

DEVELOPMENT OF SMALL DAMS IN POTHOWAR PLATEU OF PUNJAB (PAKISTAN)

DEVELOPPEMENT DES PETITS BARRAGES SUR LE PLATEAU DE POTHOWAR DE PENDJAB (PAKISTAN)

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ABSTRACT

Pakistan falls in arid to semi-arid region of the world. The rainfall is neither sufficient nor regular, to meet the growing needs of agriculture. Barani [rainfed] agriculture contributes about 10% of the total agricultural production of Pakistan and depends on rainfall for its water need. Most of the rainfall occurs during monsoon season from July to September.

Punjab is the most populous province of the country and contains major portion of the Indus Basin Irrigation System. In North West it has a substantial tract of uplands called Pothowar Plateu. This area has undulating topography and agriculture depends on rainfall and groundwater abstraction. This area has great potential for small dams. So far Punjab Government has constructed fifty (50) dams and some ten (10) dams are under construction. Besides supplying water for irrigation, these dams have many indirect benefits. They help recharge the groundwater, provide water for domestic and municipal purposes, control soil erosion, control floods in hilly and plain tracts, help to develop fish culture and also provide recreational activities. However, there are several issues relating to these dams which still need to be addressed, such as development of command area, low water conveyance and application efficiencies, reduction in reservoir capacity due to sediment deposition and vegetation growth, evaporation and seepage losses. With no salinity and groundwater problems, good climate for production of high value crops and proximity to markets, this area should increase its share in agriculture production using high efficiency trickle or bubbler systems.

Key words: *Small dams, Irrigation, Groundwater recharge, Pothowar plateau (North-west Pakistan), Poverty alleviation.*

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RESUME

Le Pakistan est situé dans la zone aride et semi-aride du monde. La précipitation n'est ni suffisante ni régulière pour satisfaire les besoins agricoles croissants. L'agriculture Barani [pluviale] contribue à environ 10% de la production agricole totale du Pakistan et dépend de la précipitation pour satisfaire ses besoins en eau. La plupart des précipitations se produisent pendant la saison de la mousson (de Juillet à Septembre).

Le Pendjab est la province la plus peuplée du pays et contient la grande partie du système d'irrigation du bassin de l'Indus. Au Nord-Ouest, il existe une grande superficie de hautes terres appelées Plateau de Pothowar. Cette zone possède une topographie ondulée et ici l'agriculture dépend des précipitations et des captages d'eau souterraine. Cette région détient un grand potentiel pour la construction des petits barrages. Jusqu'à maintenant, le gouvernement du Pendjab a construit 50 barrages et environ 10 barrages sont en cours. En outre la fourniture d'eau à l'irrigation, ces barrages portent de nombreux avantages indirects. Ils aident à recharger la nappe phréatique, fournir l'eau à satisfaire les buts domestiques et municipaux, contrôler l'érosion des sols, les inondations dans les régions montagneuses et plaines, aider à développer la pisciculture et les activités récréatives.

Cependant, il est nécessaire d'aborder plusieurs questions relatives à ces barrages, telles que le développement du périmètre irrigué, le transport d'eau faible et l'efficacité d'application, la réduction de la capacité du réservoir en raison de dépôts de sédiments et la végétation, l'évaporation et les pertes par infiltration. Dans l'absence des problèmes de salinité et des eaux souterraines, le climat favorable à la production agricole à valeur élevée et la proximité des marchés, ce secteur devrait augmenter sa part dans la production agricole en utilisant le système d'irrigation par tuyaux perforés de haute efficacité.

Mots clés : *Petits barrages, irrigation, recharge des eaux souterraines, Plateau de Pothowar (nord-ouest du Pakistan), réduction de la pauvreté.*

1. INTRODUCTION

Pakistan possesses a large river Indus, which along with its tributaries namely Chenab, Jhelum, Ravi, Kabul and Sutlej, forms one of the mightiest River System of the world. The River System comprises 19 large river headworks, 45 independent irrigation Canal Systems measuring 64,000 kilometers, some 1.6 million kilometers of water courses and 138 large dams of height 15 meter and above including 3 super storage reservoirs. Schematic diagram of Indus Basin Irrigation System is shown in **Figure-1**

