a village level.[21] The total number of influentials in the sample villages, along with their attributes are presented in table 8. The values mentioned in the table reflect the main attributes of leadership that were identified by the respondents.

Table 8. Leadership in the sample villages.

	6R	8L	27R	29R	41L	46L
Number of influentials (i)	8	6	4	3	7	11
Population/i	440	750	625	500	715	230
Attributes:						
Political position	3	3	3	1	4	3
Numberdar	1	1	-	1	-	1
Landownership	-	1	3	2	-	3
Social attributes	6	5	4	3	6	9
Religion	-	-	-	-	-	2
Caste	3	6	-	-	-	2

Chaks 6R, 8L and 46L appear to be more caste conscious, as respondents consider the caste base an important attribute for an influential. Caste may play a role in the other villages, but it was not explicitly mentioned by respondents. A position as numberdar in a village does not automatically make a person influential. From a total of 13 numberdars in the sample villages (2 to 3 for each chak), only 4 were reported to be influential. Political position yields, relatively, the most influence, when almost 50 percent of the influentials have been elected to representative bodies.[22] The smallest number of influentials is found in 8L and 41L, while the highest number of influentials is found in 46L.

The leaders in chaks 27R and 29R can be qualified as big landlords employing tenants to cultivate their lands. They are often inter-competing for influence in the villages, which is most evident during the time of (local) elections. The three influential landlords in 27R are not residing in the village, but wield influence when major decisions are taken. Part of their influence is transferred to their tenants or servants, who have been found to transgress rules or agreements under the protection of their masters.

In chaks 6R and 41L, landholding size is generally small (see tables 7 and 9) and landownership does not play a major role in village affairs. In chak 8L, leadership is reportedly

21 In chak 46L, for instance, farmers of all four watercourse commands in the village applied jointly to the Irrigation Department to change their warabandi from katcha (=loose) to pucca (=fixed).

22 This argument can also be turned the other way round, in a sense that influentials seek to obtain political positions.

fragmented, caste being the main basis for labeling individuals as "influential." There is no individual capable of inducing the different castes to work on projects of common interest.

In chak 46L, the situation is more complex with a large number of influentials identified by the respondents. A religious leader along with the leader of the main caste plays a positive role in uniting the villagers. Often, decisions pertaining to village affairs (e.g., during elections) are taken by a group of 11 village representatives and accepted unanimously by the villagers.

Table 9. Largest landholding sizes in sample villages (ha).

Landholding	Sample village					
	6R	8L	27R	29R	41L	46L
Biggest	12	101[a]	81	61	7	41
2nd biggest	10	9	20	10	6	26
3rd biggest	10	10	11	10	5	20
Average	11	0.04	38	27	6	29
Coefficient of Variation	0.1		0.8	0.9	0.2	0.3

[a] However, this farmer owns about 80 hectares in other village areas.

4.4 Conflicts and Conflict Resolution

Small conflicts and quarrels between villagers occur frequently in the sample villages. Land and water, scarce resources in rural Punjab, are major causes of these conflicts and many examples of such disputes were given by respondents, regarding, for instance water theft or the alignment of field ridges. These disputes are ranked here according to their frequency of occurrence:

1. water theft (within the watercourse)
2. disputes on the alignment of ridges of fields
3. theft of agricultural commodities
4. quarreling among women and children
5. divorce
6. murder cases
7. litigation of Haq Shufa[23]

These conflicts are usually kept to the village and are dealt with by a village *panchayat.*[24] The panchayat can be official and registered with the government, but in most

[23] This relates to the (Islamic) tradition of giving preference to neighbors when selling land. When villagers feel they have not been given the opportunity to buy land, because an outsider has offered more money, disputes arise.

cases it is informal. The composition and size of a panchayat are not fixed and often only part of the panchayat convenes to take a quick decision regarding minor conflicts. A permanent panchayat is only present in chak 46L, where it is sustained mainly through the influence of the religious leader in this village. A panchayat (or part of it) generally convenes at the request of one of the parties to hear both sides and to take a decision. The panchayat can fine villagers or impose other sanctions on people found at fault.

Conflicts because of water are common in the sample watercourses. However, the frequency of theft cases varies from once a month to once in several months for the different watercourses. These disputes were generally referred to the panchayat for settlement. In some other cases, they were resolved between the accused and the aggrieved. In very few cases, the theft cases were referred to the police or the Irrigation Department.

The village panchayats impose different sanctions on those found guilty of stealing water. The most common type of sanction is the imposition of a monetary fine. Usually the fine amounts to double the cost of the water that was stolen. In some watercourses, the panchayat has fixed minimum and maximum amounts for the penalty, depending upon the severity of the case, ranging from Rs 200 to 500 per case. In watercourse 41L, for instance, if somebody irrigates one acre of land by stealing water, this person will then have to pay the cost of 4 hours of water turn (irrespective of the time consumed for irrigating that particular field). The amount of the fine also depends upon the nature of the case. In watercourse 8L, a fine of Rs 500 was imposed. This amount was demanded by the aggrieved person since he had spent this amount in the process of lodging a case with the police.

Another way of imposing a penalty on a villager is by charging the offender an amount of water to be returned to the wronged party. The convention is to charge double the amount of water stolen, but cases of equal amounts of water being fined were also recorded, depending on the source (canal or tube well) and scarcity of the water.

A third type of penalty that was recorded was the issuing of a verbal warning to the offender. The custom is to give this warning in an open gathering and in the presence of ordinary villagers, which is considered very humiliating.

The fourth penalty imposed by the panchayat is directing the offender to apologize to the aggrieved party. This is usually done after the imposition of a monetary or other penalty. The offender apologizes and if the aggrieved party forgives, the penalty is repealed. Apologizing directly to the aggrieved party was also observed to occur without the intervention of the panchayat.

