

# Institutional and Management Issues in the Development of Irrigation with Small Dams in the Potwar Area of Punjab

A. H. Zaidi

## BRIEF DESCRIPTION OF POTWAR AREA

THE POTWAR AREA lies between Jhelum and Indus rivers in the Rawalpindi Division of the Punjab Province of Pakistan and has an area of about 16,800 sq km (Fig 1.1). The area is characterised by deteriorating land resources and fragmented landholdings with limited water resources. The topography of the area is undulating and gradually sloping from the northeast to the southwest with deep incised river valleys. The altitude of the area varies from 300 to 600 m above mean sea level. Five major rivers flow through the area (Fig 1.2) which have a very distinct seasonal flow pattern with peak discharges during the period July-August and little or no discharge during the remaining part of the year. The annual precipitation ranges from 1,000 mm in the northeast to 350 mm in the southwest.

The population of the Potwar area is approximately 7.3 million of which about 70% live in the rural areas. The agriculture is mainly rainfed and single crop and is the major source of livelihood. The principal crops are wheat, barley and maize. The yields are very low on account of the shortage of water and age-old agricultural practices.

## FARMERS CONDITION IN THE POTWAR AREA

The land tenure system in the area is mainly dominated by small owner-operated units with the average farm size between 3.5 and 4.5 ha and further declining on account of population pressure and inheritance customs dividing the holdings. On account of small and isolated landholdings, soil conservation measures are becoming difficult to implement as they require cooperation of adjoining field owners. The rain-fed farms are under great income stress ([Master Plan of Barani Area Development Vol I 1988]). Except where dams have been constructed, there is a general scarcity of drinking water supply which is obtained from streams, springs, village pond, etc., which is dependent on rainfall. The off-farm income is now gradually becoming a major portion of family income resulting in considerable migration to urban areas.

## EXISTING STATUS OF SMALL DAMS

Groundwater resources are very limited in the Potwar area as basement rocks contain few productive aquifers except a narrow belt of alluvial sediment deposits along the rivers. A substantial quantity of water that flows down in this area in the rainy season has little chance to soak and build up a groundwater reservoir and goes down unharnessed to the Jhelum and Indus rivers. This flow aggravates the situation further by carrying along with it a huge quantity of fertile top soil. The only alternative to develop the water resources in the area is through construction of medium/small size storage dams as basement rocks outcropping at innumerable places in the ravines provide suitable locations for such works.

The construction of small dams in this area started in 1961 with the establishment of a Small Dams Organisation (SDO). During the period 1961-88 this Organisation completed 20 dams to provide irrigation to an area of about 10,000 acres, besides making drinking water supply available for the rural population (Fig 1.3). The height of these dams varied from 8m to 23m with gross storages ranging from 0.1 to 8.0 million cubic meters. Salient statistics of these dams are given in Table 1.1. To further develop the agricultural potential for the uplift of the rural area and to ensure balanced regional development, the Asian Development Bank (ADB) provided a loan of US \$48.8 million to the Government of Pakistan during 1988 for the construction of 12 more small dams and associated command area development works besides extension/rehabilitation of irrigation distribution systems on some of the existing dams. Eight of these dams have since been completed and are now operational (Table 1.2) while the remaining are near completion (Table 1.3).

The small dam projects have remained under criticism from their very inception for the poor utilisation of storages and nonachievement of desired objectives of the command area development as visualised at the planning stage. Detailed evaluations in this regard have been carried out from time to time by a number of agencies and a number of constraints have been highlighted. Besides inadequacies in planning and designing of the projects, it has been found that proper socio-economic surveys and assessment of farmers' interest and ability to participate in the irrigation development were not carried out. Other constraints relate to the small size of farms and

fragmented/scattered landholdings and absentee farmers, etc. In view of this experience, there was great emphasis in the ongoing ADB project on prior socio-economic surveys and institutional strengthening and involving the beneficiaries in construction and O&M of their watercourses and command area development.

### **NEED FOR INSTITUTIONAL STRENGTHENING**

The long-term success of any project depends on the specific institutional arrangements devised by the relevant governmental organisations and other participating groups. The time scale for institutional involvement may be for lifetime involvement such as is currently the case with the SDO management and maintenance of dams or it may be terminated soon after project inception if a project is expected to be self-perpetuating. The institutional arrangements need to be supported by sound laws and regulations consistent with the social, cultural and political system of the country. Proper institutional structures which take into account the specific project requirements are therefore necessary and these have to be related to the prevailing local customs and not simply to national objectives resources. A small irrigation scheme, like that connected to a small dam, is more likely to succeed if low-cost technology is adopted which is not dependent on a constant inflow of costly inputs, and is supported by sound institutional arrangements.

