# REORGANIZING IRRIGATION: LOCAL LEVEL MANAGEMENT IN THE PUNJAB (PAKISTAN)

Douglas J. Merrey'

Discussions of the problems facing irrigated agriculture in Pakistan usually begin with an irony: despite the favorable climate, fertile land, hard working farmers, and possession of the largest integrated irrigation system in the world, agricultural production is very low. It is low by any standard in relation to similar situations in other countries, to the potential demonstrated year after year on demonstration plots and - even more so - to the needs of Pakistan's rapidly growing population.

Before World War II, the area which is now Pakistani Punjab was a major exporter of wheat. By Independence in 1947 exports had ended. Output per capita continued to decline until the mid-1960s. By the early 1970s. with the adoption of high yielding varieties of wheat, per capita productivity had returned to the levels of the late 1940s, but during the 1970s it stagnated. In most years up to 1978 Pakistan had to import about one quarter of its wheat requirements. Although the figures have improved significantly since 1978, mainly as the result of the introduction of improved rust resistant varieties, yield per hectare remains low.

Although the irrigation system had originally been built in order to transform drylands into highly productive farmland, the productivity of large areas has been either destroyed or significantly reduced by salinity and a rising water table. A considerable proportion of the population now lives under the threat of this type of desertification. Some surveys show that more than half the approximately 13.5 million hectares of irrigated land in the Indus Basin are affected by varying degrees of waterlogging and salinity (Clyma et al. 1975a; Malik 1978). The situation is regarded so seriously that newspapers carry learned and often passionate articles by experts and frequent editorials urging more action.

There is considerable controversy concerning the seriousness of waterlogging and salinity in Pakistan, and whether the situation is deteriorating or improving. Two factors are responsible for the controversy: first, the relevant information is inadequate, inconsistent, and subject to different interpretations; second, because such large funds are involved in the various programs for controlling the problems, the whole question has become a political issue.

The process of deterioration is generally blamed on the twin menace of salinity and waterlogging. In order to reverse it, several programs have been launched to reclaim waterlogged and saline land by means of drains and high capacity tubewells to lower the water table (referred to as the Salinity Control and Reclamation Program or SCARP), and to flush salts out of the soil. Until recently, all the irrigation projects in Pakistan emphasized large-scale capital-intensive construction: SCARP tubewells, link canals, and dams - culminating in the Tarbela Dam Project on the Upper Indus River. This dam is billed as the largest earth-filled dam in the world. It is financed by huge foreign loans and is designed for both irrigation water control and the generation of electricity. It is important to note that these projects were based on research that was in turn based on certain assumptions about local level water management. The loss of water in watercourses before it reached the crops was assumed to be minimal, and due mostly to evapotranspiration. It was not thought to be adding to the water table. In particular, it was assumed that most of the water delivered to tertiary irrigation ditches (watercourses) reaches the root zones of the crops.

---

'Social Scientist. International Irrigation Management Institute. Digana Village via Kandy. Sri Lanka

In the early 1970s research teams from Colorado State University, in cooperation with Pakistani organizations, especially the Mona Reclamation Experimental Research Project (supported by funding from the United States Agency for International Development), began to explore the possibility that a major cause of the twin menace should be sought at the farm level.

They started by measuring watercourse and field application efficiencies. These studies demonstrated a wide variety in the delivery efficiencies of watercourses, but on the whole they were shown to be substantially lower than had previously been assumed. Overall, delivery efficiencies of watercourses seem to be less than 60% - often substantially less; that is, 60% or less of the water entering the watercourses reaches the fields. Unlevelled land, fragmented plots, and lack of knowledge about plant-soil-water relations reduce the efficiency of water use even further. Early studies in a SCARP area demonstrated that wastage of water in these areas is especially high, SCARP tubewells pump the ground water into watercourses where it mixes with canal water, increasing the available irrigation water, while lowering the water table. However, because of poor watercourse construction and maintenance, most of the water returns to the groundwater, minimizing the effectiveness of the SCARP program in reducing waterlogging. Overall, Pakistan's irrigation system is estimated to be operating at less than 30% efficiency; that is, less than 30% of the water diverted from the rivers is stored in root zones for crop use.'

These findings led to the development of pilot projects designed to improve the efficiency of water delivery and usage in order both to increase agricultural productivity and to reduce waterlogging and salinity. A key component of these projects was an attempt to induce local water users to cooperate in reconstructing and maintaining their joint watercourses. This component has also proved to be a major obstacle: it is quite difficult, though not impossible, to organize farmers to co-operate on a short term improvement project, but it is even more difficult to induce them to continue cooperating for maintenance and management of the watercourse on a longer term basis. This paper presents a case study of a reconstruction project on one watercourse and identifies the impediments preventing its successful completion. It also summarizes the results of a larger survey of organizational problems on improved watercourses. The basic argument is that a major source of the severe technical problems of Pakistan's irrigation system is ineffective organization of management especially at the local level; and attempts to improve the system so far have been hindered by the failure to recognize this social dimension of the problem.

## The "Indus Food Machine": History and Development Plans

The history of the development of Pakistan's irrigation system is not long, but it is complex. The best recent account is that of Michel (1967), which draws on older histories of irrigation in Punjab plus British and Pakistani administrative and technical documents, and post-Independence research. Only a brief summary is possible here.

Environment. The Indus plain is a vast piedmont alluvial plain; the Indus River system has a mean annual flow of 175,156 million cubic meters in Pakistan, twice the mean annual water production of the Nile River (Johnson et al. 1977). The climate is predominantly arid and semi-arid: in the northern regions annual evaporation averages about 152 centimeters (cm) while in the south it is about 190 cm; annual precipitation ranges from 50 cm in the north to 7.5 cm in the south. The combination of low and unpredictable rainfall and sub-tropical arid to semi-arid climate makes irrigation a necessity for successful agriculture. Because the major portion of the modern system. as well as the research reported here, are centered on what is now the Province of Punjab in Pakistan, the remainder of this paper focuses of this area.

---

[2] The findings of the Colorado State University research are reported in Corey and Clyma (1975); Clyma et al. (1975a and b); Reuss and Kemper (1978); Johnson et al. (1977); Eckert et al. (1975); and others.

The Punjab plains are crossed by six rivers, the Indus, Jhelum, Chenab, Ravi, Sutlej, and Beas. Since the implementation of the Indus Waters Treaty of 1960 between India and Pakistan, Pakistani Punjab has been utilizing the waters of the western rivers -the Indus, Jhelum, and Chenab; the bulk of the others rivers' water is utilized by India. The rivers are silt-laden and, because of the deposition of heavy silt particles, the beds are usually higher than the flood plains. The flood plains were (and still are) subject to flooding during the summer monsoon. The land between the rivers includes areas in the central portions that are above the flood plains. These high areas are called bar. Before the modern irrigation system these bar were covered by grassy and woody vegetation. They were exploited by semi-nomadic people with large herds of camels, sheep, goats, and cattle. These people also engaged in some rainfall agriculture, and cultivated small parcels of land irrigated by Persian wheel wells, an endless chain of pots worked by a gear and shaft mechanism and powered by yoked animals. These wells were often 15 - 30 meters deep.

