Production Practices and Productivity

Almost an equal number *of* respondents cultivated cotton at Bareji Distributary and Dhoro Naro Minor, but in terms of area sown, the area at Dhoro Naro minor was more than double than that of the Bareji Distributary (Table **9.3).** More planted area was destroyed at Dhoro Naro, too. The seed rate used was also high at all sites except for Bareji. where the average use *of* seed was near the recommended level. More expenditures were incurred per acre of crop at Bareji and resultantly, they harvested more cotton per acre that was almost double than that of Dhoro Naro Minor. It appears that the farm productivity for cotton is more or less directly related to expenditures incurred per acre *of* the crop at the pilot sites.

Cotton	Mirpurkhas	Nawabshah	Sanghar	
	Bareji Distributary N=158	Dhoro Naro Minor N=159	Heran Distributary N=139	Khadwari Minor N=24
Area Sown(Acres)	499.65	1057.0	789.0	96.0
Area Destrov (Acres)	175.45	296.0	122.0	7.0
Seed Used/Acres (Kg)	5.6	8.86	7.21	7.56
Total Expenditure/ Acre (Rs)	4071.29	2071	3103	3427
Yield/Acre (Maund)	18.76	9.36	12.43	11.39

9.3.2 Wheat Production Practices and Productivity

A maximum number **of** water users had sown wheat at Heran Distributary and Dhoro Naro Minor compared **to** other sites, and the area planted was also more. More area was destroyed at Bareji Distributary. The quantity of seed used per acre was highest at Bareji Distributary. Expenditures incurred per acre was highest at Khadwari Minor, but the yield was the lowest. In this case, the yield seems inversely responding to the total expenditures incurred per acre, but there are undoubtedly reasons that were not discovered during this socio-economic baseline survey.

Cotton	Mirpurkhas	Nawabshah	Sanghar	
	Bareji Distributary N=126	Dhoro Naro Minor N=152	Heran Distributary N=155	Khadwari Minor N=19
Area Sown(Acres)	513.75	1283.00	1046.5	86.00
Area Destroy (Acres)	168.00	78.5	65.5	0.0
Seed Used/Acre (kg)	56.83	53.98	49.49	52.11
Total Expenditure/ Acre (Rs)	2214.29	1961.25	2208.55	2605.26
Yield/Acre (Maunds)	213.51	26.48	20.36	17.78

9.3.3 Sugarcane Production Practices and Productivity

More respondents at Heran Distributary had cultivated sugarcane and planted more acreage compared to the other pilot sites. **At** Bareji. more area was destroyed but this distributary also lead the figure for seed rate used and total expenditures incurred per acre of crop. The yield was also higher at Bareji Distributary compared to other pilot sites.

Sugarcane	Mirpurkhas	Nawabshah	Sanghar	
	Bareji Distributary N=77	Dhoro Naro Minor N=50	Heran Distributary N=101	Khadwari Minor N=6
Area Sown(Acres)	203.25	110.5	242.5	8.50
Area Destroy (Acres)	48.5	***8.75***	**17.0**	3.50
Seed Used/Acres (Kg)	3522	2668.94	2938.0	2500
Total Expenditure/ Acre (Rs)	4536.00	3178.02	3547.20	3360.0
Yield/Acre (Maunds)	512.23	431.84	450.63	270.0

9.4 Crop Yields by Farm Location Along the Watercourse

In this section, the yields of major crops are compared with respect to location of the farm along the watercourse reaches for the different pilot sites.

The per acre yield of cotton was found generally higher at the tail farms compared to head and middle areas: the differences were, nevertheless, very small. Among various pilot sites, the average yield at all of the three locations was higher at the head, middle and tail of Bareji Distributary compared with those of other pilot sites. The cotton yields with respect to farm location are presented in Table 9.6.

Farm Location	Districts and Pilot Sites			
	Mirpurkhas	Nawabshah	Sanghar	
	Bareji Disty	Dhoro Naro Minor	Heran Disty	Khadwar Minor
Head	14	11	11	13
Middle	20	11	11	10
Tail	20	9	13	15
Average	19	10	12	13

In case of the sugarcane crop, the average yield was more or less comparatively higher at the head farms compared to tail farms, except for Heran Distributary (Table 9.7). This may partly be attributed to relatively more availability of water at the head reaches of watercourses as the losses are comparatively less. In terms of productivity, the respondents at Bareji and Heran distributaries were more productive compared with both of the minors and the respondents on the Khadwari Minor were the most inefficient ones.

Farm Location	Districts and Pilot Sites			
	Mirpurkhas	Nawabshah	Sanghar	
	Bareji Distv	Dhoro Naro Minor	Heran Disty	Khadwari Minor
Head	556	493	355	-
Middle	527'	452	581	300
Tail	480	439	494	150
Average	518	459	512	225

Farm Location	Districts and Pilot Sites			
	Mirpurkhas	, Nawabshah	Sanghar	
	Bareji Disty	Dhoro Naro Minor	Heran Disty	Khadwari Minor
Head	22	27	23	19
Middle	21	28	19	20
Tail	22	22	20	15
Average	22	25	20	18

9.5 Income From Various Sources

This section entails the income of the respondents from different sources and for different sites. Since the water users generally have a tendency to under-report overall income, they were enquired about income for five different enterprises. These include income from crops, livestock, labour, remittances and other sources. It is important to point out that several respondents did not disclose their income and were treated as missing cases and were excluded from the analysis. In the tables below, average income from different sources is presented for each of the pilot sites separately.

9.5.1 Average Income of Bareji Distributary Respondents

Average income from crops, livestock. labour, remittances and other sources stood around 43 thousand, 11 thousand, **24** thousand, 51 thousand, and 20 thousand rupees, respectively (Table **9.9).** The average total income stood at 50 thousand rupees per annum. The value of standard deviations is very high for all categories of income, indicating that there had been wide variations in income levels reported by different respondents. Total income varied between rupees **4** to 600 thousand rupees per annum between the poorest and the richest respondents.

Source	Reporting WUs	Mean	Std Dev	Minimum	Maximum
Crops	155	43.558	50.183	4,000	500,000
Livestock	61	11,328	16.782	1,500	100,000
Labor	15	24.280	20.175	7.000	90,000
Remittances	3	51,333	60,666	5,000	120.000
Other	5	20,400	12,096	5.000	36,000
Total Family Income	161	50,079	59.815	4,000	600,000

9.5.2 Average Income *of* Dhoro Naro Minor Respondents

Average income from crops, livestock, labour, remittance and other sources stood around **40** thousand, **9** thousand, 15 thousand, 33 thousand, and 35 thousand rupees. respectively (Table 9.10). The average total income stood at 51 thousand per annum. The value of standard deviations is very high for all categories of income, except for income from remittances, indicating that there had been wide variations in income levels of different respondents for categories other than remittances. Total income varied between rupees 3.9 to 760 thousand rupees per annum between the poorest and the richest respondents.

Table 9.10. Income of Respondents of Dhoro Naro Minor (Nawabshah) from Different Sources (in Rupees).

Source	N	Mean	Std. Dev	Minimum	Maximum
Crops	166	40,389	82,231	1,000	700,000
Livestock	51	9,573	16,531	500	100,000
Labor	32	15,246	14,270	1,000	54,000
Remittances	5	32,960	15,931	22,000	60,000
Other	13	35.108	30,337	6,000	96,000
Total Family Income	160	51,050	92,859	3.900	760,000

9.5.3. Average Income of Heran Distributary Respondents

The average income, as reported by the respondents at Heran Distributary, varied between 32 thousand, **13** thousand, 21 thousand, 29 thousand and 37 thousand from crops, livestock, labour, remittances and other sources, respectively (Table **9.11**). The average total income stood at **48** thousand per annum and ranged between 2.5 to 350 thousand rupees per annum.