Decisions of the panchayat are usually accepted, according to the respondents. The villagers consider it to be their moral and ethical duty to accept the decisions of a panchayat to keep harmony within the village. This is reinforced by the belief that it is very uneconomical, cumbersome, and complicated to have cases decided by the police or Irrigation Department. Sometimes, cases that have already been registered with these bodies are withdrawn by the aggrieved party at the request of villagers. Also, cases are sometimes sent back to the panchayat for settlement. Only when no settlement is possible within the village, or when one of

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[24] Literally a body of five, a panchayat is composed of a number of villagers, who are influential and thought to have good judgment.

the parties is not ready to accept the decision of the panchayat, or a recidivist appears incorrigible, these cases are referred to and decided by the legal authorities.

An informal caste-based panchayat of around 10 people exists in chak 6R. When the village panchayat cannot come to a decision on a case, it can refer it to a formal panchayat that has been established at Union Council level (12 villages).

The process of conflict resolution is slightly more complicated in chak 8L. Although a number of conflicts have been settled by the informal panchayat in the past, cases are quite frequently referred to legal authorities. When the case concerns water, the Irrigation Department will address this problem consulting the biggest landlord of the village, who is also a member of the panchayat.

Major conflicts, erupting frequently during the time of (local) elections, are reported for chaks 27R, 29R and 46L. In chak 27R, this appears to be mainly a clash of influentials, all trying to extend their sphere of influence. The different biradaris within the Arain caste are the main groups involved in this struggle. One of the village influentials attempted to establish a permanent panchayat, but his efforts were thwarted by the other influentials and the panchayat ceased to exist after only one year. Presently, an informal panchayat exists, made up mainly of the village influentials. A number of conflicts in the village, however, have remained unresolved, as they were originated by one of the influentials (or his servants/tenants) and the panchayat was unable to deal with this.

In chak 29R, rivalry exists mainly between the different castes of the village (Jat, Sial, and Arain), who make up about equal portions of the village. An informal panchayat exists, made up of the representatives of the different castes, but many of the minor cases are dealt with by one farmer, who is thought to have good judgment. According to respondents, the number of cases regarding water theft has decreased dramatically with the spread of private tube wells.

An ongoing conflict in 46L between two numberdars is contained by the presence of a religious leader as well as a powerful caste leader, both participating in the formal panchayat of the village. The panchayat, made up of 11 members, generally does not convene as a whole for the minor cases. However, some important issues have been dealt with by this panchayat, including two murder cases.

4.5 Cooperative Works

In most of the sample villages, common projects, which were felt to be of general importance, have been carried out by (groups of) villagers. These projects are usually development works, for which money is either contributed by the villagers or sought from other sources (in most cases, the government). Works that have been undertaken in the sample villages include the construction of mosques and other religious places, pavement of roads, and the construction of village drains, schools and clinics.

Almost all the projects were short-term construction projects with a clear target. Villagers organized themselves, decided the objectives, collected or obtained money, and dissolved this informal organization once their targets were achieved. In this light, it is not strange that WUAs are seen by farmers as development organizations that can be dissolved after lining the watercourse.

In the sample villages, there are only two examples of organization that were set up with the intention of serving as vehicles for longer term cooperation. In chak 27R, a social welfare committee was established with the efforts of one of the village influentials. Villagers were called to a meeting where the committee was established, consisting of ten persons from different geographical blocks of the village. Money was collected for the first project of the committee, the construction of village drains, which commenced shortly thereafter. At the same time, other projects such as the pavement of roads and construction of a mosque were undertaken. However, soon conflicts erupted regarding the routing of the drain and the location of the waste water pond, leading to the demise of the committee.

A more successful example of a long-standing committee is found in 46L, where a social welfare committee[25] was established more than 30 years ago and is still functional. The main objective of the committee, which is officially registered with the government, is to obtain concessions on the purchase of agricultural inputs for the committee members and to facilitate loans on agricultural equipment and inputs.

Other works can be undertaken by the village as a whole or are carried out by specific groups of villagers (e.g., castes). Table 10 gives an overview of the projects carried out in the sample villages.

Table 10. History of cooperative works in the sample villages.

Cooperative works	Sample village					
	6R	8L	27R	29R	41L	46L
Completed projects	3	0	5	2	3	4
Abandoned projects	0	0	1	1	0	0
Group projects	0	5	0	0	0	0

In chak 8L, there is no example of a common project in the history of the village. A few groups of farmers, however, have constructed a total of five mosques that are used by the different castes in this village. The lack of leadership is often quoted by villagers as a reason for the poor record of cooperative works. On the other side of the scale is 46L, where four common

25 The committee is called Anjuman-e-Imdad-e-Bahimi Kashtakaran (farmers' society of mutual cooperation) and was set up before partition in 1947. It was registered legally in 1962.

projects have been successfully completed; two primary schools, a road and a (government-funded) veterinary clinic.

In general projects once started tend to get successfully completed. Only two examples are quoted by respondents of projects that were aborted during implementation. The failure of the drainage project in chak 27R appears to be much related to the way the organization was formed on the instigation of one influential. Interestingly, the watercourse 27R was lined under the OFWM program. None of the village influentials played a role in the WUA that was set up for the lining. The second failure is reported for 29R, where farmers attempted to line their watercourse. One of the village influentials was instrumental in organizing the WUA, but the WUA was confronted by a large group of farmers that were unwilling to contribute to the project. The tension among the three main castes is given as a reason for this by respondents. A second important reason is the large number of tenants/lessees in this watercourse, who are not ready to invest much money in the hardware of their irrigation system.

4.6 Social Capital

In the preceding sections, a number of social characteristics of the six sample villages have been presented. In this section, an attempt is made to synthesize this information by allotting a label (-1, 0, or, +1[26]) to each parameter for the sample villages. The selection of parameters as listed in table 11 (i.e., a, b, c, d and g), is partly derived from Merrey (1986), who used them to characterize watercourses that would be able to form a WUA and line the watercourse. We propose to add two denominators on the existence of major conflicts in a village and the ability of a village to resolve conflicts. While the former parameter is largely based on farmers' responses, the latter can be evaluated more objectively from the past record of conflict resolution of the village panchayat. Also, a parameter based on the number of *masjid* (mosque) committees is added. The existence of more than one mosque (committee) in a village is taken as having a possible negative influence on farmers' organized behavior.