### **FARMERS ORGANISATIONS IN THE POTWAR AREA**

Presently there are two types of farmers organisations in the Potwar area, formal and informal.

#### **Formal Organisations**

In the context of this study, the Water Users Associations are the most important formal organisation and they are discussed in detail later on in this paper. The other formal organisations include Co-operative Societies, Zakat and Usher Committees, Social Welfare Societies, etc. The Cooperative societies are controlled by government regulations and their main function is to help small farmers by providing them agricultural credit at low rates of interest. However their scope has since been widened to involve them in activities other than credit. There are over 3,000 such societies in existence in the Potwar area alone, with a total membership exceeding 1.5 million. The history of cooperative enterprises has not been very encouraging in this country due to the strong hierarchy of rural society where farmers owe allegiance to their landlord and go along with ethnic and kinship identities. Size and tenure of landholdings, also pose great obstacles to the cooperative endeavour.

Zakat and Usher committees have also been established by the government. They are based on the fundamental principles of Islam and require richer Muslims to contribute money to the welfare of Muslims in need. The social welfare organisations are established by groups of people in an area, with the common objective of rendering welfare services to those in need of assistance.

#### **Informal Organisations**

The informal organisations include mosque committees and panchayats which mainly work to arrange religious gatherings and settle local problems and disputes. The rural communities in this country have been used to managing and maintaining some aspects of their community via informal organisations and this experience therefore needs extending to their watercourses and agricultural systems.

### **NECESSITY OF WATER USER'S ASSOCIATION (WUA)**

For any irrigation project, there are two principal groups who share an interest in the management and operation of the project, namely the irrigation agencies and the water users. It is essential that some degree of cooperation and co-ordination is developed between these two groups in order to attain their common objective of increased agricultural production and the consequent improvement in the local economy.

There is now a growing awareness of the importance of involving water users in the active development, operation and management of irrigation systems by letting them share definite tasks and responsibilities. The objectives of effective irrigation management can be better achieved if the water users are involved at the planning

stage. However, participation by farmers requires the conceptualisation of a systematic and practical approach. The important institutional management issue in this regard is the division of responsibilities between the irrigation agencies and the water users and the types of tasks and responsibilities that can reasonably be assigned to each group. WUAs are basically field channel organisations consisting of beneficiary farmers sharing a common outlet and watercourse. The formation of associations at this level is a more feasible and manageable arrangement for assisting in the overall management and operation of larger-scale systems. Experience has shown that active farmer involvement in irrigation is cost-effective in terms of mobilising local resources for improvement and maintenance activities thus reducing Irrigation Department staff time. Farmer involvement can also extend to fee and fine collection, resolution of disputes, organised extension and farmer training.

The function of WUAs is a concern for most countries who generally favour gradual development rather than imposition. The responsibilities and functions of such associations will differ between established systems and new systems. However, it is generally accepted that the maintenance of watercourses, small irrigation channels, warabandi, water rotation among channels, voluntary labour, monitoring system performance and coordination with the Irrigation Department should be the responsibilities of WUAs.

### **ARGUMENTS IN FAVOUR OF AND AGAINST WUAS**

WUAs are now in existence in more than 37 countries, many in Asia. The achievements of these associations have been very effective and encouraging. It is now universally recognised that there should be flexibility and maximum freedom for the concerned parties in the irrigation system management to make use of farmers' capability in carrying out some of the operation and management (O&M) activities, monitoring groundwater use, organising on-farm drainage development and other related activities. For this purpose WUAs are to be developed to permit market orientation and a decentralised system. Farmers agree that warabandi and irrigation scheduling should be more flexible and objective.

Some authorities contend that social groupings of farmers are unable to operate the system efficiently through voluntary cooperation. This becomes increasingly true as system size and complexity increase. Vested interests come to the surface and kill the spirit of cooperation, and therefore involvement of the government in the watercourse command area is necessary. However, a closer relationship between the farmer, irrigation engineer and agricultural extension officials is required. Although voluntary participation of the farmers needs to be encouraged through extension methods and education, it is also necessary that departmental staff have adequate powers to provide technical guidance to the water users whenever and wherever required.

The best results are achieved when these institutions are formalised and are backed by legal status in the matter of water distribution and its application. It is also necessary to provide the water users some incentives to improve water application and introduce new technologies. It is essential that these associations are formed at the lowest possible unit which will be at watercourse level or village level where only one watercourse is serving the village.