Table 9.11. Income of Respondents of Heran Distributary (Sanghar) from Different Sources (in Rupees).

Source	N	Mean	Std. Dev	Minimum	Maximum
Crops	160	31,717	33,997	2,500	300,000
Livestock	81	12,624	13,344	1,000	60,000
Labor	44	20,625	14,187	3,000	50,000
Remittances	4	29,250	16,800	12.000	50,000
Other	17	36,588	21,809	9,000	84,000
Total Family income	159	47,935	44,294	2,500	352,200

The value of the standard deviations suggest that none of the income categories was consistent. This is also suggested by the wide ranges between the lowest and highest income groups in each category.

9.5.4. Average Income of Khadwari Minor Respondents

The aggregate average income of the respondents at Khadwari Minor ranged between rupees 5 to 95 thousand and comprised of an average of 16 thousand, 11 thousand, 5 thousand, 36 thousand and 26 thousand rupees of income from crops, livestock, labour, remittances and other sources, respectively (Table 9.12). Except for the income from labour, no other category was consistent as the standard deviations are very high.

Table 9.12. Income of Respondents of Khadwari Minor (Sanghar) from Different Sources (in Rupees).

S#	Source	N	Mean	Std. Dev	Minimum	Maximum
1	Crops	26	15,859	16,122	1,200	60,000
2	Livestock	15	11,280	15,319	1,000	55,000
3	Labor	4	4,750	500	4,000	5,000
4	Remittances	1	36,000	-	36,000	36,000
5	Other	2	26,000	19,799	12,000	40,000
6	Total Family Income	27	25,502	22,777	5,000	95,000

9.5.5 Average Income from Crops of Different Pilot Sites

There are considerable income differences among head, middle and tail farmers. The average income realized per acre from crop enterprise was almost double for the case of the head farmers of Bareji Distributary and Dhoro Naro Minor and it was even four times in the case of Khadwari Minor. At Heran Distributary, however, the average per acre income was slightly higher at the tail farms than either the head and middle locations. Average per acre income from crops was highest at Bareji (Rs 7700) and was almost 2 to 3 times of that at other sites. It was lowest at the Khadwari Minor (Table 9.13).

Table 9.13. Average per Acre Income from Crops at Various Pilot Sites by Location of the Farm (Rs. 000).

Farm Location	Districts and Pilot Sites			
	Mirpurkhas	Nawabshah	Sanghar	
	Bareii Distv	Dhoro Naro Minor	Heran Distv	Khadwar Minor
Head	10 65	**4 30**	1 9 5	2 57
Middle	6 **93**	2 95	**1 9 9**	1 **09**
Tail	6 **84**	1 9 6	2 15	0 **54**
Average	7 70	2 **94**	2 **03**	1 **08**

9.5.6. Average Total Income of Different Pilot Sites

The average incomes of the respondents from different sources are compared in Table 9.13. It is evident that the water users of Bareji Distributary had the highest average income from crops, labour and remittances compared with the other sites. The respondents from Heran Distributary had higher livestock income and income from other sources. The respondents from Khadwari Minor had the lowest income levels comparatively in all of the categories.

The total income (Table 9.14) reported by the water users of Bareji Distributary and Dhoro Naro Minor is higher as compared with others, followed by the respondents from Heran Distributary. The average total income at Khadwari Minor is the lowest and is almost half of the average income realized at the other sites.

Table 9.14 In Among F

Source of Income	Eareji Disty	Dhoro Minor	Heran Disty	Khadwari Minor
Crops	43558	4	31717	15859
Livestock	11328	9573	12624	11280
Labour	24280	15216	625	17
Remittance	33	32960	29250	36000
Other	20400	35108	36588	26000
Total	50079	51050	47935	25502

9.6 Prioritizing Factors for Increasing Productivity

The perceptions of the respondents were also obtained on the factors that are relatively more important for increasing per acre yield for various crops. The respondents were asked to rank three most important factors in order of priority. In the following sections, the results are presented for each pilot site.

9.6.1. Bareji Distributary

At Bareji Distributary, the respondents ranked increased canal water supply as the most important factor (Table 9.15). Approximately 39 per cent of the respondents ranked it first or second priority for increasing crop yields. Another 5 per cent of the respondents regarded it as the third most important factor for increasing crop productivity. Timely availability of chemical fertilizers was ranked by almost half of the respondents as priority

number 1,2 followed by priority for 38 percent of the respondents. According to 12 per cent of the respondents, it was the third most important factor contributing towards increased crop yields.

Better extension was also regarded as one of the most important factors by almost one-third of the respondents.

Particulars	Priority (Percent)			
	1	2	3	No Priority
More Canal Water Supply	28	11	5	56
Ensured Canal Water Supply	4	5	5	86
Improved Water Management Practices	2	6	11	81
Better Extension Services	3	12	15	70
Availability of good Quality Seed	4	8	5	83
Timely Availability of Chemical Fertilizer	19	19	12	50
Easy Availability of Credit Facility	3	5	5	87
Availability of Machinery on Subsidized Rates	2	5	5	88
Availability of Quality Pesticides	2	10	9	79

9.6.2 Dhoro Naro Minor

A majority of the respondents from Dhoro Naro Minor regarded more canal supplies as the single most important factor for raising crop yields. Another 7 per cent regarded it second or third priority. Another 21 per cent of the water users thought that ensured canal water supplies were the most important factor (Table 9.16).

To almost 44 per cent of the respondents, availability of good quality seed was regarded as the second most important factor to raise agricultural productivity. Apart from these factors, timely availability of chemical fertilizers, availability of quality pesticides and machinery on credit were also regarded important.

Table 9.16. Prioritizing factors for Increasing yield of Crops by the Respondents of Dhoro Naro Minor (N=168).

Particulars	Priority (Percent)			
	1	2	3	No Priority
More Canal Water Supply	60	4	4	32
Ensured Canal Water Supply	21	5	2	72
Improved Water Management Practices	1	0	2	97
Better Extension Services	1	4	4	91
Availability of good Quality Seed	9	44	21	25
Timely Availability of Chemical Fertilizer	2	24	32	42
Easy Availability of Credit Facility	1	4	8	87
Availability of Machinery on Subsidized Rates	4	7	12	77
Availability of Quality Pesticides	1	7	14	78

9.6.3 Heran Distributary

At Heran Distributary, timely availability of chemical fertilizers was the most important factor for raising agricultural productivity followed by availability of good quality seed, the more and ensured canal water supplies (Table 9.17). The factors such as improved water management practices, better extension services, credit availability and availability of good quality pesticides were regarded relatively less important. This may be ascribed to the fact that the water users are comprised of owner cultivators, who relatively have more cultivated area. They might have been able to meet their requirements.

Table 9.17. Prioritizing Factors for Increasing Yield of Crops by the Respondents of Heran Distributary (N=161).

Particulars	Priority (Percent)			
	1	2	3	No Priority
More Canal Water Supply	23	8	9	60
Ensured Canal Water Supply	20	10	9	61
Improved Water Management Practices	1	3	2	94
Better Extension Services	5	3	2	89
Availability of good Quality Seed	19	31	21	29
Timely Availability of Chemical Fertilizer	16	34	33	18
Easy Availability of Credit Facility	2	1	7	90
Availability of Machinery on Subsidized Rates	8	8	8	76
Availability of Quality Pesticides	1	2	8	89

9.6.4 Khadwari Minor

At Khadwari Minor, the most important factor to raise yields was regarded to be more canal water supply (Table 9.18). Nobody ranked this priority 2 or 3, indicating a high

demand for additional supplies. Timely availability of chemical fertilizers and availability *of* good quality seeds, along with availability *of* agricultural machinery at credit, were regarded the other most important factors.