A parameter that is omitted is the pattern in which farmers have settled in the area. In four villages, almost 100 percent of the inhabitants have settled in the area after introduction of the establishment of the LCC system, whereas in 29R and in 46L, a large number of people were living in the area prior to the introduction of large-scale irrigation (75 and 50 percent, respectively). The pattern of establishment is further complicated by the fact that after partition, large numbers of farmers have settled in the area. Farmers agreed that the village of origin (e.g., in east Punjab) was of importance for relationships between families, but indicated that caste/biradari was a much stronger determinant for social relations. During the course of the study, the exact establishment pattern could not be documented because of its complexity and, therefore, it is not included in this comparative analysis.

Presently, a substantial number of villagers have been employed abroad, mainly in the oil-producing countries. The affluence brought about by the influx of money is reportedly influencing social relationships in the sample villages. One of the characteristics associated with

[26] -1 indicates that this particular characteristic is likely to have a negative impact on farmers' ability to organize themselves for irrigation activities, 0 indicates very little impact, while +1 is allotted when a characteristic is likely to have a positive impact.

village leaders is personal wealth, traditionally based on the income obtained through agriculture, but increasingly earned through other sources. The number of villagers that have worked abroad is different for the sample villages. In 8L, 125 villagers have worked abroad, while the numbers in the other villages are less than 30.

Table 11. Social capital of sample villages: A synthesis.

Social parameter	Rating					
	6R	8L	27R	29R	41L	46L
a. castes, biradaris	0	0	-1	-1	-1	0
b. land distribution	-1	-1	-1	-1	0	+1
c. tenancy	+1	0	0	-1	0	0
d. leadership	0	-1	-1	-1	0	+1
e. conflicts	0	0	-1	-1	0	-1
f. conflict resolution	+1	-1	-1	0	0	+1
g. cooperative works	+1	-1	-1	-1	+1	+1
h. masjid committee	+1	-1	+1	-1	-1	+1
Score	+3	-5	-5	-7	-1	+4

Notes:

a.

Merrey (1986) took the presence of a single biradari in a watercourse/village as a factor contributing towards successful organization of farmers in WUAs. Since the objective of the paper is to identify links between social parameters and irrigation practices, only those biradaris belonging to agricultural castes are counted. The existence of more than a single biradari can be seen as potentially divisive. The number of biradaris in the sample villages is invariably greater than 1, ranging from 4 (6R) to 10 (46L). For this reason, the label '1' is not attributed to any of the villages. However, there are differences in the way caste/biradari antagonisms are reported for the sample villages.

In chak 29R, important differences are perceived to exist between different castes, while in chak 27R and chak 41L, there appears to be a permanent schism within the Arain caste between different biradaris. A label of '-1' is, therefore, allotted to those watercourses. Interestingly, the caste leader in chak 46L appears to be playing a unifying role for the different biradaris of the Mayo caste. Whether or not this is sustainable is not clear and the label '0' seems to be appropriate here.

b.

Land distribution is often considered related to power/influence relationships among farmers. Equitable distribution of land is seen as a factor contributing to farmers' cooperation (Merrey 1986), while the presence of a lot of small farmers combined with a few landlords can impact negatively on cooperation. Here, farmers in chak 8L have complained that there is no leader to organize them, because of the fact that the majority of the farms are very small (less than 1 ha) and fragmented. Even though land distribution is fairly equitable, 6R and 8L will, therefore, be labeled '-1.' The average farm size in watercourse 41L is not much bigger than that in 6R and 8L, but the number of farmers with marginal farm sizes (less than 1 ha) is much smaller, which justifies the label '0.' 29R has a number of absentee landlords and an inequitable land distribution, evidenced by a high Coefficient of Variation (CV). For this reason '-1' is awarded. 27R has the highest CV, because of the presence of a few big landlords (one farmer has 80 ha) and is given '-1.' Only 46L receives '+1' as the majority of the farmers (more than 60 %) have lands in the range of 2-5 ha and the biggest landlord in the village has only 40 ha.

c.

Related to the land distribution is the status of the farmers. A high number of tenants and lessees can have a negative impact on the long-term collaboration between farmers, especially because they have less incentive to invest in land. In most of the sample watercourses, the percentage of land on contract or cultivated by a tenant is about 30. 8L, 27R, 41L, and 46L are given '0.' 29R has an unusually high percentage of tenants/lessees and gets '-1' while 6R gets '+1.'

d.

The leaders in 27R and 29R are absentee landlords, who are often competing for influence. These chaks are given a '-1' rating. In 8L, farmers are complaining about the lack of leadership, which they claim is not unrelated to the land distribution. This chak is, therefore, also awarded '-1.' In 46L, very clear leadership is displayed by a religious leader in collaboration with the leader of the main caste, obviously giving this chak a '+1' rating. In 6R and 41L, leaders are, although not very prominent, able to influence organized behavior of farmers, according to the respondents. The label '0' seems appropriate here.

e.
Conflicts are reported to exist for all chaks, so that it does not seem to be justified to award a label of '+1.' In addition to that, major conflicts are reported for 27R, 29R, and 46L, which are allotted '-1.' The others get '0.'

f.
Not unrelated is the way that these conflicts are resolved, generally through the panchayat. In 6R and 46L, conflicts are dealt with in a regular forum, while respondents express their general satisfaction regarding the functioning of these panchayats, which yields '+1.' On the other side of the scale are 8L, where the panchayat does not have the necessary standing to resolve conflicts, and 27R, where the official panchayat was dissolved because of conflicting interests, thus scoring '-1.' In 29R and 41L, the panchayats are functioning reasonably well albeit informally, which gives '0.'

g.
The history of cooperative works is a good measure of the ability of villagers to organize themselves to undertake a project to achieve a common goal. Following table 10, 8L, 27R, and 29R are given '-1,' as common projects have either not been undertaken or have not been successfully completed. All the other villages have successfully completed 3 to 4 different projects and are allocated '+1.' In 6R, 27R, and 46L, there is one single mosque and a masjid committee for the entire village, which yields '+1.' In 8L and 41L, there is more than 1 masjid committee, while farmers in 29R are unable to form such a committee. In all three cases '-1' is given as a label.

