

IRRIGATION SYSTEM IN PAKISTAN

KEY FACTS

No. of major Reservoirs:	3
No. of Barrages:	16
No. of Headworks:	2
No. of Inter-link Canals:	12
No. of Canal Systems:	44
No. of Watercourses:	107,000
Length of Canals:	56,073 km
Length of Watercourses:	1.6 million km
Average Canal Water Diversions:	104.7 MAF
Groundwater Abstractions:	41.6 MAF
No. of Tubewells:	> 550,000
Irrigated Area:	36 million acres
Average Escapage to the Sea:	39.4 MAF

1.0 THE DEVELOPMENT OF THE IRRIGATION SYSTEM

Controlled year round irrigation began in 1859 with the completion of the Upper Bari Doab Canal (UBDC) from Madhopur Headworks (now in India) on Ravi River. Until that time, irrigation was undertaken through a network of inundation canals, which were functional only during periods of high river flow. These provided water for *kharif* (summer) crops and some soil moisture for *rabi* (winter) crops.

The last inundation canals were connected to weir controlled supplies in 1962 with the completion of Guddu Barrage on Indus River. UBDC was followed by Sirhind Canal from Rupar Headworks on Sutlej in 1872 (also in India) and Sidhnai Canal from Sidhnai Barrage on Ravi in 1886. The Lower Chenab from Khanki on Chenab in 1892, and Lower Jhelum from Rasul on Jhelum in 1901 followed suit. Lower and Upper Swat, Kabul River and Paharpur Canals in NWFP were completed between 1885 to 1914.

By the turn of the century, it became apparent that the water resources of the individual rivers were not in proportion to the potential irrigable lands. Ravi River, serving a large area of Bari Doab, was deficient in supply while Jhelum had a surplus. An innovative solution was developed in the form of the Triple Canal Project, constructed during 1907 -1915. The project linked the Jhelum, Chenab, and Ravi rivers, allowing a transfer of surplus Jhelum and Chenab water to the Ravi. The Triple Canal Project as a land-mark in integrated

interbasin water resources management and also provided the key concept for the resolution of the Indus Waters Dispute between India and Pakistan in 1960.

The Sutlej Valley Project, comprising of 4 barrages and 2 canals, was completed in 1933, resulting in the development of the unregulated flow resources of the Sutlej River and motivated planning for the Bhakra reservoir (now in India).

During the same period, the Sukkur Barrage and its system of 7 canals serving 2.95 million hectares of land in Lower Indus were completed. Haveli and Rangpur from Trimmu Headworks on Chenab in 1939 and Thal Canal from Kalabagh Headworks on Indus were completed in 1947. This comprised the system inherited by Pakistan at the time of its creation in 1947.

At independence, the irrigation system, conceived originally as a whole, was divided between India and Pakistan without regard to irrigated boundaries. This resulted in the creation of an international water dispute in 1948, which was finally resolved by the enforcement of Indus Waters Treaty in 1960 under aegis of the World Bank. The treaty assigned the three eastern rivers (Ravi, Beas, Sutlej) to India, with an estimated total mean annual flow of 33 million acre feet (MAF) and the three western rivers (Indus, Jhelum, Chenab) to Pakistan with a transfer of irrigation supplies from the western rivers to areas in Pakistan formerly served by the eastern rivers as well as some development potential to compensate for the perpetual loss of the eastern waters. The Indus Basin Project including Mangla Dam, 5 barrages, 1 syphon and 8 inter-river link canals, was completed during 1960-71, while Tarbela Dam started partial operation in 1975-76.

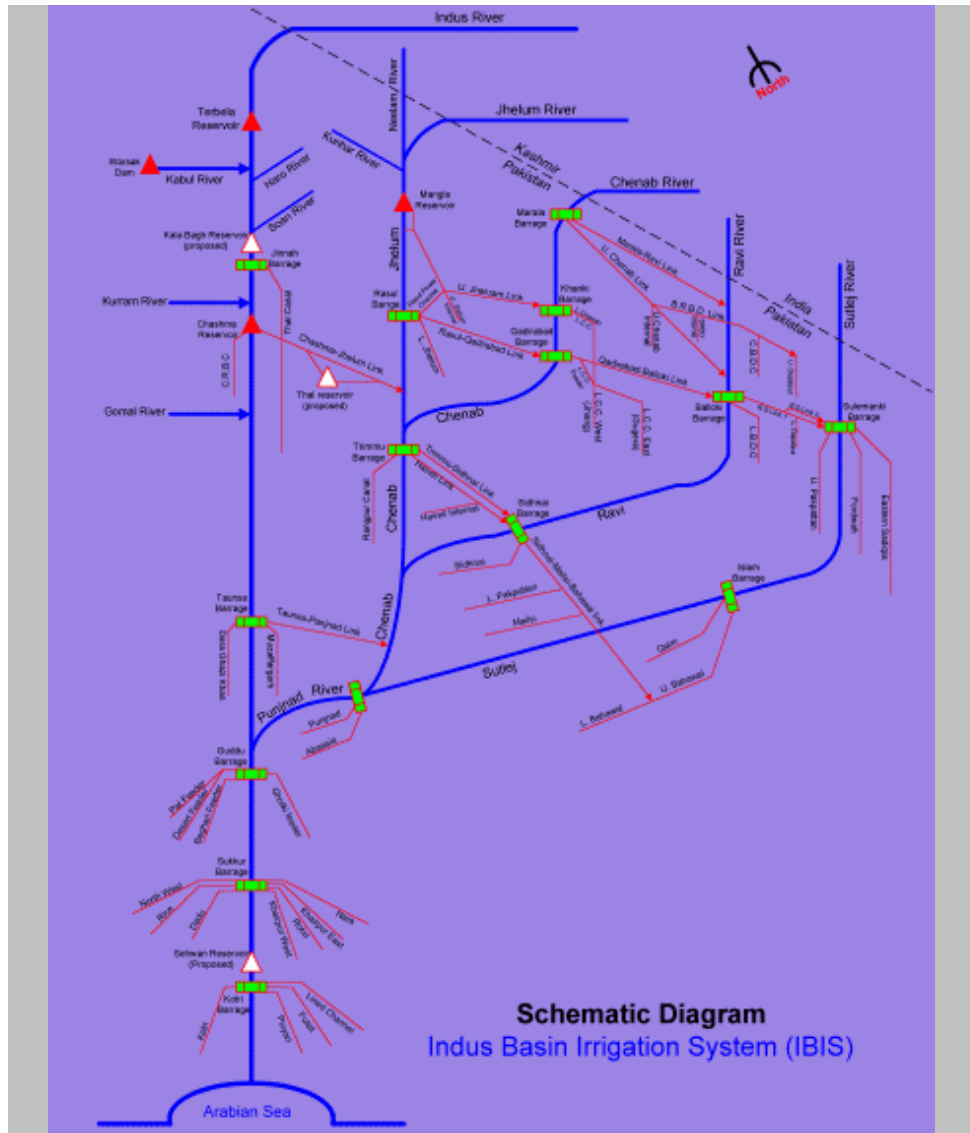
After partition, Kotri, Taunsa and Guddu Barrages were completed on the Indus River to provide controlled irrigation to areas previously served by inundation canals. Also, three additional inter-river link canals were built prior to the initiation of Indus Basin Project.