Table 9.18. Prioritizing Factors for Increasing Yield of Crops by the Respondents of Khadwari Minor (N=27).

Particulars	Priority (Percent)			
	1	2	3	No Priority
More Canal Water Supply	74			26
Ensured Canal Water Supply	4	4		92
Improved Water Management Practices	-		4	**96**
Better Extension Services				100
Availability **of** good Quality Seed	11	15	37	37
Timely Availability **of** Chemical Fertilizer	-	37	30	33
Easy Availability **of** Credit Facility		7	15	**78**
Availability **of** Machinery on Subsidized Rates	11	**22**	4	63
Availability **of** Quality Pesticides		11	**7**	**82**

The respondents believed that better extension services will not do any good. Similarly, no scope for improved water management practices was perceived. They accorded no priority to reliability of the canal supplies. This indicates that perhaps they were not adequately aware of the question as adequacy and reliability are the problems that have been identified by the respondents as the major problems.

10. SUMMARY

10.1 Background and Objectives

In July **1995,** the International Irrigation Management Institute (IIMI) started an action research program in collaboration with the Department of Agricultural Engineering and Water Management of the Government of Sindh to launch three pilot projects on water users organizations in the LBOD project area with the prime objective of testing their viability in managing parts of the irrigation system. Then, based on the results of the pilot projects, recommendations were to be made for future extensions.

These pilot projects are to help organize farmers into Water Users Organizations (WUOs) in three selected distributary/minor canal command areas, one in each of the three LBOD districts. The selected pilot distributaries/ minors established on an agreed set of criteria were Bareji Distributary in Mirpurkhas District, Dhoro Naro Minor at Nawabshah District, and Heran Distributary at Sanghar District.

Each of the three pilot sites was of intermediate size, having 20 **to** 30 watercourses and a command area of about 5,500 hectares, with a manageable number of people.

The socio-economic baseline survey was designed as a starting point for the action research program at the three pilot sites. The results of the survey can help in designing the action research program with a better understanding of the project area, its problems and possible constraints, and.can also provide some verifiable indicators that can be monitored and tested during the implementation and after completion of the pilot projects.

10.2 Methodology/Design

A purposive sample was chosen that would consider all necessary aspects of the pilot area. Afler discussions among the staff, it was decided that a two-stage stratified systematic random sample would be designed to identify the target group that would be interviewed on a recall basis on a well designed and pre-tested structured interview schedule. The Social Organization Field Teams at the three pilot sites were **to** act as enumerators.

In total, 9 watercourses from each distributary/ minor were selected in such a way that there was an equal representation of the head, middle and tail reaches. Besides, one watercourse from each of the three reaches of Khadwari Minor was selected because it is almost an additional irrigation sub-system served by the Heran Distributary. Thus, the total sample size comprised of 30 watercourses with 50% coverage of the water users on each watercourse, yielding a total sample size of 530 water users.

Several problems were faced during the actual conduct **of** the survey. Non-availability of the respondents at the time of visit of the field staff was one of the major problems. The solution was sought by paying two to three visits at the **site** for interviewing the respondent. Yet, Four of the respondents could not be traced and interviewed till the end of the survey, which were discarded from inclusion in the survey. Similarly, engagement of water users in cultivation of the cotton crop during that time was another problem. This problem was resolved by paying visits in the evening *to* the water users who were unavailable during the day time.

Another problem encountered was due to the cultural set-up of the pilot area. A number of absentee landlords and other landowners, who were not the water users, objected to having their tenants interviewed. Some of the tenants could not respond to questions on crop yields as the production was taken away by the landlord and was weighed by him. Such tenants were informed by their landlord about their own shares only. Being an interview on a recall basis, the responses *to* some questions were difficult *to* remember for the water users. They only responded in hunches and crude estimates to such questions. The duration of the interview was recorded as being almost two hours initially, which was boring for the water users. Sometimes, the water users had the tendency to respond indirectly with a story as a pre-text. Later, however, the enumerators gained experience and the interview duration was reduced.

The questionnaire was pretested and the teams were trained. The survey was launched during March 1996 *to* June 1996. The reference period were Rabi 1994-95 and Kharif 1995.

10.3 General Characteristics **of** the Respondents

The average age of respondents stood around 40 years in all of the pilot sites. The composition of various age groups revealed that a maximum of the water users were between 31 to 60 years of age.

The experience in irrigated agriculture for the water users ranged between 20 to 30 years on average. This indicates that the average age at the time of entry into the occupation stands at 15 to 20 years.

Most of the respondents on all the pilot sites were married. In the socio-cultural context of rural Sindh, a male cannot stay unmarried for long afler adolescence.

The tendency to become a farmer seems highly dependant upon the father's occupation. Most of the farmers were farmer's sons. Only about one out of every 10 respondents was an offspring of a non-farmer.

A majority of the respondents at the three pilot sites were illiterate, Khadwari being an exception. The average number of school going children is also very low, indicating future illiteracy levels will not decline significantly.

The average family size ranged between 8 to 13 in the pilot area. A majority of the respondents at Bareji Distributary were non-muslims, while at other pilot sites, the majority of them were muslims.

The mean number of full-time family workers engaged in farming ranged between 2 to 4, while there were 1 to 2 additional part-time workers from the family members engaged in farming.

A majority of the respondents were tenants at Bareji. Dhoro Naro and Heran sites, whereas a majority of the respondents at Khadwari Minor were owner Operators.

Average operated area of the respondents varied between 7 to 20 acres at different sites, out of which they owned 5 to 15 acres and the rest of the area had been leased/ rented in. Both the average area operated and owned were higher at Khadwari Minor, comparatively because of a higher tendency of self cultivation by the owner operators.

10.4 Irrigation Sources and Practices

Canal water is the only irrigation source at the pilot sites. The conjunctive use of canal and tubewell is very low due to unfit groundwater. Most of the respondents from Sanghar and Nawabshah were of the view that the water availability was not sufficient, while almost half of the respondents at Bareji Distributary were found satisfied with present sources of irrigation for the crop water requirements.

According to a majority of the respondents at all sites, the canal water was sufficient for rabi crops but was insufficient for kharif crops. Most of the respondents from Khadwari Minor, nonetheless, reported that it was insufficient during both of these seasons.

To a majority of respondents at Bareji and Dhoro Naro, they were satisfied with the water distribution at the watercourse, whereas a majority of the respondents at Heran and its Khadwari Minor had mixed feelings about this. Those who were not fully satisfied with water distribution opined that both the government and a farmer's organization can improve this situation by a joint effort.

The basin method of irrigating the fields was popular among the majority at Heran Distributary, Dhoro Naro and Khadwari minors, while a combination of basin and furrow methods was popular at Bareji Distributary. Wild flooding was not being practiced, probably because of levelling problems in the field and consequent expected losses of water.

Although a majority of the water users had officially fixed water turns, at Bareji the respondents expressed that it was not being followed, most probably because of a high concentration of tenants and servants in farming and because the decision to distribute water is not under their jurisdiction. The water distribution in such cases is undertaken by the zamindar. himself, or his kamdar.

The average time allocated per acre for canal water varied between 15 to 21 minutes, while the water users reported that the actual time needed to irrigate an acre was 4 to 8 times higher. This means that each acre receives water on average after at least four weeks.