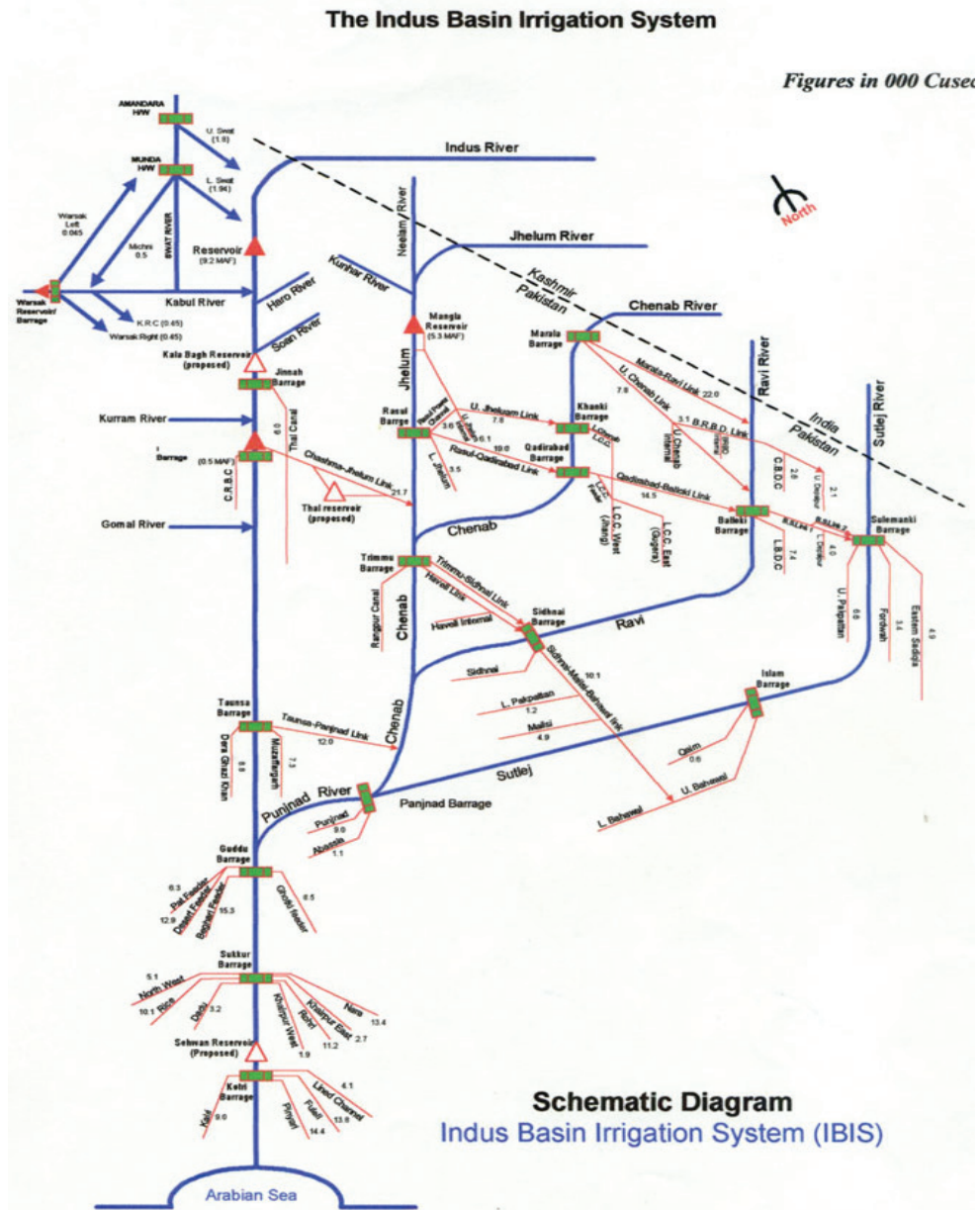


Fig. 1. Schematic diagram of Indus Basin Irrigation System

Barani (dry land or rainfed agricultural lad) Area of Punjab comprises Rawalpindi, Sargodha, Gujranwala, Dera Ghazi Khan Divisions and a part of Tribal Area. About 96.97% of total *Barani* area falls in these divisions and 30.5% of the total *Barani* Area falls in Rawalpindi Division called Pothowar. Agriculture in Pothowar area is primarily dependent upon rainfall. In Pothowar area two third of the total annual rain precipitates during the three monsoon months of summer i.e. July, August & September, while the remaining nine months are nearly