Development of the System. The British began planning canal projects even before the annexation of Punjab in 1849. The first modern canal in Punjab, the Upper Bari Doab Canal, was opened in 1859 and irrigation commenced in 1861. Thereafter the British continued building increasingly sophisticated and large-scale canals, with stock-taking interludes between them, until the end of their rule. Since 1947, Pakistan, with the aid of international donors, has completely remodeled and expanded the system. Aside from several new canal projects, two huge dams (Mangala and Tarbela) have been completed, and link canals constructed to carry water from the western to the eastern rivers and canals to replace water retained by India. According to the official figures, there are some 62,790 kilometers of canals in Pakistan; and there are 88,000 watercourses, irrigation ditches that carry the water to the farmers' own lateral ditches and to their fields. These average over three kilometers in length. Of 14 million hectares of cultivable land with access to river water for irrigation, about 10 million hectares are irrigated and cultivated every year. It is no surprise that the system has been referred to as the "Indus Food Machine" (ibid.; Planning Commission 1978:3).

The British engineers who built the system had no previous experience in building irrigation works. When they began, they had little theoretical knowledge of hydraulics, and knew little about groundwater hydrology and the like (Michel 1967:50-51). Furthermore, modern construction technology - machinery and building materials - was not available at first. By trial and error and experiments they developed many of the basic formulas and techniques now used throughout the world.

The system uses barrages to divert water from the rivers into the canals. The canals are designed for continuous operation at or near full capacity, some year-round (perennial canals), some for only the summer season (non-perennial). They are designed to maintain a "stable regime;" that is, silting and scouring ultimately balance in the main canals (Michel 1967:61). But the amount of flow cannot be regulated on demand and it may sometimes be interrupted during floods or repair work. Water flows continuously from canals into distributaries, through concrete modular outlets (mogha) into watercourses (which often have several branches). and finally into farmers' laterals and onto the fields (Fig. 1). The mogha is designed to deliver a fixed quantity of water when the canal is flowing at full capacity. Each watercourse commands from 60 - 250 hectares of land, generally cultivated by from 10 to over 150 farmers. The Irrigation Department is directly responsible for the operation and maintenance of the barrages, canals and distributaries, to the mogha. It also lays out the route and commanded area of the watercourse, but its operation and maintenance are the joint responsibility of the farmers cultivating land in its commanded area. Individual farmers (or small groups) build and maintain small ditches (laterals) to carry water from the watercourse to their own fields.

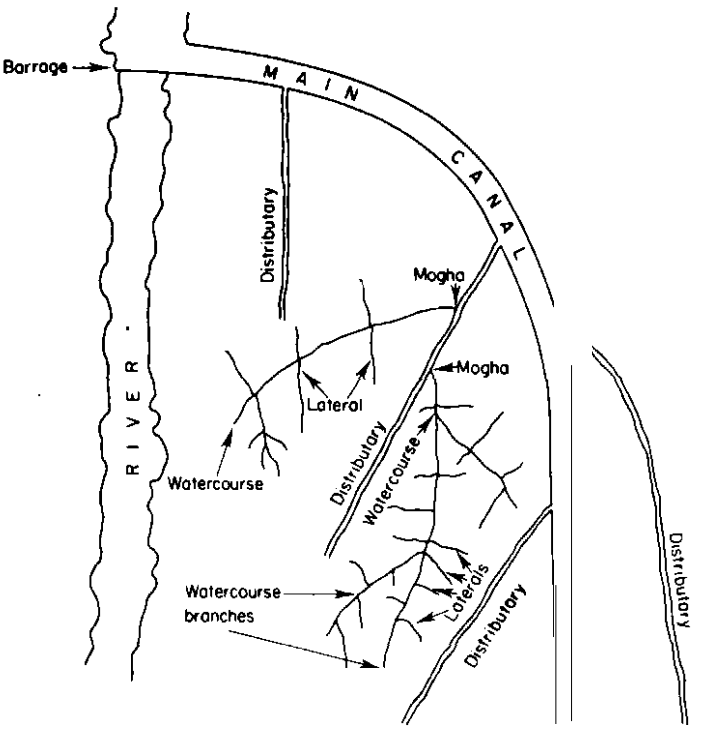


**Fig. 1. Schematic diagram of canal system**

Each farmer has a right to water proportional to the size of his land holding. Water is distributed on a time basis: each farmer is alloted a period of time to take water, usually on a weekly rotation basis. Originally the watercourse rotations *(warabandi)* were devised by mutual agreement among the shareholders. Shareholders who cannot agree on a rotation system may apply to the Irrigation Department to'establish a fixed legal system; most watercourses have now been converted to this pakka *warabandi.* Because it is a continuous flow system farmers receive the same share every week regardless of needs - which leads to periodic over- and under-irrigation. Trading of water among farmers is illegal because it causes waste, but it is commonly practiced.

The system was originally designed to operate with a minimum of human regulation or interference. For example, water is regulated at the head of the canal, but it is not possible to vary the flow into watercourses. Aside from engineering considerations, undoubtedly the British knew that recruitment of competent and responsible people would be difficult and a flexible system of water distribution would lead to uncontrollable abuses. They were also concerned to keep operational costs at a minimum since they were interested in recovering their investment quickly. These considerations also underlay the policy of minimal local intervention: farmers were expected to build and maintain their watercourses and settle disputes among themselves. The Irrigation Department retains considerable residual power, set out in the Canal and Drainage Act of 1873 (Jahania 1973). This power is used only when the shareholders appeal to the Irrigation Department. Similarly, the extension of irrigation included no instructions to the farmers on irrigation techniques. Farmers were left to their own devices (Johnson et al. 1977:1257). The major method continues to consist of the flooding of small basins. There is no adequate means of communicating information from the users to the higher level managers, or even from the top-down. Finally. no efforts have been made to organize farmers locally on either a formal or informal basis to manage the watercourse. The watercourse is a collective or "public good" which benefits all farmers using it, but

there is no mechanism to insure that each contributes his share to its maintenance (Olson 1965; Lowdermilk et al. 1978[II]:119-29).

The British had several motives for building the canal system. In the beginning there was an idealistic and enthusiastic desire to extend irrigation to demonstrate the benefits of European science. A decisive motive for the first canal was to give employment to potentially disruptive Sikh army veterans. Another more important and lasting motive was to improve the agricultural value and thus the revenue-producing capacity of the newly annexed lands. Yet another motive was fear of famine (Michel 1967:65-66).

The earlier canals were mostly designed to improve agriculture in already settled areas. Later projects emphasized settling new waste lands, which involved not only canal building but laying out of new villages, cities, roads, railroads, etc., and distribution of land to settlers. The British hoped to reduce famine in India by making Punjab the "granary of India" and to relieve overpopulation in the eastern districts of Punjab by settling farmers from these areas on new lands.

Characteristics of Modern Indus Basin Development Plans. Michel (ibid.) provides a detailed account of all the programs that have been proposed to solve the problems of the Indus Basin irrigation system, and the results of their implementation up to the mid-1960s. In this section I do not discuss these programs per se but focus on certain common characteristics of the proposals and policies. Since the Independence of Pakistan and especially since the signing of the Indus Waters Treaty in 1960 with India, a series of distinguished panels and study groups have produced long and detailed reports on the problems of the Indus Basin and their solutions. Perhaps the most influential reports have been the so-called "Revelle Report" (White House 1964) and the World Bank report (Lieftinck et al. 1969). A more recent panel, of which Revelle was a member, has reviewed the Revelle Report's recommendations and progress (or lack thereof) *so* far, and offered a series of research guidelines and topics (Planning Commission 1978).