The final score underlines the favorable environment for farmers' organized behavior in 6R and 46L, while it is unfavorable in 8L, 27R, and 29R. In 41L, the indications are less clear.

The social parameters (or social capital) are very strongly correlated. When performing a regression on the results of table 11, taking **a** to **d** as independent parameters and **e** to **h** as dependent parameters, a satisfactory relation can be established with an R^2 of 0.74.

5. IRRIGATION ACTIVITIES AND FARMERS' INVOLVEMENT

5.1 Irrigation Activities

In this section, how the social capital, defined in the preceding section, influences the way farmers in the sample watercourses organize common irrigation activities is evaluated. The underlying hypothesis is that a higher social capital will result in farmers being able to organize common irrigation activities more effectively.

Warabandi

Warabandi as an institution dates back to the early period of irrigation development by the British (1850s), but the concepts underlying warabandi could well have its origins much earlier than that (Bandaragoda and Rehman 1995). Although the concepts (especially equitability in distribution) of warabandi have been infringed upon, farmers expressed satisfaction with the present setup, clarifying that warabandi was no more unfair than institutions in other sectors of the rural economy (ibid 1995).

The vast majority of watercourses have a pukka warabandi at present, in order to have more secure water rights. Since warabandi is made pukka by the Punjab Irrigation and Power Department, even if only one farmer in a watercourse asks for it, the conversion cannot be easily attributed to farmers' organized behavior. However, the process by which the conversion has taken place is of interest. In 6R, 41L, and 46L, the villagers applied jointly for pukka warabandi for all the watercourses related to their villages. In 6R, a minority of influentials opposed the change, as katcha warabandi gave them a higher degree of freedom. In the other three watercourses, the conversion was made because of watercourse-specific issues. In 8L and 27R, a small group of tail-end farmers applied to the Punjab Irrigation and Power Department, as they felt that the water distribution was abused by larger farmers.

Farmers in the sample watercourses are generally content with the functioning of their warabandi. The satisfaction of farmers can be largely attributed to the clear set of rules and boundary conditions (Ostrom 1992) that govern warabandi: a specified time is allocated to a single farmer, irrespective of the discharge. Also, a clear hydraulic boundary,[27] the watercourse command, delineates the warabandi.

Interestingly, conflicts that are generated by a warabandi are by and large referred to the village panchayat, another traditional institution, but not related to the hydraulic boundary. Water disputes (mainly stealing) occur in all sample watercourses occasionally, but are recurrent only in 8L. In the other watercourses, the combination of clear rules and effective conflict resolution has led respondents to express satisfaction with the warabandi system.

This analysis confirms the adverse effect of the poor social capital of 8L on this irrigation activity. The effect is much less clear for the other watercourses, although the process of conversion from katcha to pukka warabandi for 6R, 41L, and 46L (the villages with the highest organizational densities) gives us an indication of the ability of farmers to establish a temporary forum to discuss and decide on a common problem. The conversion was an individual process in 8L and 27R.

Alterations in Mogha Size

One of the most common ways of improving access to canal water is to have the size of the outlet changed to increase the discharge of the outlet. This requires some organization as resources have to be mobilized and officials approached. The sample outlets are all fairly close to the design values. The only difference is found for 27R, where the crest level is about 12 cm

[27] This is advocated by many authors as a prerequisite for effective farmer organization (Uphoff 1986 and Ostrom 1992).

higher than design and for 46L where the crest level is 7 cm lower than design. None of the moghas show any tampering. At 29R, farmers have collected some money, but actual changing of the outlet has not happened yet. This irrigation activity tells us very little about the effect of social capital on farmers' collective action in this case study.

Watercourse Lining and Water Users Associations

Much has been written on the OFWM projects and on watercourse lining in Pakistan (see also earlier sections). A host of reasons for the collapse of WUAs, once the physical works for watercourse lining have been completed, has been given in the literature, both related to external conditions (sociocultural milieu, law) as well as internal structure (objectives not clear for long-term organization). However, mobilizing resources and labor for establishing a WUA and agreeing to a new (straightened) alignment of a watercourse is a common irrigation activity that requires cooperation of farmers in a watercourse. Uphoff (1986) states that the urge for farmers to organize for irrigation activities (if this is considered to improve access to irrigation water) has a curvilinear relationship with the water supply with little incentive at both extremes (i.e., very little water and an abundant water supply) for farmer organization. Given the water scarcity in the Punjab, farmers are not likely to be in the "wet" extreme of the function. It is only in watercourses where the canal water supply is very little, that farmers are unlikely to take the trouble of lining their watercourse. Such is the case in 46L.

Two sample watercourses have been lined under the OFWM program, 27R and 41L. Both WUAs have been dissolved after the completion of the improvement works. In these watercourses, farmers have reverted back to their pre-WUA organization for cleaning of their watercourses. Farmers in 41L have expressed dissatisfaction over the lining, as they feel that due to a lower bed level, the sediment intake of the outlet has increased, thus increasing the frequency of cleaning. Also, farmers have dug a parallel watercourse for the SCARP tube well in the command area.

In 29R, a WUA was established in 1992 but it has not been successful in lining the watercourse. The five-man board of the association is trying to collect money for the improvement of the watercourse, as well as the widening of the outlet. The failure of the WUA is attributed by farmers to the large percentage of tenants in the watercourse and the feuds among the three village castes. Also, the board comprises just one of the village influentials and other influentials are reportedly not ready to cooperate.

The low social capital in 29R seems to explain the failure of farmers in this watercourse to establish a WUA. However, the organizational densities do not readily explain the lining process in 27R. Interestingly, none of the village influentials participated in the board of the WUA, possibly because of the work it entails. It is hard to draw any conclusions regarding the failure of the WUAs in 27R and 41L to sustain themselves after the lining was completed, since this is a general phenomenon.