dry and get only one-third of the annual precipitation. Moreover the delayed monsoon and erratic winter rainfall, which are common features, make the crops very uncertain. On the other hand the topography of the hilly area with steep slopes, helps the rain water to form numerous streams running at high velocities, which erode the good land. Apart from damaging the land and the erosion of soil the rain water thus does not get a chance to soak down and develop any ground water reservoir. Agriculture in these areas, therefore, depends entirely on rainfall, which at times is very meager. Drought is frequently experienced and now witnessed in recent years. Consequently, to conserve the rain run-off for Agriculture, the only solution is to build up dams, which would also eliminate the hazard caused by delayed rains at the time of sowing and growing when a little delay in rainfall may result into reduction of crop yield to less than half. Physical and Hydrological features of Pothowar plateau are shown in Table 1.

Table 1. Physical and Hydrological Profile of Pothowar (Source; Small Dams Organization Punjab).

Location	Rainfed Area of Northern Punjab comprising Districts Jhelum, Chakwal, Rawalpindi, Attock
Total Basin Area	22500 Sq. Kms
No. of villages	2600
Population	4.34 Million
Annual Rainfall	400 to 1400 mm
Topography	Uneven with steep slopes
Main Rivers	Indus & Jhelum
No. of Basins	6 (Soan, Haro, Reshi, Bunha, Kahan and Kanshi)
Average Yearly Runoff	1.88 MAF ⁴
Runoff Tapped	0.22 MAF
Balance Runoff available	1.66 MAF
%age balance	88.4%

It is evident from Table 1 that Pothowar area falls in the semi arid region and is thickly populated with undulating topography and spans between Indus & Jhelum Rivers. The average annual runoff is estimated to be 1.88 MAF out of which only 0.22 MAF (11.6%) is currently being tapped and some 1.66 MAF of water goes wasted. Thus there is large potential (88.4%) of water resource development in this area by construction of small dams.

2. DEVELOPMENT OF SMALL DAMS IN POTHOWAR

In Pothowar Plateau the land is broken and uneven. Average farmer sustains on small land holding and few heads of cattle. Flow in the streams comes in the shape of flash floods during three months of monsoon causing land erosion and escaping to the sea un-utilized. In case of drought season, the small farmers are compelled to sell their livestock as they do not get a

4 MAF = Million Acre Feet. 1 acre-foot = 1233.5 m³.

sustainable income from the form land. Providing assured supply of water is therefore crucial to the life and economy of the area.

In 1961, West Pakistan Agriculture Development Corporation (ADC) was made responsible for water resources development. In 1973, the responsibility of development of *Barani* Areas was given to Irrigation & Power (I&P) Department, Punjab. Since then, Small Dams Organization is working on water resources development in Pothowar Plateau.

So far, Small Dams Organization, Punjab has completed 45 Small Dams in the area. It is customary to call non power generation dams as small dams in Pakistan, however, by ICOLD definition considering height of the dams above 15 m, almost all of these dams can be rated as large dams. These dams are being constructed at a greater pace now. From 2002 till date some 15 dams have been completed. The details regarding recently completed dams are shown in **Table-2**.

Table 2. Dams Completed in Pothowar Plateau from 2002 till 2010 (Source; Small Dams Organization Punjab)

S. No	Name of Dam	District	Height of Dam (feet)	Gross Capacity (Acre-foot)	CCA (Acres)	Year of Completion	Capacity of Channel (cfs)	Length of Channel (feet)
1	Mial Dam	Chakwal	70.31	3200	935	2004	6.00	16000
2	Lehri Dam	Jhelum	109.00	5705	2220	2006	30.00	37000
3	Jamal Dam	R.Pindi	87.00	1860	1488	2006	8.75	28100
4	Salial Dam	Jhelum	68.00	527	450	2006	4.00	8550
5	Thatti Syedan Dam	Attock	42.65	600	300	2006	3.75	10000
6	Sawal Dam	Attock	95.00	2400	930	2006	9.50	37000
7	Talikna Dam	Attock	57.87	2050	1000	2006	7.00	15000
8	Jabba Dam	Attock	83.60	860	400	2006	3.75	7800
9	Jalwal Dam	Attock	60.00	5000	2364	2006	23.00	40000
10	Khai Dam	Chakwal	82.50	2000	750	2007	6.00	12000
11	Minwal Dam	Chakwal	128.00	5921	1803	2007	16.00	34600
12	Ghazial Dam	Chakwal	73.50	2000	900	2007	7.00	18800
13	Basal Dam	Attock	65.00	1700	500	2004	4.25	11500
14	Dhok Tahlian Dam	Chakwal	74.35	1808	650	2002	6.30	31680
15	Shah Habib Dam	Jhelum	77.14	1655	450	2007	3.00	18000