### **WUAS IN PUNJAB**

In order to strengthen the management of existing institutional infrastructure for irrigation and agriculture inputs, the Punjab Government and other provincial governments promulgated a Water Users Association Ordinance in 1981. The establishment of WUAs began the same year in the project area of the World Bank supported "On-Farm Water Management Programme". Each WUA was confined to the share holders of a watercourse. The main functions of these associations were to rehabilitate, improve and maintain the watercourses and to encourage the adoption of improved on-farm water use and management practices besides other allied activities.

This experience has been very positive as far as in the Punjab Province is concerned. WUAs have proved effective in reducing the unit cost of farm level works by effectively mobilising and organising the farm labour for this effort. Over 17,000 WUAs with membership of around 600,000 farmers were organised under this program which represented about 17% of all the watercourses in the Punjab. They have made financial contributions of over

Rs.300.00 million for improvement of their watercourses during the ten years. These associations working in collaboration with Agricultural Advisory Services have enhanced the delivery efficiencies of watercourses and improvements in the availability of nonwater inputs.

However, experience showed that although these institutions remained active during the implementation of watercourse improvement works they became inactive and dormant as there was no financial assistance for O&M works and as they proved ineffective in assuring continued maintenance of rehabilitated watercourses. However, some WUAs have continued to remain active even after completion of watercourse improvement works and have played an effective role in conflict resolution.

It has been felt that these organisations could be made more effective by converting them into multipurpose cooperatives for joint operation of a machinery pool, supply of inputs and demonstration of irrigation agronomic practices. However, these institutions are still to establish themselves as self-sustaining organisations and tend to show retrogressive behaviour by reverting to traditional forms and functions of informal organisations.

## **STATUS OF WATER USER ASSOCIATIONS IN THE POTWAR AREA**

In the case of the Small Dams Umbrella Project presently under implementation, the ADB laid great emphasis on the development of the command area through participation of local farmers, and WUAs were therefore formed under the project to ensure the construction and O&M of the watercourses and to resolve any conflicts between the farmers.

As stated above, legislation was enacted in 1981 by the Punjab Provincial Governments for the formal organisation of beneficiaries, i.e., WUAs. This Ordinance was called "On-Farm Water Management & Water User's Association Ordinance 1981."

The WUAs were established on existing small dams as well as on new dams constructed under the Umbrella Project taking [cover] of this enactment although WUAs on the new dams were also required to construct new watercourses. This required suitable amendments in the Ordinance but in spite of the assurance by the Punjab Government to the Bank, the required amendments with respect to new watercourses still remain to be enacted. Thus although the work of constructing watercourses on the new dams has been under way for a number of years the required legal cover [is still to be made].

The most important function assigned to the WUAs was the improvement of existing watercourses and the construction of new watercourses and their subsequent operation and management. The ADB provided that for this purpose beneficiary farmers would provide voluntary labour and also contribute towards the cost of material as in the case of the On-Farm Water Management Programme (OFWM) in the canal irrigated areas. In view of the low farm income and high irrigation fees in the command areas of small dams, it was agreed by the Bank that the level of recovery of cost of material should be set at 5% as against 20% in the case of the OFWM. The period of recovery from beneficiary farmers was set at five years after allowing a grace period of two years. However, the ultimate aim should be to achieve eventual full cost recovery as the project benefits increase.

As the work on the project started and construction and rehabilitation of watercourses were undertaken, WUAs were established for each watercourse. The Water Management Officer of the Small Dams Organisation was authorised to register these associations under the prevailing rules and the relevant subdivisional officers were made the coordinators. Before undertaking the construction or rehabilitation works a written agreement was executed between the coordinator and shareholders of the watercourse.

## **PERFORMANCE OF WUAS IN SMALL DAMS AREA**

WUAs were established on small dams for the repair and rehabilitation of existing watercourses and also on all the new dams undertaken under the Umbrella Project for the construction of watercourses. For the formation of the WUAs, the beneficiaries of the respective villages are collected and motivated. Generally one WUA is formed for each village or watercourse but in many cases WUAs have also been formed for a group of watercourses. In all 97

WUAs have so far been established on 13 dams (Source [SDO 1994]) and their number is progressively increasing but this is more a reflection of the number of dams coming up to completion than of the success of WUA formation and continuity. Unlike the WUAs formed in the canal irrigated areas under OFWM, the WUAs formed on small dams have only a few beneficiaries and in some cases as few as only two or three shareholders each. The office bearers consist of a President, a Vice President, a Secretary, a Treasurer and members of the Executive Committee not exceeding 5 with a tenure of 3 years. The Executive Committee holds regular meetings every one to three months. The relevant rules and regulations governing the formation, registration and functioning of WUAs in the Small Dams areas have been duly framed but formal government approval is still awaited.