Regarding the maintenance of the irrigation system, the respondents had mixed feelings. The majority of the respondents from Dhoro Naro and Khadwari minors were not satisfied with the present maintenance condition of the system. Slightly less than half of the water users of the Bareji Distributary farmers were satisfied to a large extent and the majority of the Heran Distributary were satisfied to some extent with the maintenance of the irrigation system.

10.5 Irrigation System Performance

Their perceptions regarding the role of proper irrigation management on crop yields were that due to proper management of irrigation at the field, the yields of crops would increase.

Most of the respondents also claimed that they were aware of the proper requirement of irrigation water for different crops. The proportion of people who were unaware was almost negligible.

An overwhelming majority of the respondents regarded water distribution on the watercourse level as equitable. At the Khadwari Minor, however, one-third of the respondents regarded water distribution as inequitable.

The respondents had mixed feelings regarding equity among different watercourses served by the distributary. At Bareji, one-fiflh of the respondents believed that there was no equity, while more than two-fifths believed that irrigation water was equitably distributed among different watercourses. Almost one-third of the respondents were those who perhaps were unsure, or did not want to respond.

Over three-fourths of the respondents at Dhoro Naro and more than half at Khadwari minors did not regard water distribution within the distributary as equitable and conversely 77 per cent of the respondents at the Heran Distributary viewed water distribution among different watercourses of the distributary to be equitable,

Almost half of the respondents at Heran Distributary were of the view that the water was equitably distributed among various distributaries/ minors, and conversely, a majority of the respondents from its Khadwari minor opined that it was not. Almost three-fourths of the respondents from Dhoro Naro Minor also shared views similar to the majority of respondents from Khadwari Minor. At Bareji Distributary, a majority **of** the respondents did not know about water distribution among distributaries.

In general, the respondents saw an increasing equity in water distribution as their evaluation shifted from the branch canal through the distributary/minor to the watercourse. Many did not know much about the situation within the branch canal (between the distributaries), but generally acknowledged the inequity within the distributary (between the watercourses).

During kharif, more water users missed their turns. The proportion of such water users varied between **71** per cent at Heran Distributary to 90 per cent at Dhoro Naro Minor. Similarly, during rabi, the proportion of those water users who missed their turn ranged between 58 per cent at Dhoro Naro Minor to **91** per cent at Bareji. Thus, the conclusion can be made that form majority of the farmers, water availability is unreliable. The incidents of water stealing are only far and few between.

A majority of the farmers at Bareji Distributary exchanged their water turns, whereas in the other sites, the farmers did not engage in any exchange. **A** large majority of the respondents neither purchased nor sold water turns during either of the seasons. Similarly, the practice of stealing water from the watercourse during somebody else's water turn was rare.

10.6 Collective Action **and** Institutional Development

A majority of the water users at Heran Distributary knew that a WUA was formed at their watercourse. In all other sites, the water users believed that there was no WUA at their watercourse. This sounds surprising, but is justified as the number of WUAs at Bareji Distributary and Dhoro Naro Minor are very less. All of those who responded that there was no WUA on their watercourse were not the members of the WUA. The highest proportion of WUA member respondents was at Heran Distributary (21%). Others might have not been involved due to tenancy and size of cultivated area considerations. Only a small proportion of the respondents were aware of a WUA on other watercourses of the village or outside the village.

The level of collective action among the water users is quite high at all of the three pilot sites, particularly as reflected in their contribution towards the maintenance of watercourses; almost all of them participated in maintenance of the watercourse. The majority of the respondents at Bareji and Heran distributaries as well as Khadwari Minor, and about half of the respondents at Dhoro Naro Minor, were involved in the maintenance of the distributary/ minor as well. The involvement of the respondents in

collective solutions of the disputes related to land and water ranged between one-fifth at Khadwari Minor to over half at Dhoro Naro Minor. Since water and land disputes are of different kinds and nature, some can be solved within the community and many others cannot, so the involvement was low compared to maintenance of the watercourse and distributary.

Maintenance and construction of the village mosque is another collective activity that was performed by the water users at all of the three pilot sites. The degree of participation ranged between 31 per cent at Bareji Distributary to 97 per cent at Heran Distributary. Participation in collective maintenance of the village school was also noticeable. This was, nevertheless. lowest at Dhoro Naro, where only around 6 per cent of the respondents participated. At Heran Distributary, four respondents out of every five were involved in collective maintenance of the village school. The activities that were not. but could be undertaken by the respondents collectively were collective purchase of agricultural inputs and disposal of the marketing surplus of the produce realized at their farms.

An overwhelming majority of the respondents were aware of some organization catering to development works in their area. This awareness was lowest at the Dhoro Naro Minor. For the rest of the three distributaries/ minors, the awareness was as high as around 97 per cent.

Many of the respondents, themselves, were involved in that organization as initiating members of the organization. The proportion of such respondents ranged between roughly 27 per cent at Bareji to 67 per cent at Khadwari.

An overwhelming majority of the respondents showed their willingness towards working for development with people. The proportion of such respondents was higher than 92 per cent of the total at all the pilot sites.

A vast majority showed their willingness and readiness to contribute labour and affordable money for such an organization. The level of willingness varied between 85 per cent at Dhoro Naro Minor to 100 per cent at Khadwari Minor.

A majority of the respondents wanted to form a water users association. Low response at Heran Distributary can be attributed to the fact that some of them are already members, and for the rest of them, it is not applicable. On the contrary, there are very fewer numbers of already established WUAs at Bareji Distributary and Dhoro Naro Minor, who are more interested to form a WUA.

Though many of the respondents did not have a formal exposure to an organized effort for solution of common problems, but they have knowledge and are willing to form, federate and sustain water users organization as they showed a willingness to even contribute funds for financial liabilities of the organization.

10.7 *Waterlogging and Salinity Management*

An overwhelming majority of the respondents believed that land levelling is a crucial factor for optimizing the utilization of water. Nine out of ten respondents were unaware of precision land levelling. Over 10 per cent of the respondents from Dhoro Naro Minor were familiar with precision land levelling, which was the highest proportion among all of the pilot sites.

In general, the quality of groundwater was regarded not suitable for irrigation purposes. A majority of respondents claimed that they had knowledge about the depth to water table in their respective areas. The proportion of the respondents who responded positively ranged between almost **90** per cent in Dhoro Naro and Khadwari minors to **98** per cent at Heran Distributary.

The average farm area affected by waterlogging and salinity varied between almost 2.5 acres **(19** and **12** % of the mean area operated, respectively) at Dhoro Naro and Khadwari minors to over 4 acres (52 and 24 per cent of the mean area operated, respectively) at Bareji and Heran distributaries. There are high variations among various responses regarding area affected within each distributary/ minor.

To most of the respondents, the ground water table has dropped during the last two years. The extent of reported water table drop varied between around one foot at Bareji Distributary to about four feet at Dhoro Naro Minor. The reported figures, nevertheless. varied among different respondents of the same distributary to a great extent as the respective standard deviations are quite high. The responses from Khadwari Minor, however, about reported water depth can be regarded quite consistent as the standard deviations are less than half of the mean.

At the Bareji Distributary in Mirpurkhas, a majority of the respondents *(66%)* used grass to control waterlogging and salinity. Cultivation of rice for leaching salts is another common practice adopted by one-quarter of the respondents. Use of gypsum and plantation of salt resistant trees are, however, not yet so popular. At the Dhoro Naro Minor in Nawabshah. none of the salinity control measures is frequently practiced; only **16** per cent of the respondents cultivated grass to control salinity. Among the respondents from Heran Distributary, the cultivation of grass, rice and planting trees are somewhat popular as 42 per cent, 32 per cent, and 27 per cent of the water users were using these measures, respectively. At Khadwari Minor of the Heran Distributary, almost every fifth respondent planted trees and/ or cultivated rice for lowering the water table and minimizing salinity, while every ninth respondent was reported using gypsum for reclaiming the land.