While these panels have suggested a wide variety of solutions to the problems of Pakistan's irrigation system, all of their recommendations share several basic characteristics. The first is that they all have emphasized engineering and technological programs: large-scale tubewell projects, dams and link canals, and the like. The White House (1964) report recommended a massive integrated extension program to get farmers to adopt modern technology, but this program never materialized. The second characteristic is that all of the advice offered has required massive capital outlays, mostly of foreign origin. Michel discusses Pakistani criticism of the SCARP tubewell programs made on this basis in the early 1960s - criticism that was not heeded and that Michel himself dismisses (1967:470-72). The third characteristic is that the implementation of the proposed projects requires continuous input from foreign experts; that is, foreign consultants financed by major donors to Pakistan have advised Pakistan to adopt highly capital - and foreign-expert - intensive solutions, many of which have been and are being implemented. Michel discusses this point and defends the use of foreign consultants, but his arguments are not entirely convincing (ibid.:357-64).

The final major characteristic of the advice given in the Revelle and World Bank reports concerns the administration and organization of the system. Neither panel included any kind of social scientist other than economists. No research data on organization were available, but there is no indication in the reports that this was perceived as a handicap. Both reports were written after the Water and Power Development Authority (WAPDA) had been set up to execute the large scale water, power, and reclamation projects envisioned by Pakistan's planners; in fact, Michel suggests that one motivation for establishing WAPDA may have been to attract foreign aid (ibid.:350). The few pages devoted to advice on organizational matters (White House 1964:179-84; Lieftinck et al. 1969[II]:186-91) suggest further centralization of planning and management at the highest levels, and better co-ordination of the various organizations involved. No serious consideration seems to have been given - either by the foreign advisors or by the Pakistani planners and administrators -

to the problem of the relationship between the users of the irrigation water and the managers of the system; all assumed that the problems and their solutions were ones the planners understood best and could impose from above. One short paragraph in the Revelle Report, entitled "Long Range Goals," does suggest that "a central hope for the future should be the gradual emergence of associations for farmers...." (White House 1964:184), but this obviously was for the future, after the system had developed; it was not recommended as a strategy for developing the system.

More recently, for the first time in Pakistan's history, research has begun to focus on local level water management, This research has identified local level waste and mismanagement of irrigation water as a key constraint on improving agricultural production as well as a cause of waterlogging and salinity. Research on a similar irrigation system in India suggests that certain characteristics of the administration of the system itself result in farmers' uncertainty about their water supply, and this is a major constraint on productivity (Reidinger 1974; Gustafson and Reidinger 1971). All of this research has resulted in a recognition of the importance of local organizational factors, and recommendations for forming local farmer organizations (Water Management Research Project 1976 Planning Commission 1978).

Many of these recommendations, however, retain the "engineering mentality" of earlier advisors; that is, farmer participation and organization are viewed as being of the same order as technological problems: the function of research is to discover the appropriate organization of design - "the solution" - and introduce it. Just as the problems of rising water-tables, salinization, and inadequate supply of irrigation water are "solved" by installation a network of tubewells, so, it seems to be assumed, inadequate organization can be solved by installing a new farmer organization. Furthermore, only the formation of local organizations with vaguely defined but limited responsibilities have been suggested. There has been no consideration of the dynamics, the adequacy, or the consequences of the present organization of the irrigation system.

Most of the high-powered recommendations and the policies pursued to date, then, share the same characteristics: an orientation toward purely technical solutions, designed and implemented from the top down, with the financial and advisory aid of foreign organizations, and an assumption that the experts know best what the problems are and how to solve them. Although the major reports and recommendations are thick and comprehensive, none have seriously addressed the most fundamental problem of all for the future of the Indus irrigation system: how should it be organized? What should be the role of its users in its management? What have been the consequences of the present organizational structure? Policy based on faulty assumptions about the goals, values, ability to co-operate, and behaviors of local users is bound to fail. For example, if local irrigation associations were established in Pakistan and the legal framework for these organizations were to specify Western rules and procedures, such as decision-making by majority vote and some version of Robert's Rules of Procedure, these organizations would probably not work in the way envisioned by the planners. Such procedures are inconsistent with local users' decision-making patterns as well as with the prevailing stratified socio-economic structure of rural society. The remainder of this chapter illustrates the potential of an approach from social science towards the problems of designing and evaluating programs to involve the farmers in local irrigation improvement projects.

## Watercourse Reconstruction: A Case Study

Gondalpur (a pseudonym) is a village in central Punjab, on the Chaj Doab, the area between the Jhelum and Chenab Rivers. This area has traditionally been called Gondalbar, because historically the Gondal tribe dominated the area. In the flood plains among the rivers, intensive agriculture based on flooding by the river, inundation canals, and wells, has been practiced for centuries. Being located above the flood plain, Gondalpur had no canal or inundation irrigation before 1904. The vegetation of this semi-arid area consisted of various small and deep-rooted trees which

provided fuel, fruit, and fodder, and a variety of grasses on which the ancestors of the present inhabitants raised large herds of cattle. At the time of the first British survey in 1857. there was one Persian wheel well irrigating 7 hectares; irrigation was also practiced during the monsoon by catching runoff in a low place, and planting primarily millets, By the 1880s, 30 years after British rule was established in the area, there were 3 Persian wheel wells. The wells tapped a water table 15 - 25 meters deep, so that even with good oxen or buffaloes, only about one-fifth of a hectare could be irrigated in a 12 hour turn.

Informants claim that animals, not land, were wealth: a man's standing in his community depended mainly on the size and quality of his herd. Agriculture was meant to supplement a diet which was based on dairy products and meat. The British land records show that the short-lived previous regime of Ranjit Singh had imposed a head tax on animals and no tax on land in this village. The British discontinued this policy and imposed a moderate (in their eyes) land revenue. This meant that land had to be registered in individuals' names - an innovation. Informants say that their ancestors regarded this as an unfair burden and some sold or gave their land rights to others for almost nothing. Stories are told of how people in nearby villages punished their enemies and servants by having land registered in their names.