From the above it will be clear that although there are elaborate rules, regulations and instructions governing the formation and working of WUAs they have still not become established as viable bodies which can continue to function even after the completion of the project and play a useful role in the upkeep and management of their watercourses and resolving water disputes which are supposed to be their ultimate goal.

### **CONSTRAINTS IN FUNCTIONING OF WUAS IN THE SMALL DAMS PROJECTS**

A discussion with the officials of the Small Dams Organisation was held on the subject and the following constraints were identified:

1. In the initial stages, big problems were experienced in collecting the shareholders and motivating them to form WUAs. This was due to local rivalries and groupings on the basis of caste and social status and poor results of cooperative activities in the past.
2. There are a large number of absentee landowners in the area. Socio-economic factors had prompted the manpower to leave their families and homes in the hope of better social statuses and an economic future. A study by the Economic Research Institute has shown that 14% of the households in the area had one or more members of their family working abroad most of whom were earlier involved in farming activities.
3. There was no arrangement for imparting any training to the members and office bearers of the WUAs so that they could understand the bye-laws and the basic philosophy behind the formation of WUAs.
4. Although WUAs were successful to a great extent in the rehabilitation or construction of watercourses they did not perform well in the repair of watercourses damaged by rains, floods or other natural events.
5. It was generally felt that the present tenure of three years of WUAs was inadequate for developing a cooperative working spirit and that this should be increased to at least 4-5 years.

### **SUGGESTED IMPROVEMENTS IN THE CONSTITUTION OF WUAS IN THE POTWAR AREA**

1. A consideration of the local leadership pattern is very important when forming the WUAs. Since the Potwar villages are full of retired army personnel, it will be desirable if the seniormost residing army person is nominated as chairman of the WUA by the Deputy Commissioner of the district while other members could be elected by the water users themselves. The number of members of the WUA will depend on the extent of the command area under their jurisdiction. Since the watercourses from small dams generally provide irrigation to only a small area of a few hundred acres, the jurisdiction of WUAs associated with small dams may extend over the entire irrigation channel in the case of larger command areas at watercourse level.
2. The existing ongoing Small Dams Umbrella Project provides for the formation of WUAs to ensure the success of the development in the command area. The Punjab Water Users Ordinance (1981) provides

for the formation of such formal organisations by the Agriculture Department for the purpose of rehabilitation, operation and management of existing watercourses. However, in the case of the Small Dams Project it was considered necessary that the functions should also cover the construction of new watercourses and the establishment of such associations should be done by the Small Dams Organisation and not by the Agriculture Department.

3. Past experience has shown that most WUAs do not remain viable after completion of construction or rehabilitation works on watercourses and the subsequent maintenance of these watercourses has not been given adequate attention. It is therefore necessary that the WUAs are kept alive during this period by imparting follow-up assistance and training. It is also necessary to motivate them to take up development-oriented activities for achieving the goal of sustainable agriculture.
4. In small dams where there is more than one WUA in the command area, the WUAs should be federated at dam level so that multipurpose institutions are created, leading to a self-reliant social setup thus minimising dependence on government functionaries. However, before the formation of federations is taken up, the WUAs have to command the confidence of the water users and demonstrate their effectiveness at the present level and this should be given careful consideration. Alternatively, such federations may be tried on a pilot project basis on selected dams to evaluate their performance for possible replication.
5. The responsibility for operation and management of the offtaking channels from the small dams can be handed over to the WUAs or Federations as soon as they are properly trained to handle their complexities. As a matter of fact, small dams provide an ideal background for such an experiment having small but independent and conveniently manageable irrigation systems.

## **OTHER INSTITUTIONAL IMPROVEMENTS**

### **Planning, Design and Implementation**

The Small Dams Umbrella Project lays great emphasis on the command area development and for this purpose a Planning, Design and Command Area Development Division (PD&CAD) has been established for preparation of feasibility reports, the design of new projects and speedy development of command areas. This division has done useful work on the preparation of feasibility studies but the work of the command area development is backward. It is the SDO's own experience that the command area development work can be better organised by the respective small dam divisions on account of their easier contact with beneficiaries and appreciation of their problems. It is strongly felt that this division with some reorganisation should be made a permanent part of the SDO and it should continue to work on planning, design and feasibility studies besides developing and maintaining the hydrological monitoring network and evaluating and processing this data.

### **Hydrological Network**

Although the SDO has been in existence since 1961, there is no organised programme of collection or processing and evaluation of hydrological data in the Potwar area for use in the future planning and developing of water resources and evaluating the performance of existing small dams. Thus there is a great need to establish a well-laid-out, integrated hydrological monitoring network and regular sedimentation surveys in the Potwar area for assessing the feasibility of future schemes.