Watercourse Cleaning

Desiltation has traditionally been an important feature of the irrigation canals in the Indus Basin, because of the high sediment load of canal water. Tertiary outlets have been designed in such

a way that they draw the maximum possible sediment load to prevent the distributaries (the desiltation of which is the responsibility of the government) from silting up. Cleaning usually consists of removing sediment from the bed of the watercourse and vegetation from the sides to improve the flow of water. Also, banks of the watercourses are strengthened, particularly at nakkas and field inlets, where banks are naturally weaker than at other places. While cleaning of the main watercourse (or *sarkari khal*[28]) is a collective responsibility, various individual arrangements exist for cleaning of branch watercourses. Intensity of cleaning is usually marginally lower for branch watercourses.

The intensity of cleaning of the sarkari khal in the sample watercourses is quite high[29] (see table 12) and watercourses are in a reasonably good physical state. Watercourses are desilted, on average, once a month, with a slightly higher frequency in kharif, when the sediment load of a canal is higher. In 41L, the frequency of cleaning is higher than in other watercourses. Farmers attribute this to the fact that the bed level of the lined watercourse is too low, which has increased the silt draw of the outlet, necessitating a very frequent watercourse cleaning. In 29R, farmers have difficulty in organizing themselves for cleaning their watercourse.

Table 12. Intensity of cleaning for sample watercourses (per year).

Watercourse	6R	8L	27R	29R	41L	46L
Intensity	12	12	12	6	17	12

The initiative for undertaking watercourse cleaning is taken frequently by watercourse tail enders. Only 6R and 41L have a permanent leader for watercourse cleaning, who decides the time of cleaning. Announcements for cleaning are made through the loudspeakers of the village mosque by the *wagari*.[30] Respondents say that most farmers participate in the cleaning, while those who do not have to pay a fine. It is the prerogative of the cleaning leader to penalize villagers for not showing up for the work. The fines are spent on refreshments for participating farmers or for other purposes (e.g., the entertainment of government officials when visiting the village or covering the traveling expenses of farmers who go to government offices for village matters). The fines range from Rs 5 per acre at 46L to Rs 10 per acre at 6R, 8L, and 27R. A fine of Rs 50 is fixed for each defaulter of the 29R and 41L watercourses.

While 6R and 41L have permanent work supervisors, farmers in 29R and 46L usually select their supervisor at the start of each cleaning. In 8L, four farmers are selected to represent the different castes. In 27R, no supervisor is selected.

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28 *Sarkari* means government, *khal* means channel.

29 In the literature on water management at tertiary level in Pakistan, published in the 1970s, frequency of cleaning is quoted to be invariably lower than reported here. Increasing demand for water may have led to this increase.

30 A *wagari* (time-keeper) keeps track of time and is often consulted by farmers for the timings of their water turns.

There are two standard rules for division of work among farmers. The most common of these two is the allocation of work proportional to the holding size. The other is cleaning of watercourse from the nakka (division structure) to the upstream nakka by the farmers who share this structure. The latter system is less popular, as it involves a second division of work at the nakka level. Disputes are rife in the cleaning of watercourses: "small and big farmers do not cooperate."

These disputes occur mainly in 8L, 27R, and 29R, villages with the lowest organizational densities, while watercourse cleaning in the other three watercourses is better organized with permanent work supervisors in 6R and 41L and a temporary work supervisor in 46L.

Distributary Maintenance

Distributary cleaning has traditionally been the responsibility of the Irrigation Department (ID). Precluding the involvement of farmers at this level was thought essential to maintain a "fair" distribution of water (Gilmartin 1994). However, farmers in the sample areas have frequently participated in the cleaning of Junejwala minor, sometimes at the request of the department,[31] while farmers (particularly those at the tail-end villages) have also often taken the initiative themselves. In the latter case, the Irrigation Department is usually asked for permission. Farmers generally use spades and tractors with mounted blades.

Farmers in all the sample villages have at one time or another participated in the cleaning of Junejwala minor. They are contacted by Irrigation Department staff through the village numberdar or other influentials. While farmers from villages located at the head of the minor are generally not keen on participating (and only show up when strongly "encouraged"), as the cleaning is (at best) not directly in their interest and often even decreases canal supplies to their watercourses, farmers from tail watercourses are readily available to contribute

The poor maintenance and desiltation are partly responsible for the inequity that exist between head and tail reaches of distributary canals. In the parent channel of Junejwala minor, Pir Mahal, farmers of the tail area blocked the channel in 1991 to protest the low water supplies at the tail. This effort of the farmers was rewarded by the Irrigation Department during the annual closure of 1992, when the head portion of Pir Mahal distributary was desilted heavily (mechanically).

Also, during the self-help desiltation campaign of the Punjab Chief Minister, Junejwala minor was targeted. A length of about 11 km, starting from the head was desilted by ID, as head-end farmers are generally reluctant to participate. The minor was reopened after closure, but the farmers of the tail area did not see satisfactory improvement and requested the Punjab Irrigation and Power Department for permission to do some desiltation themselves. Farmers were allowed to do so and given specifications of width and depth of the channel to be maintained. The farmers worked for one day and desilted a portion of about 1.2 km. The desiltation of 1992 has improved the surface supplies at the tail of Junejwala minor considerably (see section 3).

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[31] During the "self-help" desiltation campaign launched by the Chief Minister of Punjab in 1992, about 100 farmers from tail-end villages have participated in the cleaning of Junejwala minor. The campaign has been documented in van Waijjen and Bandaragoda (1992).

In addition to the regular maintenance and repair during the annual closure period, there are cuts and breaches in the banks of the channels that need attention during the year. Cuts and breaches are due to several reasons; especially, cattle entry and human intervention. The usual practice regarding the repair of breaches is that farmers try to inform the Irrigation Department of the occurrence of breaches, upon which the channel is generally closed immediately at the head. After that departmental laborers get together and reach the affected location for repair work. This second step usually takes 2 to 3 days. Farmers are playing an important role in repairing the breach points, particularly the small ones, which are repaired by the farmers without even bringing them to the
notice of the department. In case of large-size breaches when a departmental labor force is at the site, farmers are generally found helping them, since the department has no machinery to close breaches.