A perusal of Table-2 reveals that all of these 15 dams have been completed in the last five years. This shows a greater pace of small dam development in Pothowar as compared to the past. It is perhaps due to the fact that no inter-provincial conflicts exist on construction of small dams in Pothowar Plateau and also no large investment at federal level is involved which requires greater national consensus resulting in delay. Also another 5 dams are nearing completion in 2011 (**Table-3**).

Table 3. Dams Nearing Completion in Pothowar Plateau In 2011 (Source; Small Dams Organization Punjab)

S. No	Name of Dam	District	Height of Dam (feet)	Gross Capacity (acre-feet)	CCA (acres)	Capacity Of Channel (cfs)	Length of Channel (feet)
1	Domeli Dam	Jhelum	120.00	8690	3000	30.00	29200
2	Dharabi Dam	Chakwal	91.50	37000	6400	32.00	131800
3	Gurah Utam Singh Dam	Jhelum	94.00	2679	1500	12.25	30000
4	Phalina Dam	R.Pindi	74.00	3900	2200	21.60	37500
5	Haji Shah Dam	R.Pindi	66.25	2200	1520	13.75	25250

Table 3 shows that 5 more dams would be added to already completed 45 dams making the figure to 50 by the end of 2011. This will add another 14,620 acres of culturable command area in the Pothowar Plateau resulting in increased agricultural yield from the area. Moreover 10 dams have been designed and are in pipeline for start of construction under (**Table4**).

Table 4. Planned Dams of Pothowar Plateau Under Annual Development Programme of the Government of Pakistan 2009-10 (Source; Small Dams Organization Punjab)

S. No	Name of Dam Site	District	Height of Dam	Gross Storage Capacity (Aft)	CCA (Acres)
1	Taja Bara Dam	Attock	57.00	2250	1300
2	Sadrial Dam	Attock	69.00	2750	825
3	Shahbazpur Dam	Attock	79.00	5000	1260
4	Ugahun Dam	Rawalpindi	85.00	8100	3000
5	Dhok Hum Dam	Chakwal	87.00	8000	1250
6	Mundi Dam	Chakwal	47.00	450	400
7	Dhok Jhang Dam	Rawalpindi	100.00	2650	1050
8	Uthwal-Lakhwal Dam	Chakwal	133.00	18000	3500
9	Ghabir Dam	Chakwal	138.00	66203	15000
10	Cherah Dam		131.20	24750	15 MGD

A perusal of Table-4 reveals that by construction of these 10 dams another 27,585 acres of culturable command area would be added in the Pothowar Plateau resulting in increased agricultural yield from the area in the next few years. Also an assured water supply of 15 Million Gallons per Day to Rawalpindi City is envisaged by the construction of single purpose Cherah Dam by the Small Dams Organization.

Further to that, Small Dams Organization has identified 22 more sites for dams construction in future. The location of dams completed, nearing completion, included in 2007-08 Annual Development Programme and those identified is shown in Index Plan in **Figure-2**