During the 49 years between the first British land settlement and the arrival of the canal water in Gondalpur. however, there was a substantial rise in population and a gradual extension and intensification of agriculture (Table 1). Population grew far more rapidly than did the extent of cultivable land, mostly as a result of immigration. There was also a fairly large-scale transfer of control over land to outsiders - and a concomitant increase in tenancy. The Lower Jhelum Canal was officially opened in 1901, but its water did not reach Gondalpur until the 1904-05 winter *(rabbi)* growing season. Its impact was immediate: scores of hectares of land came under cultivation during both the summer *(kharif)* and winter growing seasons. Former cattle keepers and part-time farmers became full-time farmers, either on their own land or as tenants on others' land. The area available for grazing animals declined while the number of animals increased, so that even a few years before the canal was introduced most farmers had begun devoting a substantial percentage of their land to growing fodder for their animals. Other changes since the introduction of canal

***Table 1.*** **Changes in population and cultivated area in Gondalpur since 1857.**

| Year | Population | Areas of crops harvested to hectares | | | |
|---|---|---|---|---|---|
| | | Rainfed | Irrigated | | Total |
| | | | Well | Canal | |
| 1857 | 67 | 18.8 | 7.3 | 0 | 26.1 |
| 1890-91 | 310 | 87.1 | 17.2 | 0 | 104.3 |
| 1901-02 | 568 | 69.3 | 18.2 | 0 | 87.5 |
| 1905-06 | na | 4.5 | 0 | 194.4 | 198.8 |
| 1910-11 | 565 | 0 | 0 | 233.7 | 233.7 |
| 1921 | 767 | 2.0 | 0 | 315.1 | 317.1 |
| 1931 | 758 | 133.4 | 0 | 139.7 | 273.4 |
| 1951 | 914 | 40.5 | 0 | 242.6 | 283.1 |
| 1961 | 1117 | 25.9 | 0 | 313.9 | 339.8 |
| 1972a/ | 1246 | 36.5 | 0 | 384.3 | 420.8 |
| 1977b/ | 1450 | 21.4 | 5.2 | 356.2 | 382.8 |

***Sources:*** **All data are from unpublished village records except the 1961, 1972, and 1977 population figures. The 1961 and 1972 population figures are from the District Census Handbooks for those years; the 1977 population is based on a census carried out by the author and his wife in February-March 1977. "Na" means "not available." a/ The figures for area harvested are 1968-69 figures, the closest ones available to the 1972 population figure. b/ The figures for area harvested are for 1975-76.**

irrigation include: a further rise in population; increasing fragmentation of land holdings; major changes in diet; increasingly intensive agriculture; and a rise in the water table of 12 to 20 meters, so that today nearly everywhere it is less than 6 meters below the surface, and in some it is less than a meter and a half. A large low-lying tract in Gondalpur has become waterlogged and an adjacent previously productive area is now saline and unproductive. The major crops today are wheat and fodder crops in the winter, and rice, sugar cane, fodder crops, and some melons and cotton in the summer. Most of the land is double-cropped every year.[3]

Watercourse Social Organization'. The dominant landowners in Gondalpur, the Gondals. are divided into four named *biradari,* brotherhoods which are local co-resident groups based on a combination of patrilineal descent and marriage (Alvi 1972). The biradari are concentrated on different watercourse branches (Fig. 2).

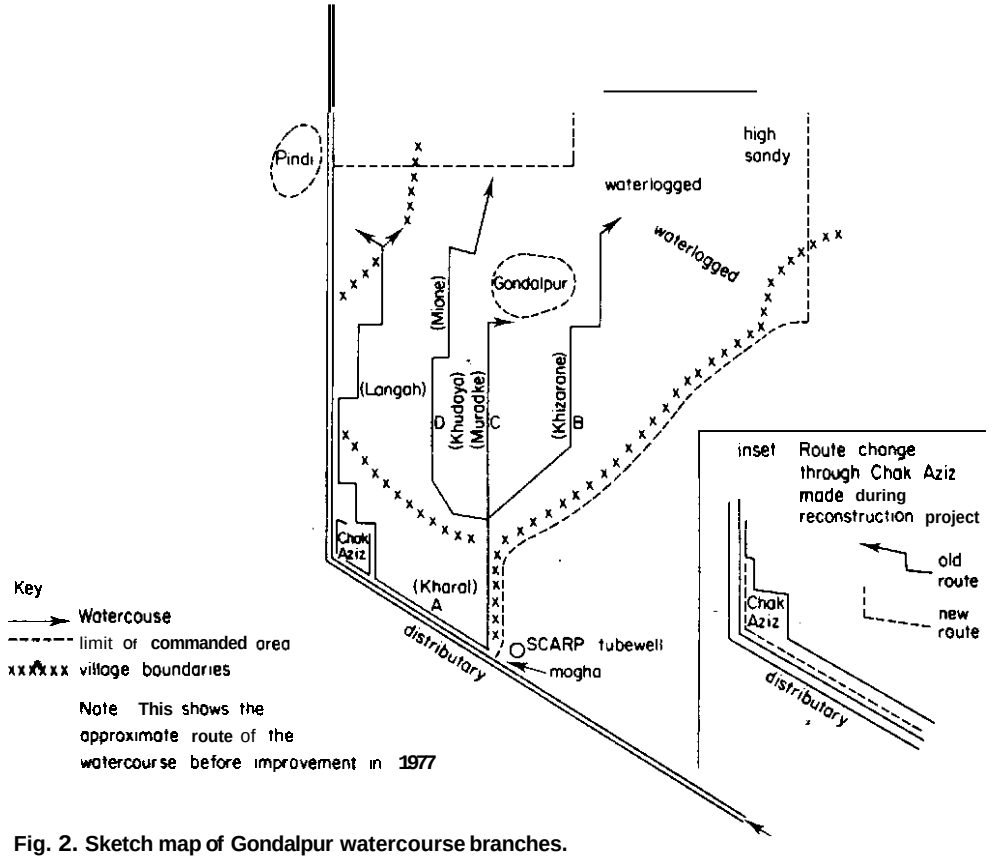


**Fig. 2. Sketch map of Gondalpur watercourse branches.**

[3]The changes in Gondalpur between 1857 and 1977. both those that preceded and those that followed the introduction of canal irrigation. are the subjet of D. Merrey (1983).

'Much of the material on the watercourse reconstruction project and implications of the concept of *izzat* appear in Merray (1979)

Table 2 shows the relationship between biradari and watercourse branch. The Gondal biradaris are Khirarane (branch B), Muradke (branch C), and Khudaya and Miane (branch D). The first three so dominate particular branches that they are known by their names. Besides the Gondals, families belonging to other groups or *zat,*[5] also have land on various branches. A few Awan have very small holdings on branches B and C; two Bhattis have some land on branch B, as do three Sayid families; and some Muradke and Khudaya have land on branch B, though most of this land is either waterlogged or saline, or too high for irrigating. On branch D, aside from the Khudaya, a few Pindi farmers also have land, as do the religious leaders of Gondalpur, the Miane. The *numbarda*[6] and his family, who have relatively large holdings (20 - 30 hectares) are Khudaya; the Miane holdings are also relatively large (about 10 hectares for each of three households), while the other two Gondal biradaris are mostly small farmers (2 - 8 hectares). Ehattis outnumber Gondals in the village as a whole as do the Massali laborers, but the former are mostly tenants and the latter landless and poor.