Farmer-organized behavior for this irrigation activity is short-lived, with a clear common goal, for which considerable potential exists. Since the interest is obviously much location-specific, no conclusions can be drawn regarding the effect of social capital on organization of this irrigation activity.

Private Tube Wells and Water Markets

Groundwater has increasingly become an important source of irrigation water in Pakistan's Punjab. This common resource is exploited quite individually. Malik and Strosser (1993) show that PTO (power take-off) and diesel-driven tube wells are used less than 10 percent of the time, while electric tube wells are used on average 40 percent of the time. Farmers tend to prefer to have their own tube wells, thereby reducing interactions with other farmers. This is also the case in the sample areas, where only in a few cases tube wells are shared by more than one owner. Tube wells with multiple owners are found in three sample watercourses, five in 46L, four in 8L, and two in 29R. Owners are generally related (family, biradari). Other ways to have access to groundwater without having a tube well is through water markets. Water markets are an important feature of contemporary irrigated agriculture in the Punjab, where farmers want a certain flexibility in their canal water supplies and where non-tube well owners want to have access to groundwater resources. However, recent research has given some evidence that tube-well owners obtain better yields than tube-well water purchasers, indicative of the fact that tube-well owners will serve their own interests first (Strosser and Kuper 1994).

Tube-well densities are in the range of 8 to 10 per 100 ha of irrigated area, which conforms with data collected elsewhere in the Punjab (Malik and Strosser 1993). A lower density is found in 29R (5 per 100 ha), probably because of the inequity of landholding distribution with a few big farmers and a large group of tenants, who are naturally reluctant to invest in a tube well. A lower groundwater quality may also contribute to the lower density. A density of 14 tube wells per 100 ha is found in 41L, which can be attributed to the large number of farmers (60% of the farmers have a landholding of between 1 and 5 ha).

Private tube-well water is traded throughout the year in all sample watercourses. The variation between watercourses and between seasons is considerable. The transaction rate is highest in 8L, where 47 percent of the private tube-well water is traded in kharif and 50 percent

is traded in rabi. The transaction rate is lowest in 6R and 41L, where 4 and 3 percent are traded in kharif, and 2 and 3 percent in rabi, respectively (table 13).

On average, electric tube well water constituted the largest part of the water transactions (60 %). In 1991, the average number of operation hours sold per electric tube well was 307, which is 9 percent of the total operation hours. The average number of hours sold by diesel tube wells is 54 hours, which is 15 percent of the total operation hours. The PTO bores sold 8 percent of the operation per tube well, which is just 22 hours per tube well for the whole year of 1991.

Table 13. Water transactions in the sample watercourses of Junejwala minor.

Water transactions	Sample watercourse					
	6R	8L	27R	29R	41L	46L
Hours sold per 100 ha CCA						
Kharif 1991	196	2118	461	470	290	965
Rabi 1991-92	38	665	149	50	93	492
% of the operational hours						
Kharif 1991	4	47	11	14	3	12
Rabi 1991-92	2	51	23	29	3	20

Although the Canal and Drainage Act of 1873 specifically states that trading of canal water is not allowed, it is not an uncommon feature in the Punjab (Strosser and Kuper 1994). In some watercourses (e.g., 6R), turns are sold for the entire season by tail enders, who would receive very little water anyway, due to losses in the watercourse. However, most of the trading of canal water is limited to exchanges of water. Farmers who are irrigating a field but cannot complete watering of an entire field or group of fields, try to continue irrigating using another farmer's turn, which they will compensate for in their next water turn. Sometimes, canal water is exchanged for tube-well water, usually on a 1:1 basis, but in 6R and 41L on a 1:1.5 basis, as more value is attached to canal water for its good quality and fertility. Also, when a farmer does not need water at the time of his turn, he will give it to other farmers who can make better use of it.

Exploitation of the groundwater resource is generally done on an individual basis. Farmers who are able to obtain credit and good groundwater quality will install tube wells, rather than relying on water markets, which seems justified under present conditions. Presently, groundwater exploitation is not regulated by the government and no restrictions are placed on farmers who install tube wells. Given that groundwater tables in the Punjab in fresh water areas are generally going down, farmers are likely to face constraints on the utilization of groundwater. Taking Uphoff's inverted U shaped relationship between water availability and farmers' cooperation, it is likely that a certain degree of organization among farmers is going to be required soon.

In our analysis of the effect of social capital on farmers' organized behavior, the effects of private tube well ownership and water markets are not readily explained, given the relative abundance of the resource. Explanations are likely to be found in other factors, such as landholding size, tenure type, groundwater quality, etc., which is not the scope of this paper.

5.2 Factors Influencing Farmer Organizations

The analysis of section 5.1 shows clearly that irrigation activities in the study area show very little sustained interaction or organized behavior.[32] Century-old irrigation institutions such as warabandi have developed into arrangements with very clear rules and boundaries to minimize conflicts between affiliated groups of farmers.

The analysis of section 5.1 shows that only four irrigation activities[33] could be identified with some form of organized behavior. These activities were evaluated for their degree of organization by farmers in the different sample watercourses, by attributing a label (-1, 0 or +1) similar to the synthesis carried out in section 4.6 for the social capital. The results of this analysis are summarized in table 14.

Table 14. Irrigation activities and organized behavior in the sample watercourses in Junejwala minor.

Irrigation activity	6R	8L	27R	29R	41L	46L
a. warabandi	+1	-1	-1		+1	+1
b. mogha alterations						
c. watercourse lining			+1	-1	+1	
d. watercourse cleaning	+1	-1	-1	-1	+1	+1
e. distributary maintenance						
f. water markets	-1	+1	0	0	-1	0
Total	+1	-1	-1	-2	+2	+2

32 In fact, Gilmartin (1994) argues that the design concept of the irrigation system was to have the social setup not interfere with the water allocation and distribution for fear of distorting the principles of equitability.

33 An irrigation-related activity that has not been described here is the collection of irrigation fees by Irrigation Department staff. They work through the numberdar, a villager who has been appointed by the government to liaise between farmers and Irrigation Department.