## **Occupier's Rates**

In the irrigated areas of Punjab Province there is a fluctuating system of assessing the occupier's rates (water rates or abiana). There is a different schedule of rates for each of the 27 major canal systems and 17 classifications of crops. The water rates on the small dams area are also charged on the basis of actual assessment but are double the rates for the adjoining Canal System. The present fluctuating system of assessment is not conducive to the growth of irrigation on the small dams schemes and the flat rate system is certainly going to be more useful and workable and will increase water use efficiency in view of the peculiar socio-economic conditions prevalent there.

## **Revenue Collection**

It appears that the revenue - collection aspect is not presently attracting the required attention and there is only a skeleton revenue staff. As a result the work of booking of irrigation and assessment of water rates and other recoveries, revenue is not collected properly. The maintenance of the revenue record is also in bad shape. The recovery of 5% of the cost of material on the construction of watercourses has not been started so far although the grace period has expired. The revenue wing of the SDO requires to be suitably strengthened on the basis of a realistic yardstick keeping in view that small dams are wide apart from each other and in many cases situated in areas not easily accessible.

## **Operation and Management Funding**

The existing small dams have suffered since their completion because of poor maintenance and lack of timely repairs, on account of inadequate O&M funds. The dams and allied structures generally remain in a state of disrepair and irrigation channels remain extensively damaged. The irrigation channels of the dams often pass through difficult terrain and have a number of cross drainage structures apt to get damaged during heavy monsoon rains. However, O&M funds have never been enough to speedily repair the damage and maintain the works adequately. The O&M funding of small dams was first set in 1981 but remained unchanged till 1992 when an ad hoc increase of 100% was made. It is imperative that a revised and realistic assessment is prepared and all O&M funding is provided on this basis.

In the irrigation schemes in this country there is no link between the O&M funds and receipt of water charges. There is now a growing realisation that O&M requirements should be met from the recovery of water charges. The international aid agencies have been insisting that the gap between O&M and water rates recovery should be gradually narrowed. However in the case of the small dams project area the O&M, charges per irrigated hectare are higher than conventional canal irrigation and it has also to be kept in mind that the storages of the small dams besides providing irrigation, also result in other direct and indirect benefits. However, to narrow the gap between the O&M and water charges there should be greater farmer participation in O&M which should be gradually increased to the level where beneficiaries can take over the distribution of supplies and maintenance of their irrigation channel themselves. These small and independent irrigation schemes provide ideal settings for such experiments.

## **Land Levelling Work**

Generally, the command area of the dams is uneven and efficiency of gravity irrigation is poor unless the land is properly prepared and levelled. Thus land levelling in the command area is a prerequisite for successful irrigation development. As a result of the fragmented landholdings, low farm income and other social and physical factors, the water users are not in a position to undertake this work themselves from their own resources. Taking into consideration this factor, it was established in the Umbrella Project that 25% of the command area needed to be levelled and recovery of only 5% of the cost would be made from the beneficiaries which will be reviewed periodically. Presently the land levelling work is one of the most successful components of the project and farmers

are very enthusiastic about it. On account of the usefulness of this programme for the efficient development of irrigation, this should be continued with a gradually increasing level of recovery.

#### References

[Centre of Excellence in Water Resources Engineering, Lahore(1979) National Seminar on Land and Water Resources Development of Barani Areas.]

[Ch Nazar Mohammad, Secretary,Irrigation and Power Department, Government of Punjab (1986) ADB Regional seminar on Irrigation service Fees at Manila.]

[HARZA Engineering/NESPAK (1987). Master Plan of Barani Area Development.]

[Hyundai Engineering Company Ltd. (1985). Small Dams Project - Appraisal Report.]

[Ministry of Agriculture Government of Pakistan (1987). Cooperative and Water Users Associations.]

[National Engineering Services of Pakistan (1988). Evaluation of Small Dams in Punjab.]

[Punjab Economic Research Institute (1989). Screening Survey of Potential Small Dam Sites.]

[Punjab Water Users Association Ordinance (1981).]