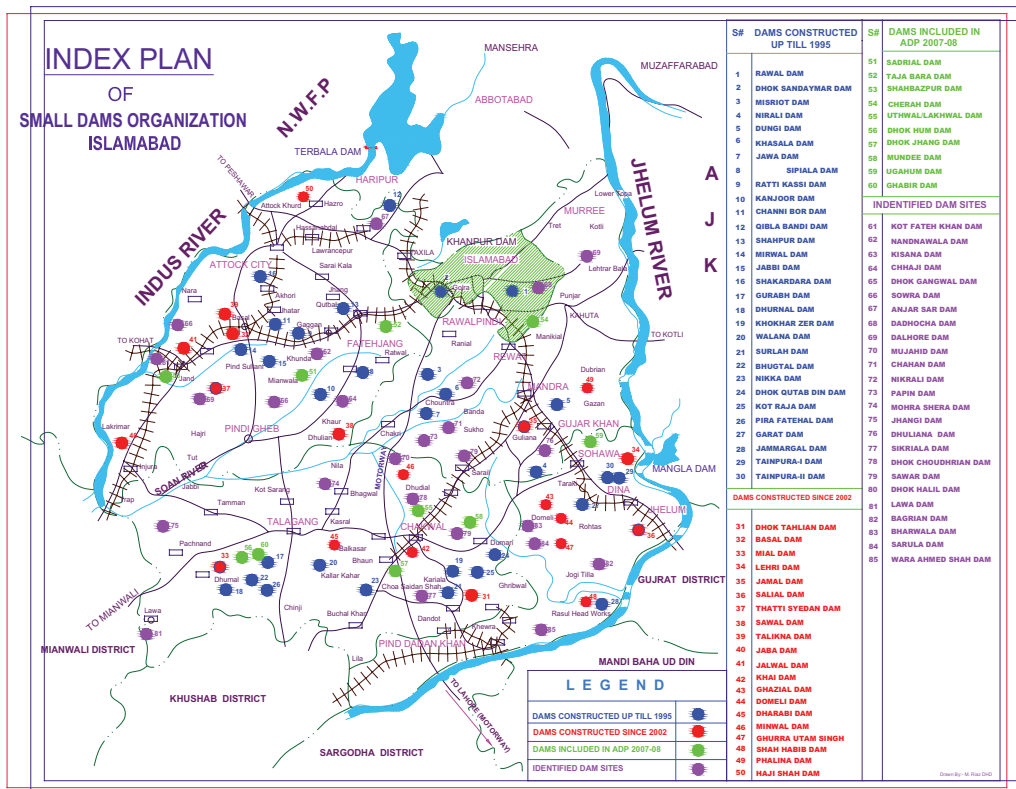


Fig. 2. Index Plan of Completed, Nearing Completion, in Pipeline and Identified Dams in Pothowar Plateau, (Source; Small Dams Organization, Punjab)

The above details reflect keen interest of the Government in Water Resources Development in Pothowar Plateau.

3. CONCLUSIONS AND RECOMMENDATIONS

There are positive socio-economic impacts of small dams in the Pothowar plateau. Some notable merits are listed below:

- With assured supply of water, switch-over from traditional crops to high value crops like Orchards, vegetables, fodders, horticulture, flora culture etc.

- Sufficient growth of fodder for development of livestock farming leading to production of meat, milk etc.
- Poverty alleviation by increasing farm incomes
- Fulfillment of drinking and domestic water requirement of nearby villages.
- Checking migration of rural population to avoid burden on cities.
- Improvement of general environment of area and health of people.
- Contribution towards recharging of ground water aquifer.
- Time spent by women folk in fetching water from far-flung areas would now be available for child care and other house hold activities.
- Promotion of community participation.

Direct monetized benefits from completed Small Dams in Pothowar Plateau are shown in Table-5

Table 5. Direct Benefits from Completed Dams in Pothowar Plateau (Source; Small Dams Organization Punjab).

Culturable Command Area	62,764 Acres
Average Yearly Revenue	
➤ Abiana (Irrigation Water Charges)	RS.38.84 Million
➤ Drinking Water	RS. 3.15 Million
➤ Fishries	RS. 5.24 Million
➤ Others	RS. 2.5 Million
Total:	RS.49.73 Million

It is concluded from Table 5 that relative share of Abiana (Irrigation Water Charges), Drinking water & Fisheries components is 78.10% , 6.33% and 10.54% of the total monetary benefits respectively. Thus there is room for enhancement of Fisheries industry in the area. Also Abiana (Revenue from water released for agricultural purposes) can be increased by further development of supply channels and increasing culturable command area. However, the monetary benefits are merely a bonus and the social & environmental gains are invaluable

There are several issues relating to Small Dams in this area which still need to be addressed on priority.

- The command areas of small dams are not properly developed to realize optimum irrigation benefits.
- The water losses in conveyance and application are considerable and duty of irrigation water is on lower side.
- Gradual loss in reservoir capacity due to sedimentation and vegetation growth is on the increase in the reservoir area.
- The water losses due to evaporation and seepage are also high.

- Mechanism of small dam inspection and monitoring with regard to safety needs much improvement.

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