Notes:

a.
The conflicts regarding water distribution in 8L and 27R, leading to individual farmers initiating the conversion to pukka warabandi, justify the label '-1,' while the joint application of 6R, 41L, and 46L demonstrates that farmers are capable of organizing themselves for a perceived common interest.

b.
Farmers in the study area have not (yet) gotten together to approach the Irrigation Department for changes in outlet dimensions, which are having an impact on the supply to their watercourses. No scores can be attributed on the basis of this study.

c.
In 27R and 41L, farmers have successfully lined their watercourse, while in 29R, the process failed. Hence the allotted labels.

d.
In 29R, the intensity of cleaning is very low, because of difficulties of becoming organized. In 8L and 27R, cleaning is a fragmented and complicated process. All three watercourses get '-1.' In 6R, 41L, and 46L, cleaning is a joint process, which is well organized, yielding '+1.'

e.
No sustained organization is present to carry out yearly maintenance to Junejwala minor, although it is clear that farmers in tail watercourses participate more often in this activity. Not enough evidence of farmers' collective action could be traced, which is why no scores have been attributed.

f.
In 6R and in 41L, the number of water transactions is surprisingly low, vindicating the score of '-1.' On the other side of the scale 8L can be found, where about 50 percent of the tube-well water is traded, for which reason '+1' is given. In the other watercourses, water transactions constitute about 10-30 percent of the tube-well water.

Although it is difficult to test a methodology only on four parameters for six watercourses, the results correspond reasonably well with the organizational densities that were found for the six sample villages. The sample villages can be separated into two main groups. Where in 6R, 41L, and 46L (villages with the highest organizational densities) on the one hand, farmers are able at least to create lasting institutions to deal with irrigation activities (e.g., watercourse cleaning), farmers in 8L, 27R, and 29R face a large number of problems in organizing common irrigation activities. In 8L and 29R, these problems seem to be caste based, which is in the case of 29R further complicated by the large number of tenants/lessees with

their short-term interests. In 27R and 29R, leadership is another major problem with a limited number of village influentials competing for control. All these factors contributed to the failure in 8L, 27R, and 29R to undertake/complete common projects, the high number of disputes over water, and the lack of effectiveness in organizing common irrigation activities.

When relating the values of table 14 to the parameters of table 11, which make up the social capital, a reasonable correlation is found. Taking the total scores of the social capital as independent parameters and the values of table 14 as dependent parameters, an R^2 of 0.72 can be found. When looking in more detail at the hypotheses of section 1.2, it appears that leadership and the history of cooperative works are the most significant social parameters influencing the organization of irrigation activities. Hypotheses 4 and 6 are, therefore, accepted (see table 15).

Effective conflict resolution in combination with the credibility of the punishment awarded to offenders appears to be more important in sustaining farmers' organizations than the existence of major conflicts in a village, when comparing table 11 and table 14. This leads us to accept hypotheses 10 and 17 and reject hypothesis 16. Also, a high number of tenants was shown to have an adverse impact on the ability of farmers to carry out communal projects, which means that hypothesis 15 is accepted.

When correlating the land distribution to the organized behavior of farmers (table 14), no straightforward relation is found, even though the disparity in holding (expressed through standard deviation) gives slightly better results (R^2 is 0.13). Results may be better if data for the entire village are used rather than watercourse-level data. The presence of one or two individuals with very large holding sizes appears to be negatively related to farmers' organized behavior (see table 9), effectively qualifying hypotheses 1, 2, and 13.

The presence of a single caste/biradari in a watercourse/village seems hypothetical in present day Punjab. However, in four of the six sample villages, one agricultural caste is clearly dominating, leading in three cases to relatively well-organized common irrigation activities (6R, 41L, and 46L). The reason hypothesis 5 needs to be qualified is that in the case of 27R intra-caste disputes disrupt organized behavior. There appears to be much less correlation with the biradari setup.

The size of villages and watercourses appears to be not very much related with the organizational behavior of farmers, thereby rejecting hypothesis 8 for the sample. Similarly, hypothesis 18 can be rejected.

No information was collected on the progressiveness of the communities and the level of education of villagers, which is why hypotheses 3 and 7 cannot be tested.

Two types of formal organization were identified in the sample villages. Obviously, only in the case of 46L did farmers perceive a relative benefit in sustaining a formal farmer organization (cooperative), while the potential benefits were not enough for farmers in other villages. The farmers' cooperative was not the focus of the study, and not enough is known to test hypothesis 9. Also, hypotheses 11, 12, and 14 cannot be investigated with the available data. The other formal organizations that were found were the WUAs, of which the relative benefits of sustained life are known to be nonexistent.

Table 15. Social factors contributing to effective organization of irrigation activities.

	Factor	Accepted	Rejected	Need to qualify
1	equitable landholding distribution			x
2	equitable distribution of power and influence			x
3	progressiveness of the community			?
4	history of cooperation on community projects	x		
5	one single biradari in a village or watercourse			x
6	leadership	x		
7	education			?
8	a small group size		x	
9	high relative benefits			?
10	credibility of punishment	x		
11	the sense of ownership			?
12	built on existing organizations			?
13	homogeneity of background			x
14	accountability			?
15	a small number of tenants	x		
16	no major conflicts		x	
17	effective conflict resolution	x		
18	single masjid committee		x	
Total		5	3	4

6. CONCLUSIONS

1. Informal organizations of farmers are established for specific common projects with limited duration and are dissolved when the targets are achieved. The study shows that irrigation activities, which need long-term association of groups of farmers (warabandi, watercourse maintenance) are organized in such a way that interactions (and possible disputes) are minimized through clear rules and boundary conditions. These arrangements, which appear to be the solution farmers have found to deal with the large heterogeneity in the farming community (landholding size, tenure status, education, wealth, influence), seem to function surprisingly well. A balance is found with which most farmers are content even though the end result (e.g., water distribution) may not be "equitable."

2. Increased farmers' participation is going to be pilot-tested on a few distributaries in Pakistan in the near future in an attempt to address the low performance of irrigated agriculture in Pakistan. The experiences of the On-Farm Water Management (OFWM) projects that have been implemented in Pakistan have shown that establishing formal, sustainable farmers' water management organizations in rural, factional Punjab is not an easy task. A good understanding of the process by which existing arrangements for common irrigation activities have evolved would help in defining an approach that would be more robust.