S. No.	Basin	Name of Dam	Name of River	Storage Capacity		Designed Command Area (Acres)	Height of Dam (m)	Year Completed	Impoundment Area (Acres)	Catchment Area (Sq.Km)	Area Cultivated 1992-93	Type of Dam
				Live (Aft)	Dead (Aft)							
1	Soan	Rawal	Korang River	43000	4500	8390	34.6	1962	1922	275.2	208 + 238 = 446	Gravity
2	Soan	Bango	Chhabbar	89	73	136	8.3	1965	14	3.1	-	Conc. Gravity
3	Soan	Gurabh	Gurabh	243	679	1460/350	23.3	1966	2	16.8	22 + 233 = 255	Earthen
4	Soan	Dhurnal	Nikki Nalah	757	888	1004/500	16.5	1971	9	21.0	102 + 421 = 523	Earthen
5	D	Qibla Bandi	-	1137	692	2000 / 850	21.3	1971	110	23.6	436 + 412 = 848	Conc. Gravity
6	Soan	Kanjoor	Kanjoor Kas	2400	426	2500	15.3	1978	106	32.2	61 + 13 = 74	Conc. Gravity
7	Soan	Khasala	Khasala Kas	1498	918	1350/1250	18.5	1985	106	25.4	64 + 93 = 159	Conc. Gravity
8	Soan	Walana	Narata Nalah	1278	915	1200	21.3	1984	103	25.9	34 + 0 = 34	Conc. Gravity
9	Soan	Simly	Soan River	20000	15000	1200	76.2	1982	421	152.8		Rockfill
10	Soan	Misnot	Dumel Kas	221/268	292	100	12.0	1963	36	8.1	40 + 46 = 86	Conc. Gravity
11	Haro	Sipiala	Sipiala Kas	245	330	52.5	9.9	1964	54	10.4	17 + 32 = 49	Conc. Gravity
12	Haro	Shahpur	Nadna Kas	4095	10241	4308	25.9	1986	700	203.9	51 + 198 = 249	Conc. Gravity
13	Resi	Ratti Kassi	Nurpur Kas	1012	648	650	14.3	1970	140	22.0	102 + 271 = 373	Conc. Gravity
14	Haro	Channibor	Channi Kas	1173	785	1500	19.5	1979	153	24.6	57 + 232 = 289	Earthen
15	Bunha	Nirali	-	416	266	800	14.2	1970	40	9.2	0 + 115 = 115	Earthen
16	Bunha	Dhok Tahlian	Kathan Kas	791	629	750	19.5	1971	73	21.0	112 + 534 = 646	Conc. Gravity
17	Bunha	Khokharzer	Bhutti Nalah	2602	710	800/1200	23.5	1979	119	20.7	381 + 1824 = 2205	Earthen
18	Bunha	Surlah	Surlah Nalah	1555	350	1800	18.6	1985	85	15.5		Earthen
19	Kahan	Garat	Garat Kas	1690	538	1600	20.1	1982	103	14.0	295 + 355 = 648	Earthen
20	Kanshi	Dungi	Hachiora Nallah	959	801	350	21.8	1971	102	19.9	0 + 101 = 101	Conc. Gravity