***Table 2.*** Biradaris involved in watercourse reconstruction?'

| | Number of Households | Number of People | Watercourse" branch | Position on branch |
|---|---|---|---|---|
| ***Gondalpur biradaris:*** | | | | |
| Gondal-Khudaya | 11 | 70 | D; a little on B | H, M. T |
| Gondal-Khizarane | 212 | 105 | B | H, M, T |
| Gondal-Muradke | 7 | 43 | C; a little on B | H, M, T |
| Gondal-Miane | 5 | 36 | D; a little on A | M, T |
| Langah | 5 | 36 | A | M |
| Awan | 11 | 47 | B and C[c/] | M |
| Bhatti-Rajeane[d/] | 18 | 78 | B (2 households) | M |
| Sayid | 3 | 25 | B | H, M |
| ***non-Gondalpur biradaris:*** | | | | |
| Kharal (Chak Aziz) | 3 | ? | A; a little on B | H |
| 3 Pindi biradaris[e/] | under 10 | ? | A & D | T on both |

**Notes:** Branches: A - Chak Azir, B - Khizarane. C - Muradke. and D - Khudaya H - Head, M - Middle, T - Tail,
[a/] This is **not** a complete list of all biradaris in Gondalpur; only those having land irrigated by the reconstructed watercourse ar listed. Values are based on 1977 complete household census. [b/] See Figure 2.
[c/] Very small holdings. Only two households of this biradari have land on this watercourse. There are 7 Bhatti biradaris in Gondalpur with a total of 90 households and 416 people as of 1977. [e/] These biradaris did **not** play an important role in the improvement project - their major holdings are on other watercourses; they generally acted together on this project.

[5] *Zat* is a cognate of the word usually translated as "caste" or "sub-caste" in North India, but caste is **not** a proper translation of zat here since zats as understood in Gondalpur are **not** endogamous or systematically ranked vis-a-vis each other. For a complete discussion of ceste in Gondalpur (and Pakistan Punjab) see K. Merrey (1983).

[6] *Numbardar* is a hereditary position created by the British: he collects the land revenue and irrigation fees for the government, keeping a percentage for himself, and acts as an intermediary between the villageis and government officials.

At the head of branch A, where it passes through Chak Aziz, are four related households of Kharal zat. One is a very large landowner (about 122 hectares), having bought much land in a nearby village. His brother has about 20 hectares on branch A and their half-brother's two sons have about 20 hectares between them. Though these two brothers often quarrel with each other, they did not during the watercourse project. I shall refer to them collectively as the "step-nephews." Following the Kharal, on Gondalpur land, branch A irrigates the land of several very small farmers (0.5 - 9 hectares) of Langah zat. The members of this zat, though poor, have marriage relations with the Khuydaya, Muradke. Kharal, and a large Pindi landlord. Some of the land belonging to the Miane is irrigated after the Langahs by branch A, and finally, at the tail, branch A irrigates small portions of the relatively large holdings of several Pindi families.

Watercourse Conditions Before Reconstruction. At the time of the study (1976-77). the level of maintenance of all the branches on the watercourse was extremely poor. A SCARP tubewell had been installed at the head of the watercourse in the mid-1960s. doubling the amount of water flowing through it. As is generally the case in the SCARP areas, the intensity of cultivation increased substantially as a result of the increased water supply. Most land is now double-cropped each year on this watercourse. However, the capacity of the watercourse was not increased. Furthermore, for some years after the installation of the tubewell, there was no perceived shortage of water. According to informants this led to a decrease in maintenance efforts, atrophying the already weak sanctions enforcing participation in watercourse cleaning. Further, fragmentation of plots has led to increased numbers of illegal (that is. not sanctioned by the Irrigation Department) cuts in the main water channels. The watercourse on all branches was choked with grass, bushes, and trees; leaked through rat holes, thin banks, and at junctions; and water remained standing in many low sections after irrigation. On branch A, since the Chak Aziz land is relatively high, the Kharal owners actively sabotaged efforts to clean the head of the watercourse. Silting raised the water level, and thus their ability to irrigate their high land, but it blocked a large percentage of the water from reaching the middle and tail farmers.

The Reconstruction Process. The lack of watercourse maintenance, combined with increasing pressure to raise production (in part limited by the water supply), had created considerable dissatisfaction with the condition of the watercourse by 1976. In response to this dissatisfaction, I was instrumental in arranging for the Mona Reclamation Experimental Project to choose this watercourse for an experimental improvement program.' In this program, the Government supplies technical advice, supervision, and materials such as concrete outlets *(nakka)*. The farmers are responsible for supplying all labor for the earthen improvements, masons for installing outlets, concrete sections, and culverts, and for subsequent maintenance. Some Gondalpur farmers had heard about the success of the improvement program in other villages: according to a survey they were aware that the losses from their watercourse were high and they were eager to improve it.

The improvement program on this watercourse undoubtedly faced more problems than is usual on a single watercourse, but this makes it an important case to study as all of the problems encountered characterize other watercourse reconstruction efforts to various degrees. A description of all that happened during the six months of active improvement work would constitute a book in itself; a brief summary will show the kinds of problems faced by the project.

At a farmer meeting in June 1977. two committees were set up: one, for branch A, included a Kharal representative from Chak Aziz (the youngest of the two step-nephews), a Gondalpur Langah, and Pindi numbardar. For the main branch and branches B, C, and D, one Khudaya, one

---

**'The arrangement was that I would observe, but not participate in. the process; in fact. people often sought my intervention to influence the engineers and upon occasion I did offer suggestions to the Mona Project personnel - which were rarely followed.**

Khizarane. and an Awan were chosen. The branch C Muradke refused to take part in the improvement program on their branch and therefore had no committee member. There were several reasons for their refusal: they did not perceive much of a water shortage; they preferred to continue cutting their watercourse freely; and, because they were angry at their Awan relatives over unrelated issues, they opposed any program the Awan supported.

Work began on branch A - but on the same day as an announcement of land allotments under the land consolidation program in Gondalpur; therefore, only Chak Aziz shareholders were present at the work site and they successfully pressured the Government engineer to start work on a new route for the watercourse that was parallel to the distributary around their village (see inset on Fig. 2). This route had been discussed previously and opposed by the middle shareholders, but now it became a fait accompli and they could not oppose it. Because the old route had passed through the step-nephews' land and another Kharal's courtyard, while the new one is on Government land and higher than the old one, the Kharal benefited substantially from this change.

Over the next few months work continued fitfully on branch A, and the engineer had branch D and B work begun even though he had not yet done a survey to indicate the route, width, and depth. The farmers on B and D noticed that their water supply was reduced as a result, leading to considerable tension between them and the engineer. At the meeting with the farmers, the engineer accused the farmers of not co-operating with him and gave them an ultimatum - to follow his instructions without argument or he would abandon the project. The farmers were angry but agreed to his demands. These branches were then surveyed and the work redone.'

A number of disputes broke out among the farmers (aside from a series of continuing disputes between the farmers and government officials):

1. On branch D, two Khudaya, the numbardar (supported by the Miane), whose lands were at the head and middle, and his paternal cousin, a watercourse committee member most of whose land is at the tail, disputed over how far towards the tail the improvement work should go. The numbardar and Miane wanted the work to stop about 300 meters short of the cousin's land, so that no improvement work would be done on the section through their land. When the tail cousin refused to cooperate unless his demands were met the numbardar agreed, though the Miane continued to protest and refused to cooperate on the work.

2. The Miane, near the middle and tail of D, continued to dispute with Khudaya over how far the improvement should go and over the route of the watercourse. The engineer, based on his survey, wished to straighten it. Because it skirted the edge of Mianes' land and over the years had shifted, increasing their land, moving it would have reduced their land slightly. It was straightened, finally, but over their continuing protest.

3. On branch B, the Khizarane leader frequently argued with Muradke, Khudaya, and Sayid shareholders over the division of the work.