10.8 Drainage System Performance

Almost all of the respondents were familiar with the drainage system in the project area. Although every fourth respondent at Dhoro Naro Minor and every tenth respondent at Bareji was unaware of the drainage system, yet all of them believed that drainage will help in increasing crop yields. Whereas 1, 6 and 4 per cent of the respondents were unsure about this at Bareji Distributary, Dhoro Naro Minor and Heran Distributary, respectively.

Almost all of the respondents at all of the pilot sites regarded drainage equally important for the land to save it from the twin menace of waterlogging and salinity and a great majority shared the view that if properly operated and well maintained, it will be beneficial for the lands in the area.

They also had an opinion that drainage is important for saving the land from waterlogging and salinity and that drainage should be maintained and operated properly and regularly.

A majority of the sampled water users are of the view that operation and maintenance of the drainage system is the responsibility of the government. Nevertheless, one-third of the respondents at Bareji Distributary and Dhoro Naro Minor and one-fourth of those at Khadwari believed that it was either the responsibitity of the farmers, themselves, or a joint responsibility of the government and the users.

Roughly three out of four respondents were willing to provide services / money for operation and maintenance of the drainage system. The highest level of willingness was shown by the respondents from Khadwari minor (89%), followed by those of Heran Distributary *(83%).* those of Bareji Distributary (79%), while the lowest were those of Dhoro Naro Minor (73%).

Furthermore, they were also willing to maintain the drainage system through their organizations. The level of willingness oscillated between *89* per cent at Heran Distributary to *68* per cent at its Khadwari Minor.

10.9 Farm Resource Production Practices, Productivity and Income

Among the three pilot sites, respondents from Heran Distributary and its Khadwari Minor had the maximum concentration of tractors and threshers (16 and 7, respectively). Water users of Dhoro Naro Minor at Nawabshah enjoyed a monopoly in possessing seed drills *(3* only) and had more rotavators.

The respondents from Dhoro Naro minor had more livestock compared with the other pilot sites.

Almost an equal number of respondents cultivated cotton at Bareji and Dhoro Naro. but in terms of area sown, the area at Dhoro Naro was more than double than that of Bareji. More planted area was destroyed at Dhoro Naro, too. The seed rate used was also high at all sites except for Bareji, where the average use of seed was near the recommended level, More expenditures were incurred per acre of crop at Bareji and, resultantly. they harvested more cotton per acre that was almost double than that of Dhoro Naro Minor. It appears that the farm productivity for cotton is more or less directly related to expenditure incurred per acre of crop.

A maximum number of water users had sown wheat at Heran Distributary and Dhoro Naro Minor compared to other sites and the area planted was also more. More area was destroyed at Bareji Distributary. The quantity of seed used per acre was highest at Bareji Distributary. Expenditures incurred per acre was highest at Khadwari Minor, but the yield was lowest. In this case, the yield seems inversely responding to the total expenditure incurred per acre.

More number of respondents at Heran Distributary had cultivated sugarcane and planted more acreage compared to other sites. **At** Bareji, more area was destroyed, which also led the Figure for seed rate used and total expenditures incurred per acre of crop. The yield was also higher at Bareji Distributary compared to other pilot sites.

The average incomes **of** the respondents from different sources show that the water users of Bareji Distributary had the highest average income from crops, labour and remittances compared with the other pilot sites. The respondents from Heran Distributary had higher livestock income and income from other sources. The respondents from Khadwari Minor had the lowest income levels comparatively in all of the categories.

The total income reported by the water users of Bareji Distributary and Dhoro Naro Minor is higher compared **to** others followed by the respondents from Heran Distributary. The average total income at Khadwari Minor is the lowest and is almost half of the average income realized at other sites.

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Annex **1.** Questionnaire for Socio-Economic Baseline Survey

IIMI **SOCIO-ECONOMIC BASELINE SURVEY FOR PILOT PROJECT FOR FARMER-MANAGED IRRIGATED AGRICULTURE UNDER LEFT BANK OUTFALL DRAINAGE (LBOD) STAGE I PROJECT, SINDH, PAKISTAN**

Name of the interviewer _____

Respondent's Code No. _____

Date of interview _____

Time started: _____ Finished: _____

Village & Deh _____

Watercourse No. _____

Farm location on the W/C. **1)** Head, 2) Middle, 3) Tail _____

Distributary/Minor _____

Characteristics **of** the Respondent

1. Name of the respondent _____

2. Father's name _____

3. Caste/Sub-caste [ ]

4. Age (Years) _____

5. Marital status _____
[Married=1, Single=2, Widower/Widow=3] [ ]

6. Father's occupation
[Same as respondent=1, Other=2] [ ]

7. Educational level

i.	Illiterate	ii.	Primary
iii.	Middle	iv.	Matric
v.	F.A/F.Sc	vi.	B.A/B.Sc
vii.	M.A/M.Sc	viii	Any other(Sp)_____ [ ]

8. Religious Muslim ------- Non-Muslim ---------

9. **Respondent's Family**

Particular	< 5 years			5-15 years			>15 years			Grand Total		
	M	F	T	M	F	T	M	F	T	M	F	T
Number of members												
How many are at school?												
How many are working at farm a. Full time												
b. Part time												

Irriaation Practices

10. Years of experience with irrigated agriculture _____ years

11. Source of irrigation for your land in this watercourse.

1. Canal
2. Public tubewell
3. Private tubewell
4. Canal + private tubewell
5. Any other **(Sp)** _____

12. To what extent the overall water you get to fulfills you irrigation requirement?

1. Not at all
2. *To* some extent
3. To large extent
4. Any other **(Sp)** _____

If answer is i or ii, then ask how do you overcome this crop water deficiency? _____

_____

13. Irrigation method.

1. Basin
2. Furrow
3. Wild flooding
4. Basin+Furrow _____

Water Manaqernent

14. Kind of warabandi.
    1. Kacha
    2. Pakka [ ]
    3. No warabandi practice

15. Who determines warabandi

    1. Irrigation Department
    2. Mutual arrangement by farmers
    3. Any other (Sp) _____ [ ]

16. How much time is allocated to you per acre? _____

17. What is the timing of your water turn at this watercourse?

    From _____ to _____ Day _____

18. How much time it takes to irrigate one acre of land (on an average) at your watercourse? _____ minutes/acre

Irriqation System Performance

19. Do you think that irrigation water is equitably distributed among distributaries ? Yes/No
    [Yes=2, No=1, Don't Know=9] [ ]

    If no, why?. _____

    _____

20. Do you think that irrigation water is equitably distributed within the distributary command area ? Yes/No
[Yes=2, No=1, Don't know=9] [ ]

If no, why? _____
_____

21. Do you think that water is equitably distributed within your watercourse? Yes/No
[Yes=2, No=1] [ ]

22. Was canal water sufficient for the crops you cultivated in last Kharif season? Yes/No [Yes=2, No=1, Did not Cultivate=9]

_____

23. Was canal water sufficient for the crop you cultivated in last Rabi season? Yes/No
[Yes=2, No=1, Did not Cultivate=9]

_____

24. To what extent are you satisfied with the present distribution of water at watercourse level?

1. Not all
2. To some extent
3. To large extent

If not at all, who can improve water distribution?