A = Dams Constructed under A.D.C.SDO

B = Dams Constructed under S.D.O/A.D.C and Rehabilitated under Umbrella Project

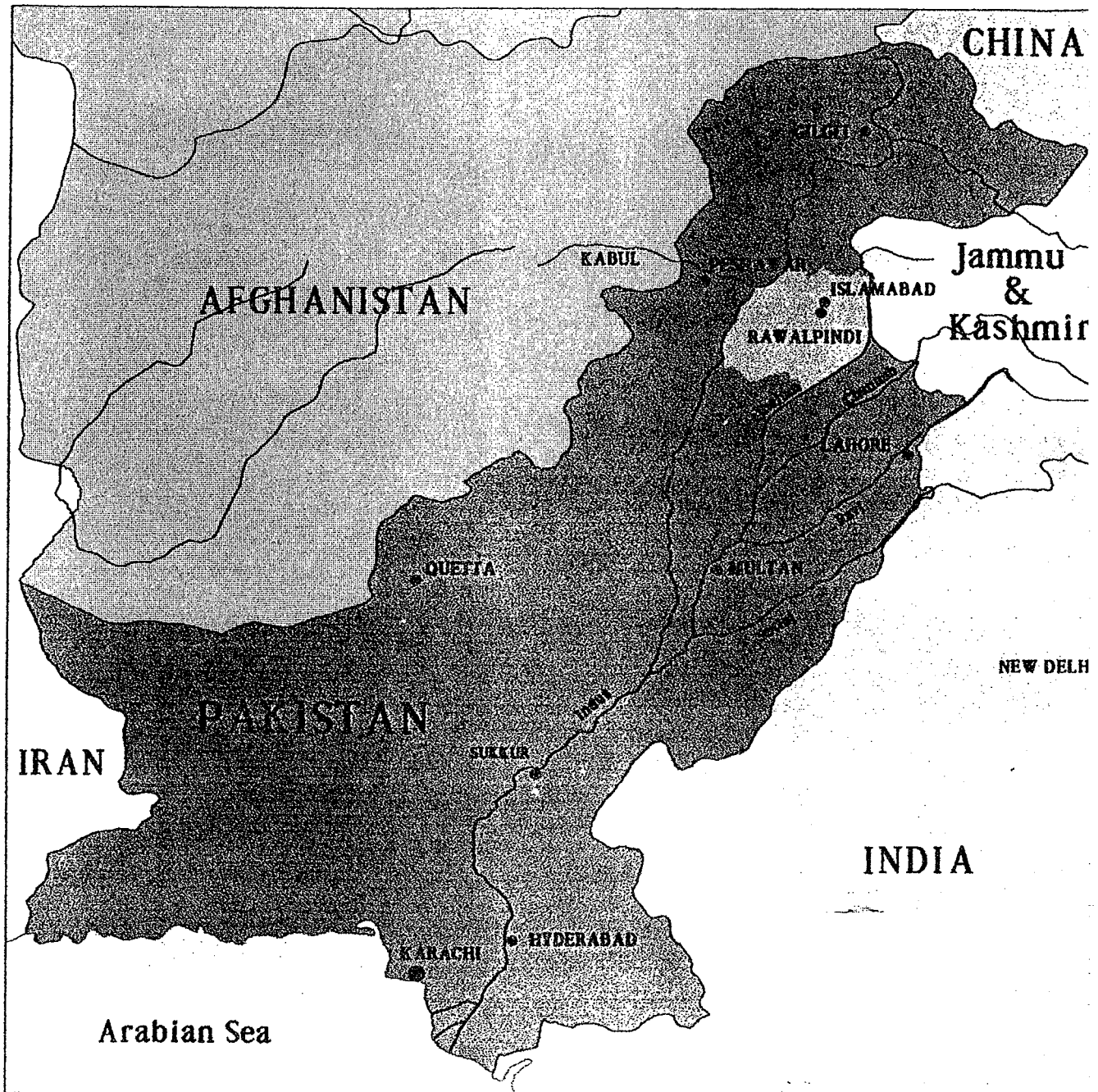
Table 1.2. Small dams constructed under the umbrella project.

S.No.	Basin	Name of Dam	Name of Stream on which Dam Constructed	Storage Capacity		Designed Q. of Canal (Cusecs)	Pond/Area (Acres)	Catchment Area (Sq. Km)	Designed Command Area (Acres)	Type of Dam	Height of Dam (m)	Year Completion
				Live (AF)	Dead (AF)							
1	Soan	Bhughtal	Sirji Nalah	675	465	6.5	66	22.66	600	C.Gravity	22.85	1990
2	Soan	Nikka	Nikka Nalah	830	418	7.5	48.16	22.56	692	C.Gravity	29.57	1990
3	Haro	Djok Sandaymar	Nikki Kas	518	133	3.5	49.00	9.19	550	Earthen/con	14.65	1990
4	Resi	Mirwal	Dubran Kas	2726	1039	4.00	233	37.55	1050	C.Gravity	24.07	1990
5	Resi	Jabbi	Jabbi Nalah	2753	1127	15.58	165	15.17	1495	Earthen	21.64	1991
6	Bunah	Kot Raja	Kuthan Kas	1344	1500	14.00	168	24.18	1112	Earthen	16.30	1991
7	Bunah	Dhok Qutab Din	Ratna kas	827	946	7.32	60	15.27	711	Earthen	24.2	1991
8	A	Jammerghal	Jammerghal Kas	1502	930	7.25	124.73	15.17	660	Earthen	15.27	1992