3. The hydrological boundaries of the irrigation system in Pakistan do not coincide with social (e.g., village) or administrative boundaries. In practice, however, the two systems are highly interactive. The study shows evidence of the fact that the social characteristics of a village influence the effectiveness of common irrigation activities, which take place within the boundaries of hydraulic units. Water disputes occurring at the watercourse level, for instance, are solved by the village panchayat. In recent proposals, farmers' participation in irrigation management in Pakistan is generally thought to have to follow hydrological boundaries, thereby following the original design concept of the irrigation system, albeit at a different (secondary) level. If farmers' participation in irrigation management is considered, it would be advisable to consider the village a possible level of organization for farmers.

4. In this case study, only some of the hypotheses that have been formulated in the past regarding external and internal conditions for successful farmers' organization could be tested. A perceived successful history of cooperation on common projects, presence of leadership, the credibility of punishment, and a small number of tenants were shown to have a positive impact on farmers' organization. At the same time, farmers were able to effectively organize common irrigation activities even when major conflicts existed, there was a large group size, and there was more than one mosque in the village. The rejection of these hypotheses may be related to the nature of existing organizational arrangements for common irrigation activities, where farmers avoid close association.

5. During the conceptual phase of the development of the canal systems in the Indus Basin, irrigation engineers favored exclusion of farmers from the operation and maintenance of the

main and secondary systems in order not to have them interfere with a "scientific" equitable water distribution (Gilmartin 1994). Farmers have increasingly become involved at higher levels of the irrigation system, mostly for individual gains, contributing to tail shortages and inequity. Given the historical concept and the negative experiences with farmers' interventions, the irrigation agency has expressed fear for farmer participation in irrigation management, which is presently advocated by donors and the federal government. Redefining the roles of Irrigation Departments and farmers will, therefore, prove to be a difficult process, as there is no perceived successful history of farmer participation in irrigation management.

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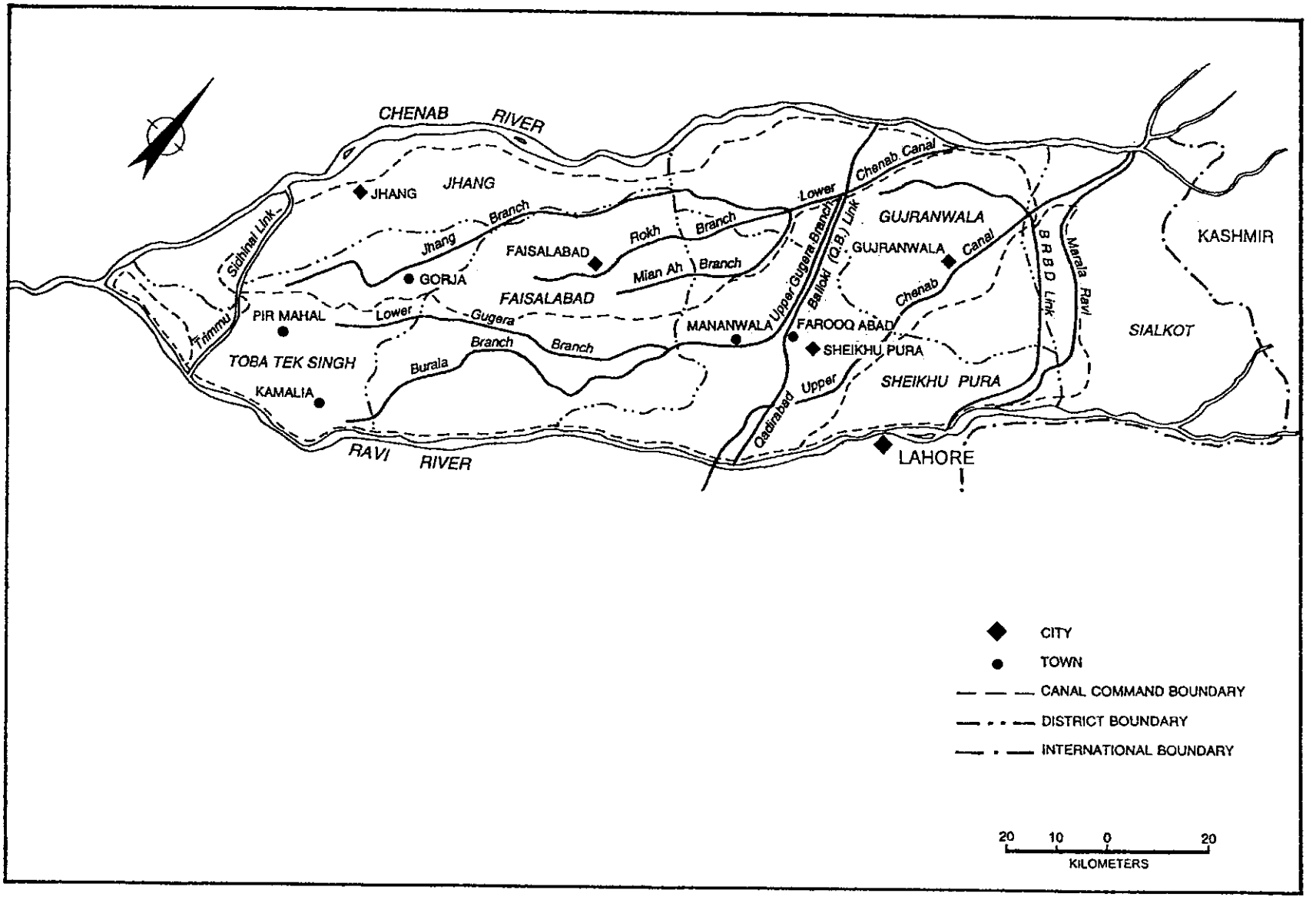
LOCATION MAP OF LOWER CHENAB CANAL



LOCATION MAP OF SAMPLE VILLAGES IN JUNEJWALA MINOR AREA