1. Government agency
2. Farmers organization
3. Both
4. Any other (Sp) _____ [ ]

25. Do you believe that due to proper management of irrigation at your field, the yield of crops would be increased? Yes/ No
[Yes=2, No=1] [ ]
If no, what are the reasons?

_____
_____

26. Do you know the requirement of proper irrigation water for different crops? Yes/ No [Yes=2, No=1] [ ]
How you measure the requirement of water for different crops?

_____
_____

27. Water Transactions

Statement	Yes/No [Yes=2, No=1, Not Applicable=9]	Kharif (No.)	Reason
1. Did you miss your water turn(s) during last kharif season?			
2. Did you exchange irrigation turn during last kharif season?			
3. Did you purchase water during last kharif season?			
4. Did you sell water during last kharif season?			
5. Was water stolen from your turn during last kharif season?			

Statement	Yes/No [Yes=2, No=1, Not Applicable=9]	Rabi (No.)	Reason
1 Did you miss your water turn(s) during last Rabi season?			
2. Did you exchange irrigation turn during last Rabi season7			
3 Did you purchase water during last Rabi season?			
4 Did you sell water during last Rabi season?			
5. Was water stolen from your turn during last Rabi season?			

Institutional Development

28. Is WUA formed at your watercourse? Yes/No [Yes=2, No=1, Don't know=3]

If no, ask **Q. 36**

29. If yes, are you a member of this WUA ? Yes/No [Yes=2, No=1, Not Applicable=9]

State reason(s) to support your answer.

_____

30. How many are the members of this WUA? [Not Applicable=99]

31. How many are the members of the Executive Committee? [ ]

_____

32. How the members of the Executive Committee are selected?

_____

33. Are you satisfied with the members of Executive Committee? Yes/No [Yes=2, No=1] [ ]

State reason(s) to support your answer.

_____

34. Who contributed for improvement of W/C?

1. Government _____ [ ]
2. Farmers _____
3. Both _____

35. Has the WUA been useful to you ? Yes/No [Yes=2, No=1] [ ]
If yes, how? _____

_____

If no, what in your view is lacking in WUA?

_____

_____

36. What activities has the WUA undertaken?

1. _____

2. _____

3. _____

37. Is there any WUA in your village or outside village?
Yes/No/Not applicable
[Yes=2, No=1, Not applicable=9] [ ]

If yes, how the WUA is useful to its members?

_____

_____

If no, would you like to have WUA at your W/C?
Yes/No/Not applicable
[Yes=2, No=1, Not applicable=9] [ ]

38.Organizational Behavior

Areas of Collective Action	Yes/No [Yes=2, No=1, Not Applicable=9]	If yes, how do you perform this action?
a. Maintenance of W/C		
b. Maintenance of distributary/minor		
c. Land and water disputes		
d. Purchase of inputs		
e. Marketing of crop produce		
f. Maintenance/ construction of village mosque		
g. Maintenance/ construction of village school		
h. Maintenance/ construction of village street/road		
i. Any other (sp)		

39. To what extent are you satisfied with the maintenance of irrigation system? [ ]

1. Not at all
2. To some extent
3. To large extent

State reason to support your answer

_____

_____

40. Identify the problems related with operation and maintenance of irrigation system and the institutions responsible for the problems?

Problem	Institutions				
	PID	OFWM	Revenue Dept.	Farmer Comm.	Legislator
1 Inequity					
2 Unreliability					
3 inadequacy					
4 (a) Maintenance at W/C					
(b) Maintenance at Distributary					

Farmer's Perceptions

41. How many times the following agents or representatives *of* the agencies have visited vnur farm or vou visited them durina last two seasons?

Agent	Times (0 or other number]		What Benefit did you get?
	Agent	Respondent	
1. Agriculture Extent agent			
2. Fertilizer company agent			
3. Pesticides company agent			
4. OFWM representative			
5. Mobile credit officer			
6. PID representative			

42 Tenancy status (This refers only *to* Ihe land in this watercourse) [ ]

1. Owner-Operator
2. Tenant (share cropper)
3. Lessee (on cash)
4. Owner-Operator-cum-Tenant
5. Owner-Operator cum-Lessee
6. Owner-Operator-cum-Lessor
7. Tenant-cum-Lessee
8. Owner-Operator-cum-Tenant-cum-Lessee
9. Land Owner-cum-7enant
10. Land Owner
11. Owner Operator-cum-Tenant-cum-Lessor

Particulars	Total Area			Cash rent/ Rate
	A	B	Total	
1. Total Area you own				
2. (a) Area you operate as tenant (share cropper)				
(b) Area you operate as Lessee (cash)				
(c) Total (2a+2b)				
3. (a) Area you have given out Io Tenant (share cropper)				
(b) Area you have given out to Lessee (cash)				
(c) Total (3a+3b)				
4. Area operated (1+2c-3c)				

Statement	Yes/No [Yes=1, No=2]
I Do you own tractor?	
2. Do you own following modern equipments?	
a. Thresher	
b. Seed drill	
c. Rotavator	
d. Reaper	

Soil *and Water Status*

45. Quality of ground water. [ ]

1. Fit for irrigation
2. Marginally fit for irrigation
3. Unfit for irrigation
4. Don't Know

46. Waterlogging and salinity

Number of acres of your land in this watercourse affected by waterlogging and salinity _____ [ ]

47. Method(s) used for reclamation of your land?

Action	Waterlogging and salinity Yes/No [Yes=1, No=2]
a. Action taken	
b Use gypsum	
c. Grow grass	
d. Plant trees	
e. Rice cultivation	
f. Any other (sp)	

48. Do you know the depth of Watertable of your land? Yes/No [Yes=2, No=1] 1 1

If yes, how much depth of watertable is now-a-days _____ [ ]

And how much depth of watertable was 2 years ago _____ [ ]

State reason(s) to support your answer.

_____

_____

CROP, AGRICULTURAL PRACTICES AND INPUTS

49. Cropping pattern, production and marketing:

Season/crop	Area sown (ac)	Area destroyed (acre)	Seed used/ac	Total production (mds)	Price Rs/40 Kg	Total exp/acre
KHARIF						
Cotton						
Sugarcane						
Rice						
Maize						
Fodder						
Orchard						
Vegetable						
RABI						
Wheat						
Gram						
Fodder						
Oil seed						
Orchard						
Vegetable						

50. Name three main factors (priority wise), from the followings, which help in increasing yield per acre?

Factors	Priority
More canal water supply	
Ensured canal water supply	
Improved water management practices	
Better extension services	
Availability of good quality seed	
Timely availability of chemical fertilizer	
Easy availability of credit facility	
Availability of machinery on subsidized rates	
Availability of quality pesticides	

Livestock	Number
Bullocks	
cows	
Camels	
Buffaloes	
Sheep	
Goats	
Donkeys	
Horses	
Poultry	

52. Estimated Family Income (per year)

Income from **crop** _____
Income from livestock _____
Income from labor (from outside farm) _____
Remittances _____
Any other _____
Total family income _____

Land Management

53. Do you level your land properly to optimize the utilization ***of*** water level? Yes/ No [ ]
[Yes=2, No=1]

If no, what are the reasons?

_____

_____

54. Have you heard about precision land levelling? Yes/ No [
[Yes=2, No=1]

If yes, how do you know?

_____

_____

_____

_____

Drainage Management

55. Are you familiar with the drainage system in your area? Yes/ No [ ]
[Yes=2, No=1]

If yes, what you know about ***the*** system?