Source: Small Dams Organisation

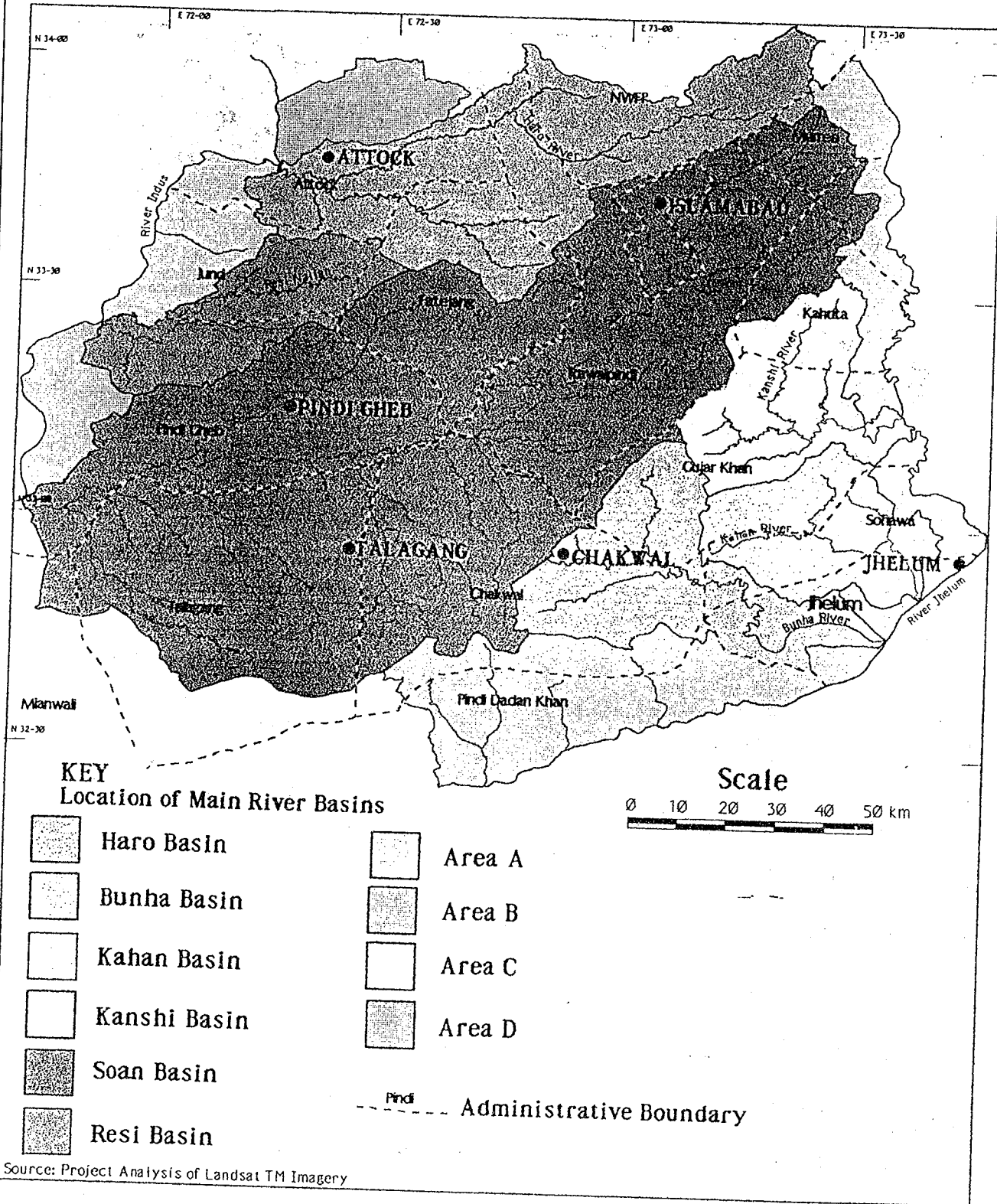
Sr. No.	Basin	Name of Dam	Name of Stream on which Dam Constructed	Storage		Capacity Dead (AF)	Q of Canal (Cusecs)	Pond Area (Acres)	Catchment Area (Sq.Km)	Type of Dam	Height of Dam (m)	Designed Command Area (Acres)
				Operational (AF)	Operational (AF)							
1	Soan	Jawa	Jawa Kas	900	675	5	76	9.34	Zoned	82.43	800	
2	Soan	Pira Fathal	Gandial Nalah	2900	-	-	242	68.7	-	-	2420	
3	Resi	Shakardara	Nachindi Kas	2081.88	3597.07	33.5	155.21	156.89	C.Gravity	35.05	4200	
4	Kahan	Salial	Tbr of Basli	305	105	2	28	3.88	C.Gravity	22.55	400	
5	Kahan	Tainpura-1	Chakwala Kas	3023.2	1548.07	26.63	150	33.5	Zoned	24.03	1381	
6	Kahan	Tainpura-2	Tainpura Kas	834.82	534.93	6.99	45	9.2	Zoned	23.28		

Figure 1.1. Project location plan.













 Project Area

Figure 1.2. Plan of project area.




**KEY**

Location of Main River Basins

- |  |              |   |        |
|--|--------------|---|--------|
|  | Haro Basin   |  | Area A |
|  | Bunha Basin  |  | Area B |
|  | Kahan Basin  |  | Area C |
|  | Kanshi Basin |  | Area D |
|  | Soan Basin   |   |        |
|  | Resi Basin   |   |        |

**Scale**  
0 10 20 30 40 50 km

 Pindi Administrative Boundary

Source: Project Analysis of Landsat TM Imagery

Figure 1.3. Location of existing dams in the Potwar Plateau.