---

**'There were significant differences among the branches in the organization and efficiency of the work. Except for a few portions of branch D done collectively. the work on each portion of all the branches were divided among the shareholders proportionally to the amount of land they irrigated. The large farmers at the head and tail of branch A had their tenants and servants do the work, while the small farmers in the middle did their own share - and did it more quickly. Most of branch D was doen by tenants, servants, and hired laborers, and more time was spent smoking and gossiping than working, significantly slowing the work. All but a few of the branch B shareholders did their own work, and theirs was completed very quickly.**

4. On branch A, the Pindi shareholders and Miane were lax about doing their share of the work, leading to conflict with the others and long delays in completing the section.

5. The Langah committee member and the Kharal member disputed over the route changes in branch A demanded by the Kharal, as well as the division of work shares. Because of his weak position, the Langah pursued these issues more with the engineer than with the Kharal directly. In every case, the Kharal won because both the government officials and other farmers feared the consequences of the Kharal not cooperating given their strategic position on the watercourse,

6. The Kharal step-nephews, who had traditionally taken unauthorized water from the main branch, successfully sabotaged the work on that branch, including preventing the removal of trees and straightening the route. There seemed to be three reasons for their obstructionism: they realized that taking illegal water from the main branch would be more difficult; they would lose a little of the land they had occupied if the watercourse were straightened; and they were jealous. They opposed any program that would benefit the weaker Gondalpur people, perhaps fearing they would become independent.

7. The Kharal demanded and, by threatening to sabotage the project, obtained extra nakkas and double-sized culverts for their land but even after getting them the two step-nephews in particular continued to sabotage the work.

A project that was expected to be completed in less than two months was not finished in December 1977. the sixth month, when I left. When I returned in May 1978, I discovered that some sections still had not been reconstructed, especially in the middle and tail sections of A and B; some of the sanctioned nakkas had not been installed and several of the installed ones had been damaged; and no cleaning or maintenance had been done. All the branches were choked with weeds and silt and leaked from new unauthorized cuts in rebuilt banks. Even in October 1978, the normal watercourse cleaning in preparation for the winter season had only been haphazardly done.

The sections completed up to December 1977, immediately after reconstruction, did not leak, and farmers enthusiastically reported up to five times as much water reaching their fields as before. However, by October 1978. the water delivery had drastically declined to only slightly above pre-improvement rates. The watercourse sides, because of both poor construction and very poor maintenance, had deteriorated considerably and were leaking badly; much water remained standing in the ditch after irrigation and many farmers felt discouraged about the prospects of maintaining even the present level of efficiency.

## Punjabi **Culture: The Game of Izzat**

There is no doubt that one source of the problems faced by this project is the relationship that developed between the farmers and the government officials supervising the program. Although some of these engineers and extension workers have rural backgrounds, their education has seemingly made them unfit for rural work. Possessing a formal degree and a respectable position in the government bureaucracy, they are "officers." They create barriers between themselves and their clients by wearing western clothes, speaking an urban dialect, and doing all they can to create the impression that they possess a superior knowledge and position which ought to be respected. When the clients assert themselves and refuse the officer the respect (read obeisance) he claims, conflict arises and the officer's low opinion of his clients is confirmed in his mind. This kind of relationship between government officials and farmers is not confined to Pakistan.

Another factor was that the potential benefits of the program were not perceived as equally distributed (Doherty and Jodha 1977). Indeed, equal distribution of benefits in a watercourse

reconstruction program is impossible to achieve because of differences in size of landholdings, differences between owners and tenants, and most crucial, the relatively greater benefits accruing to farmers with land at the tail than to those with land at the head of the watercourse. Even if the benefits of reconstruction were distributed equally. one could argue that any rational individual will minimize his contribution toward such a collective good because he cannot be denied its benefits even if he does not invest in the project (Olson 1965). However, the active attempts by the step-nephews to sabotage the program, even on other branches in order to prevent others from benefiting, and the disputes that developed among persons whose benefits were about equal, suggests these factors are insufficient as explanations of the problems encountered,

A major source is to be sought within the social organization and culture of rural society. Punjabi rural society is characterized by a set of values and structural mechanisms which - in relation to their irrigation system - encourage conflict, make it endemic and unavoidable, and thus tend to discourage co-operation on a long term basis. These values may have been adaptive before the irrigation system but have continued to operate even though they appear maladaptive under present conditions.

The ancestors of the Gondalpur farmers who were cattle herders and part-time farmers were probably not permanent residents of Gondalpur before the British settlement. This settlement awarded permanent rights that had not existed before. One characteristic of pre-British Gondal society was relative mobility of individuals and families: larger local groups were unstable as people were free to move and often did move with their animals. The type of situation now known as the "tragedy of the commons" (after Hardin 1968). in which individual herdsmen continue to increase the size of their individual herds even after the carrying capacity of commonly owned grazing lands had been exceeded, did not arise because people were able to leave for less crowded, if not greener, pastures. It seems likely that under these conditions it was not necessarily recognition of overgrazing per se that triggered dispersion but rather a high incidence of social conflict maintained dispersion.

The most fundamental concept or theme in rural Punjabi culture, in terms of which much of Punjabi behavior can be understood. is ***izzat***.[9] Izzat may be glossed as "honor," "esteem," "reputation," "status," or "face." It is a "limited good" (Foster 1965) and one acquires it only at others' expense. As in a zero-sum game, the success of one person is a threat to all the other players, a characteristic that generates competition and jealousy. For example, when government officials agreed to a very reasonable request for a double-width culvert for truck access to one of the Kharal's brick kilns, his step-nephew demanded a double-width culvert for himself. Informants said his izzat was at stake: if he got less than his step-uncle he would lose izzat. Government personnel, not accepting the rules of the local izzat game, rejected his demand, which led to further problems with the man.

All men wish to avoid losing izzat. but many men also attempt to increase their own izzat or reduce others'. One acquires and increases one's izzat by several different strategies. First, one must have the ability and, more importantly, the willingness to use force. There is a famous Punjabi saying, "Whoever holds the stick owns the buffalo." This does not necessarily mean force is resorted to frequently; it is enough to create the impression that one is willing and able to use force and, in times of tension, much calculation and speculation revolves around this issue. The Kharal step-nephews were feared because they had demonstrated their willingness to use force in previous fights. The Bhattis of Gondalpur. mostly tenants and poor, in the past also had a high

---

[9] ***Izzat*** **is the most common and broadest term; there are others but they tend to have more restricted meanings. The term has obvious affinities, conceptual and historical with the Middle Eastern and Mediterranean concept of "honor" (see Peristany *1966* and Campbell *1964* for examples).**

izzat for the same reason. On the other hand, the Khudaya numbardar, despite land holdings, his official position, and several adult brothers, had less izzat then he might have had because it was known he feared violence. This was not an unreasonable fear since his father had been murdered in 1962.

A second means of acquiring izzat is possession of inftuence with government officials, and willingness to use it for one's supporters and against one's enemies. The Kharal step-nephews, some Pindi landlords, and a recently deceased poor and landless Bhatti leader before his death, all had a substantial amount of izzat from this source (as did the author). A third source is willingness to entertain guests lavishly, whether they are government officials or relatives at a wedding - even to the point of bankruptcy. The deceased Bhatti leader mentioned above kept himself bankrupt but high in izzat by this strategy.