_____

_____

56 Do you believe that due to availability *of* drainage system, the yield of crops would be increased? Yes/ No
[Yes=2, No=1] [ ]

If no, what are the reasons?

_____

_____

57, Do *you* think the drainage is equally important **for** your land **to** save from waterlogging and salinity? Yes/ No
[Yes=2, No=1] [ ]

If no. what are the reasons?

_____

_____

58. Do you think the drainage would give you benefit continuously **if it is** maintained and operated properly? Yes/No
[Yes=2, No=1] I 1

If no, what are the reasons?

_____

_____

59. Are you willing to give your services and or pay contribution **if** needed, while maintaining and operating the drainage system Yes/ No
[Yes=2, No=1] [ ]

If no, what are the reasons?

_____

_____

60. Whal do you think the maintenance and operation of drainage is the responsibility **of:**

1. Government agency
2. Farmers organization
3. Both
4. Any other (Sp) _____ [ ]

Willingness towards formation of Organization

61. **Do** you know that organization **of** people work effectively for the development work? Yes/ No
[Yes=2, No=1] [ ]

If yes, how you perceive the formation of organization?

_____

_____

62. Are you willing to work with the people for any kind of development?Yes/No
[Yes=2, No=1] [ ]

If yes, how you perceive your willingness in the organization?

_____

_____

63. Have you personally initiate such kind of association or involve in membership of association in your area? Yes/ No
[Yes=2, No=1] [ ]

If yes, please explain about the formation of organization

_____

_____

64. Are you willing to contribute your labor or in case affordable money towards the work to be carried out by the organization for the development **of** your area? Yes/No
[Yes=2, No=1] 1 1

If no, what are the reasons

_____

_____

65. What kind of advantages you perceive by organizing farmers at distributary/ minor level?

_____

_____

66. Do you think that the members of WUA can form the WU Federation at the distributary/ minor level for its maintenance and operation? Yes/ No
[Yes=2, No=1] [ ]

If no, what are the reasons?

_____

_____

67. Are you willing to give your services and or pay contribution if needed, while maintaining and operating the irrigation system at distributary/ minor level Yes/ No
[Yes=2, No=1] [ ]

If no, what are the reasons?

_____

_____

68. Are you willing to maintain the Drainage system through your formed organization Yes/No
[Yes=2, No=1] [ ]

If no. what are the reasons?

_____

_____

Annex 2. Profile of Watercourses at Bareji Distributaw (Mirpurkhas)

	Watercourse #	RD of Mogha	Design Discharge (cusecs)	Design Culturable Command Area(ac.)	Design Water Duty (cusecs/ 1000 ac)
	22911L	00 + 500	2.1	685	2.93
	24011R	00 + 500	0.69	254	2.71
	240/1AR	01 + 750	0.69	248	2.78
4	239/2R	04 + 900	0.97	347	2.80
5	239/2AR	04 + 900	2.32	829	2.80
6	228/1L	05 + 700	2.26	873	2.59
7	240/2R	06 + 700	1.74	601	2.90
18	240/3R	11 + 500	1 29	481	2.68
9	228/1AL	11 + 500	I.a8	670	2.80
10	228/2L	12 + 100	0.39	144	2.70
11	22711AL	12 + 100	4.36	1590	2 74
12	22711L	13 + 100	1.83	661	2.77
13	22611L	14 + 000	1.44	523	2.75
	226/2L	17 + 300	1.63	583	2 80
	22511L	20 + 000	1.54	547	2.82
	239/3R	22 + 900	0.38	136	2.79
	238/2R	25 + 100	2.25	777	2.89
	23811R	25 + 100	1.27	451	2.82
	10L	27 + 000	0.94	722	1.30
	23711R	29 + 200	1.18	294	4.00
	225/2L	30 + 300	0.52	339	1.53
	22411L	33 + 500	0.56	354	1.58
	23611AR	36 + 000	2.26	807	2.80
	13L	39 + 310	1.51	647	2.33
A V E R A G E			1500	565 125	2.650

S. No.	Watercourse #	RD of Mogha	Design Discharge (cusecs)	Design Culturable Command Area(ac.)	Design Water Duty (cusecs/ 1000 ac)
1	22911L	00 + 500	2.1	605	2 93
2	24011R	00 + 500	0.69	254	2.71
3	240/1AR	01 + 750	0.69	248	2.70
4	239/2R	04 + 900	0.97	347	2.80
5	239/2AR	04 + 900	2.32	829	2.80
6	22811L	05 + 700	2.26	873	2.59
7	240/2R	06 + 700	1.74	601	2.90
8	240/3R	11 + 500	1.29	481	2.68
9	228/1AL	11 + 500	188	670	2.80
10	228/2L	12 + 100	0.39	144	2.70
11	227/1AL	12 + 100	4.36	1590	2.74
12	227/1L	13 + 100	1.a3	661	2.77
13	22611L	14 + 000	1.44	523	2.75
14	226/2L	17 + 300	1.63	583	2.80
15	22511L	20 + 000	1.54	547	2.82
16	239/3R	22 + 900	0.38	136	2.79
17	238/2R	25 + 100	2.25	777	2.89
18	238/1R	25 + 100	1.27	451	2.82
19	10L	27 + 000	0.94	722	1.30
20	23711R	29 + 200	1.18	294	4.00
21	225/2L	30 + 300	0.52	339	1.53
22	22411L	33 + 500	0.56	354	1.58
23	236/1AR	36 + 000	2.26	807	2.80
24	13L	39 + 310	1.51	647	2.33
TOTAL			36	13563	63 61
AVERAGE			1 500	565 125	2.650

S. No.	Watercourse No.	RD of Mogha	Design Discharge (cusecs)	Design Culturable Command Area (ac.)	Design water Duty (cusecs/ 1000 ac)
1	1R	2+000	1.40	327	4.28
2	1DL	3+750	1.45	388	3.73
3	2R	5+700	1.59	436	3.64
4	1L	6+925	1.62	563	2.87
5	3R	8+981	1.46	406	3.59
6	1AL	10+250	1.76	574	3.06
7	1BL	11+000	3.35	862	3.88
8	1CL	11+000	2.86	788	3.62
9	2L	11+000	2.02	695	2.90
10	4R	12+960	3.46	1167	2.96
11	2AL	12+980	1.44	485	2.96
12	3L	13+660	1.76	560	3.14
13	4L	14+946	1.01	351	2.87
14	48L	15+276	1.43	454	3.14
15	5R	18+801	1.17	405	2.88
16	4AL	18+942	0.24	216	2.89
17	6R	22+760	0.63	83	2.91
18	5c	24+170	1.88	216	2.97
19	6AR	24+386	0.52	631	2.90
20	6L	27+526	2.46	179	2.90
21	7R	29+500	1.02	847	2.88
22	7L	31+596	2.01	353	2.92
23	9L	31+795	2.11	688	2.89
24	10L	32+275	2.38	729	2.90
25	11L	32+275	0.83	820	2.88
	A V E R A G E			288	3.1424