Success in competition, whether in organized games such as kabadi or in a stick fight, is another source of izzat. Winning, not a valiant loss, is the key. Another source is generosity. not to the general public, but towards individuals (who are obliged then to render support)." Finally, successful one-upmanship, including revenge for a previous defeat or insult is important. For example, disputes are often taken to the police; the person or group that can avoid jail or being beaten by the police, while getting the opponent punished and spending the least money doing it, "wins." Such cases often become very long, involved, and expensive but they continue even when people are aware that after so much trouble and expense they will have nothing tangible to show.

In order to improve izzat, *taqat* (strength or power) is needed, but taqat alone is insufficient; it is also necessary to use this power to help clients or defeat enemies. The richest of the Kharals has less izzat than one would predict from his wealth and government contacts because he is unwilling to use his position in this way. A person whose taqat and izzat are increasing attracts followers and allies who hope to benefit, but he also attracts the jealousy and fear of others who are likely to band together behind the scenes to plot strategies to limit or reduce him. If a group (such as a biradari) or several brothers become too powerful, efforts are made to sow dissension and thus weaken their unity. Because individuals' primary loyalties are to themselves - and each one assumes this to be true of others - efforts to divide groups, or even two brothers, often succeed.

People informally recognized as leaders are supposed to work for the benefit of their followers as a group. But more often than not such persons keep their own interests in mind first and attract clients by aiding individuals (against their enemies or with the police, for example) who are then obliged to them. Only infrequently do leaders work for the benefit of a group or community as a whole - and even when they do, others may accuse them of seeking only their own benefit.

Opposition is often expressed verbally in terms of issues, but in fact the issue is nearly always a pretext: men oppose or support decisions and programs based on their perceptions of their competitors' position. For example, even though all farmers suffered the exactions of a corrupt tubewell operator, they did nothing because, informants explained, if one man or group proposed petitioning for his removal, others would oppose. This would be done not out of love for the tubewell operator but to prevent the others from gaining some advantage from the issue or to pursue some long-standing grudge. This can he carried further: the non-cooperative behavior of the Kharal on branch A during the watercourse reconstruction was interpreted by informants as based on a desire to prevent others from benefiting - even if it means foregoing their own potential benefits. There is a Punjabi saying, "If my neighbor's wall falls, it is good - even if it falls on me." Opposition is never legitimate in the western parliamentary sense: it is always personal (or interpreted as personal) and aimed at weakening others or strengthening one's own position.

---

**"Religious generosity such as building a mosque earns one "respect" *(abad)* for piety. but is not itself a source of izzat; pious acts score points in a different game.**

There is a strong ethic of loyalty to one's kinsmen; one ought to be prepared to make sacrifices for their benefit. Marriage within the biradari - siblings and cousins exchange children - is intended to cement their affections and relationships. Divisions within the community, in Gondalpur and other villages, are usually between biradaris. This was the case for most disputes over the watercourse reconstruction program. There is a feeling that a biradari's izzat must be protected from others' attacks, and if a man's izzat suffers at the hands of a member of a different biradari, all of his close kinsmen may unite in opposition to the "enemy."

Nevertheless, despite the emphasis on loyalty to one's kinsmen, tensions among biradari members are always present. Patrilateral cousins and brothers often have tense and competitive relationships and do not completely trust each other. One's brother's or cousin's personal izzat is not necessarily one's own: hence, a man is apt to be jealous of and feel threatened by a brother's success. Tension is also generated among biradari members by joint potential rights in land. One of the worst cases of conflict in Gondalpur history, resulting in two murders and three executions, occurred within the Khudaya biradari over land: one branch attempted to deprive another branch of rights to some land. Tensions built up and the latter finally took action by murdering the numbardar and his brother. The amount of land involved was in fact not great; the real issue was izzat. If the second group had allowed itself to be deprived of the land, its members' izzat would have been severely damaged.' [1]

During the improvement process there was much petty conflict among biradari members over work shares and the like; the Kharal are seriously divided, and the Khudaya only slightly less so. The Awan and Muradke, though separate biradaris in one sense, are closely intermarried, yet. at the time of this project, they were involved in conflict over several issues which prevented them from cooperating on the project.

The sense of community within the village is real but also intertwined with izzat. In opposition to outsiders, villagers will act together in a stick fight or a competitive game to preserve the izzat of the village. However, cooperation within a community to achieve a mutually beneficial goal is very difficult as people fear others may benefit more than they or the leaders will gain undue influence. In some villages there are leaders who are sufficiently trusted (or feared) to insure that farmers cooperate to maintain their watercourse, but this is not true of most communities and is not a permanent characteristic of any community.[12]

---

"The numbardar and the cousing with whom he argued over the extent of work on the watercourse are the **sons** of the two murdered men; their relations are tense in part because of jealousy and idssatisfaction over the subsequent partitioning of their fathers' land; and in part because each fears the other will gain an advantage. An exchange of sisters would seem to be called for here but each branch is marrying matrilaterally (outside the village), thus accentuating the division.

[12] One Pakistani commentator on an earlier draft of this chapter, as well as **one** of my Gondalpur informants with whom I discussed my conceptualization of izzat, suggested that I have confused what my informant calls "false izzat" with "true izzat." "True" izzat refers to the more positive characteristics included in the concept. while "false: izzat includes more negative behaviors such as undercutting others, and creating fear in others. It is important to note that my informant hers is one of the Langah. who are not active participants in the main game of izzat. Other Gondalpur informants. while understanding the distinction. insist nevertheless that obstructionists like the step-nephews do have izzat in most peoples' eyes; men who are feared to as *badmash* (bad character, trouble-maker, bully) are also respected (even admired) and regarded as having izzat; and the badmash themselves believe they are increasing their izzat by their behavior,

## Social Organization on Other Watercourses[13]

During 1.978, I collaborated in a study of the social organization of ten reconstructed watercourses in Punjab. We deliberately chose our sample so as to include several problem and several model watercourses. We also chose watercourses for which a maximum period of time had elapsed since improvement (the range was four months to two years), and which represented several different agronomic areas of the province. The purpose of the study was to identify those sociological characteristics of rural society that both promote and inhibit effective cooperation on watercourse rehabilitation and maintenance. The results complement the intensive research reported above. Mirza and Merrey **(1979)** provide a detailed discussion of the methods and results of the research. Here only a brief summary of the conclusion is possible.

We discovered that both the ease and completeness of the actual reconstruction process, and the quality of the maintenance after improvement, vary considerably. Furthermore, there are systematic relationships between the relative success of improvement and maintenance quality, and also between these and certain sociological characteristics. Watercourses whose improvement was completed without significantdelay or disruptive conflict are generally better maintained than those where the improvement process has been difficult. The better maintained watercourses tend to have all or most of the following characteristics:

1. ***A large percentage of farmers with the landholdings in the 2.5 to 10 hectare range.*** We defined holdings in this range as "small but economically viable" in irrigated Punjab. Watercourses dominated by farmers below this range seem to be very difficult to organize for cooperative programs, perhaps because they are less committed to farming as a full-time occupation. Larger farmers usually have laborers do their share of the watercourse work, with the result that it is often done carelessly. Large farmers are also more able to violate sanctions, and are more involved in conflict.