S. No	Watercourse #	RD of Mogha	Design Discharge (cusecs)	Design Culturable Command Area(ac.)	Design Water Duty (cusecs/ 1000 ac)
1	1L	2 + 640	0.84	233	3.61
2	2R	4 + 400	0.54	228	2.37
3	3L	7 + 000	1.15	310	3.71
4	5L	7 + 180	1.91	454	4.21
5	4R	9 + 290	3.15	960	3.28
6	6L	10 + 000	1.96	520	3.77
7	7L	10 + 000	2.09	575	3.64
8	9AR	11 + 090	1.43	444	3.22
9	*8L*	11 + 900	1.69	421	4.01
10	9R	13 +070	3.20	854	3.75
11	8AL	16 + 700	1.10	291	3.78
12	10R	17 + 350	2.11	566	3.73
13	11+12R	18 +770	4.40	1186	3.71
14	13R	20 + 810	1.93	517	3.73
15	14L	21 + 830	1.13	304	3.72
16	15L	24 + 990	1.15	316	3.64
17	16R	26 + 050	2.83	759	3.73
18	17AL	26 + 720	2.00	588	3.40
20	17BL	30 + 951	1.87	491	3.81
21	18R	30 + 951	2.20	522	4.21
22	17AT	32 + 000	3.60	707	5.09
23	18AT	32 + 000	3.19	633	5.04
TOTAL			47.32	12379	86.86
AVERAGE			2.06	538.22	3.78

S.#	Watercourse #	RD of Mogha	Design Discharge (cusecs)	Design Culturable Command Area(ac.)	Design Water Duty (cusecs/ 1000 ac)
1	IAL	7 + 000	1.02	367	2.78
2	1L	9 + 000	0.83	384	2.16
3	2R	11 + 000	2.06	557	3.70
4	3L	17 + 000	1.28	375	3.40
5	4R	17 t 000	2.62	655	4.00
6	5T	17 + 000	1.64	439	3.74
7	6T	17 + 000	1.07	288	3.72
TOTAL			10.52	3065	23.5
AVERAGE			1.503	437.86	3.357

Annex *6.* List **of IIMI** Staff **Wh** Contributed to the Baseline Survey

S.#	NAME	DESIGNATION	STATION
1	Dr Yameen Memon	Sociologist & Team Leader	Hyderabad
2	Mr. Avaz Solangi	Purchaser	Hyderabad
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4	Mr. Mohammad Iqbal	Driver	Hyderabad
5	Mr. Warvam Baloch	Supervisory Social Orqanizer	Mirpurkhas
6	Mr. Ghulam Mustafa Talpur	Social Oraanizer	Mirourkhas
7	Mr. Muhammad Nadeem	Social Organizer	Mirpurkhas
8	Mr. Munawar Hussain Memon	Fi :se Assistant	Mirpurkhas
9	Mr Wali Mohammad Daud Poto	Field Research Assistant	Mirpurkhas
10	Mr. Nizamuddin Bharchoond	Social Organizer	Nawabshah
11	Mr. Ghafar Khoso	Social Organizer	Nawabshah
12	Mr. Abdul Rehman Soomro	Field Research Assistant	Nawabshah
13	Mr. Pervaz Ahmed Pirzado	Field Research Assistant	Nawabshah
14	Mr. Naveed Kheyal	Supervisory Social Organizer	Sanghar
15	Mr. Ghulam Shabir Soomro	Social Organizer	Sanghar
16	Mr. Abdul Maieed	Field Research Assistant	Sanghar
17	Mr. Niaz Hussain Sial	Field Research Assislant	Sanahar
18	Mr. Nademm Korai	Chowkidar	Sanghar

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1.	IIMI Working Paper No. 8 Land and Water Rights and the Design of Scale Irriaation Proiecls: The Case of Baluchistan	Robert Hecht	1988
2.	IIMI Working Paper No. 21 Tubewells in Pakistan Distributary Canal Commands: Lagar Distribulary. Lower Chenab Canal System, Punjab	E.J. Vander Velde R.L. Johnson	1992
3.	IIMI Working Paper No. 26 Changes in Waler Duties and their Impact on Agricultural Production	P. Strosser Ranal Afaq C. Garces	1993
4.	IIMI Working Paper No. 27 Management of Private Tubewells in Conjunctive Use Environment	S. Malik P. Strosser	1993
5.	IIMI Working Paper No. 28 Institutional Perspectives of Land Reclamalion Operations in Punjab A case Study of the Lower Chenab Canal (East) Circle Area	D.J. Bandaragoda Saeed ur Rehman	1994
6.	IIMI Working Paper No. 29 Farmer-Managed Irrigation Systems in Chitral	A. Hakeem Khan Abdul Majid Maliha H.Hussain E.J. Vander Velde	1994
7.	IIMI Working Paper No. 30 Water Markets in the Fordwah/Eastern Sadiqia Area - An Answer to Perceived Deficiencies in Canal Water Supplies?	Pierre Strosser Marcel Kuper	1994
8.	IIMI Working Paper No. 38 Participatory Rural Appraisal for Irrigation Management Research	Paul Gosselink Pierre Strosser	1995
9.	IIMI Working Paper No. 39 Farmers' Organized Behavior in Irrigated Agriculture in Pakistan's Punjab-A Case Study of Six Watercourse Command Areas in Junejwala Minor, Lower Chenab Canal System	Saleem M. Malik Waheed-uz-Zaman Marcel Kuper	1996
10.	IIMI Working Paper No. 40 An Investigation of Ihe Relationship between Deplh to Groundwater and Malaria Prevalence, Punjab. Pakislan	M.J. Donnelly M.H. Birley F. Konradsen	1997

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1	IMI Country Paper-Pakistan No.1 Private Tube Well Development in Pakistan's Punjab: Review of Past Public Programs/ Policies and Relevent Research.	Robert Johnson	1989
2.	IIMI Country Paper-Pakistan No. 2 Irrigation Management in Relation to Waterloaaina and Salinitv.	Jacob W.Kijne	1989
3.	IIMI Country Paper-Pakistan No. 3 Irrigation Management in Pakistan Mountain Environments.	Edward J. Vander Velde	1989
4	IIMI Country Paper-Pakistan No. 4 Institutional Factors Affecting Irrigation Performance in Pakistan: Research and Polictv Priorities.	D.J. Bandaragoda G.R. Firdousi	1992
5	IIMI Country Paper-Pakistan No. 5 Moving Towards Demand-Based Operations in Modernized Irrigation Systems in Pakistan.	D.J. Bandaragoda M. Badruddin	1992
6	IIMI Country Paper-Pakistan No.6 The Role of Research-Supported Irrigation Policy in Sustainable Irrigated Agriculture.	D.J. Bandaragoda	1993
7	IIMI Country Paper-Pakistan No. 7 Warabandi in Pakistan's Canal Irrigation Systems, Widening Gap between Theory and Practice.	D.J. Bandaragoda Saeed ur Rehman	1995

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R-6	Fanners Ability lo Cope with Salinity and Sodicity: Farmers' perceptions. slrategies and practices lor dealing with salinity and sodicity in their farming systems	Neeltje Kielen	Aug 1996
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R-10	Canal Water Distribution at the Secondary Level in the Punjab, Pakistan (M.Sc Thesis published as Research Report)	Steven Visser	Oct 1996
R-11	Development of Sediment Transport Technology in Pakistan. An Annotated Bibliography	M. Hasnain Khan	Oct 1996

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R-18	**Proceedings** of National Conference on Managing Irrigation **for** Environmentally Sustainable Agriculture In Pakistan	M. Badruddin Gaylord V. Skogerboe M.S. Shafique (Editors fa all volumes)	Nov 1996
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S-1.	Reconnaissance Study *into* Waterlogging and Salinity Research	Niels Blaauw Paul Heinshroek	1990
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S No.	Title	Author	Year
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S-18.	Modeling of Sediment Transport in Irrigation Canals of Pakistan: Examples of application (also published as Kesearch Report)	Gilles Belaud	1996
's-19 .	Methodologies for Design. Operation and Maintenance of Irrigation Canals Subject to Sediment Problems Application to Pakistan (Final Reporl): (also published as Research Report)	Alexandre Vabre	1996
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