2. ***Relatively equal distribution of power and influence among farmers on a watercourse.*** "Power and influence" was measured by asking sample farmers to rate all the other farmers on the watercourse and adding the scores. Where influence is more equally distributed, and one or a few farmers do not dominate, farmers seem to cooperate better on collective projects.

3. ***A large percentage of farmers being perceived by fellow shareholders as having some influence andpower.*** On some watercourses, power and influence scores were uniformly low - no one commanded any respect. Cooperation on such watercourses was much less than on those where the scores were higher across the board; that is, where most shareholders have at least some standing and respect.

4. ***Concentration of power and influence at the tail or at the tail and middle of the watercourse.*** Farmers at the tail of a watercourse usually receive the greatest benefits from improvements and are thus more highly motivated. If these farmers have comparatively greater influence, they often insure maximum cooperation by others.

5. ***Progressiveness of the community.*** This is measured as the percentage of farmers with a better than primary education, number of institutional services available in the community, and percentage of farmers who listen to the radio regularly. These three components together were used as a measure of community attitudes toward modernization and change.

---

[13] Some of the material in this section was first presented in D Merrey (1980), but the implications are developed further here

6. Previous history of co-operation on community projects, and lack of serious recent conflict. Communities that had successfully cooperated on previous projects - such as building a school - and which had not been divided by serious conflict in recent years, cooperate more effectively on watercourse rehabilitation and maintenance.

7. A small number of shareholders on the watercourse. On the watercourses with the largest number of shareholders - even if they all belonged to one biradari - getting the farmers to work together to rebuild and maintain their watercourse proved very difficult.

8. Membership of most of the shareholders in a single *biradari*.

In reality the ideal characteristics listed above are not found very often in rural Punjab. None of the watercourses in our sample were well-maintained, but those which were comparatively better maintained share more of these characteristics than those which were in poor condition. None of the watercourses had an effective organizational mechanism to insure that all shareholders did their share of the cleaning. On five of the ten watercourses studied, the reconstruction work had not even been completed because of conflict among the shareholders or between the farmers and government engineers. Our study shows that quality of improvement and maintenance is closely related to sociological characteristics of the watercourses, but it also shows that present forms of organization are not adequate to insure good maintenance of the system, even on relatively conflict-free watercourses.

Punjab villages exhibit a considerable variety of structural forms: single, double, and multi-biradari villages; villages with strong leaders and those with weak leaders; villages with no recent history of serious conflict and others where murders occur yearly; and villages of small, medium, and large farmers, as well as owners and tenants; and, a few villages where landholding distribution is fairly equal and many where the pattern is highly skewed in favor of a few farmers. Gondalpur's social organization included all of the characteristics shown in the later study to be least conducive to successful cooperation on a watercourse reconstruction project.

However, in contrast with the variation in social organization, there is relatively little variation in cultural values: the concept of izzat is shared to a large extent by all rural Punjabis but it leads to the pursuit of different strategies depending on the social context. Both of the studies together show that the organizational and cultural impediments to a cooperative program - such as watercourse reconqtruction - are serious indeed, and even if the watercourse is successfully rebuilt, the inability of the users to maintain it means the investment in reconstruction may be wasted. However, one can go further than this: these organizational and cultural impediments, together with the ineffectiveness of the overly centralized bureaucratic management structure of the system, are at the root of the low productivity of the system; the minimal payoffs from the huge amount of capital invested in dams, canals, and SCARP tubewells; and, to an undetermined but probably very large extent, the waterlogging and salinization - the processes of desertification.

## Conclusion

For decades, research and development projects on Pakistan's irrigation system have focused solely on the perceived technical problems and on their solution by means of large scale capital. intensive purely technological approaches. The users of the water - the farmers - have been ignored. In the 1970s, as a result of the research efforts of a number of American and Pakistani scientists, local-level problems and inefficiencies began to be recognized. However, initially this research too focused solely on technical problems such as watercourse leakage and rehabilitation. Experience with pilot watercourse reconstruction projects soon demonstrated that farmer cooperation was the key to the success of the projects. The focus on farmer cooperation, on which little research had been done, led to an increasing level of collaboration of sociologists and

anthropologists with the engineers, agronomists, and irrigation specialists in an attempt to develop and effective watercourse program. It was expected that about a dozen experimental Water User Associations would be'organized under existing laws and their activities monitored. The end-product was to be recommendations for forms of organization to be used for establishing associations of irrigators for improving local level water management (see Mirza and Merrey 1979). However, the cut-off of American aid to Pakistan in 1980, as well as various political developments in that country, made it seem extremely unlikely that this program would be carried out in the foreseeable future.[14]

This work was based on the assumption that such tinkering with the system could be effective in improving its productivity as a whole, and reversing the process of decline and desertification in the form of declining levels of maintenance at all levels, and waterlogging and salinity. This assumption now seems highly questionable. The technical problems of the system cannot be solved as if they were isolated from the larger social, cultural, and economic context. This point may appear obvious to a social scientist but it does not generally characterize development policies and programs, especially of relatively conservative countries such as Pakistan.

The "engineering mentality" has been carried over from the older style development projects such as dam construction to the more people-oriented programs. For example, the planners of the pilot watercourse reconstruction project in Pakistan believed their own rhetoric that farmers' perceptions of their self-interest in watercourse reconstruction would overcome long-standing social and cultural impediments. The social scientists were called in somewhat later and expected to carry out rapid surveys (complete with statistics) to identify the problems and propose solutions to insure the success of the project. Social scientists, can, it is true, often identify social and cultural impediments to seemingly useful projects, and social and cultural factors involved in processes of environmental deterioration, and, having identified the problems, they can suggest strategies to overcome them. There are undoubtedly many situations where this narrowly conceived role is quite adequate, but Pakistan's irrigation system is not one of them.

In my discussion of the various recommendations and development projects in the Indus Basin, I have drawn attention to the fact that none have dealt with the most fundamental issue: the organization of the system. The study of organization comprehends the nesting of local systems in larger systems, and the complex relationships among social structure, values, technology, and environment. A beginning has been made in this direction with the various proposals to decentralize the management of the system and to organize water users into viable associations,[15] but these are very preliminary and are based on as thin a data base as are many of the technological solutions now being implemented. A great deal more research is needed on the organization of the system at all levels, and especially on social constraints and cultural perceptions and motivation. Such research can be used to develop a more comprehensive and realistic model of how the Indus system actually operates. Based on this model, alternative forms of organization can be suggested.

Pakistan's irrigation system - indeed that nation as a whole - is in crisis. Poor management and maintenance of the system at all levels, waterlogging and salinization, low productivity despite capital-intensive inputs (e.g., dams, wells, fertilizer, tractors), and the socio-economic inequalities which have increased in recent years as a result of "green revolution" technological changes (Nulty 1972) are all facets of the same fundamental problem: inadequate and inappropriate organization. Capital-intensive technological projects are unlikely to lead to any substantial development of the Indus Food Machine unless accompanied by substantial and effective social and economic reorganization.

---

[14] Although the experimental work proposed under that project was not continued, the provinces of Pakistan have adopted laws to facilitate forming water users associations on watercourses, and are attempting with donor assistance to organize associations.

[15] See Radosevich (1975); Water Management Research Project (1976); Reuss, Skogerboe. and D. Merrey (1979); and D. Merrey (1983.