2.0 APPRECIATION OF THE INDUS BASIN IRRIGATION SYSTEM

The Indus Basin Irrigation System comprises of three major reservoirs, 16 barrages, 2 head-works, 2 siphons across major rivers, 12 inter river link canals, 44 canal systems (23 in Punjab, 14 in Sindh, 5 in NWFP and 2 in Balochistan) and more than 107,000 water courses. The aggregate length of the canals is about 56,073 Km. In addition, the watercourses, farm channels and field ditches cover another 1.6 million Km.

Typical watercourse commands range between 200 and 800 acres. The system utilizes over 41.6 MAF of groundwater, pumped through more than 550,000 tube wells, in addition to the canal supplies. Outside the Indus Basin, there are smaller river basins, which drain directly to the sea. One if located is on the he Mekran coast of Balochistan and the other is a closed basin (Kharan). The total amount inflow of both is less than 4 MAF annually. These streams are flashy in nature and do not have a perennial supply. About 25% of their inflow is used for flood irrigation.

Currently the total annual surface water diversions at the canal heads of the Indus Basin irrigation system are about 105 MAF.

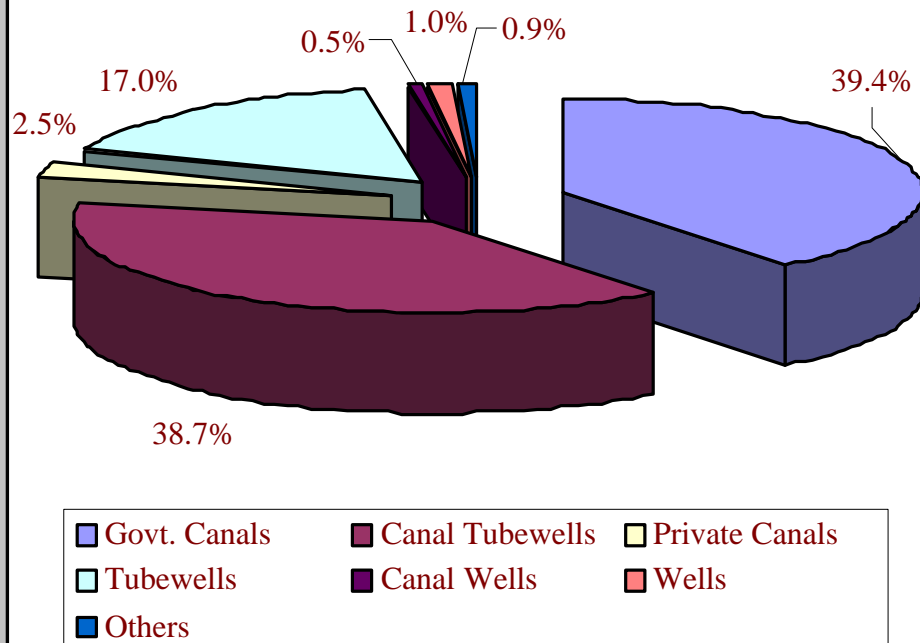


3.0 IRRIGATION SYSTEM

Irrigated agriculture is the major user of both, surface and groundwater resources of Pakistan. The average annual river diversions for irrigation in the Indus Basin are of the order of 104.7 MAF, to irrigate over 14.6 million hectares. Of this, 67.11 MAF on average are diverted during the *kharif* period, while 37.63 MAF are diverted during the *rabi* period.

During the *kharif* periods of the last ten years, Punjab used 34.3 MAF annually, while Sindh and Balochistan used 31.4 MAF and NWFP used 2.35 MAF. During the *rabi* periods of the last ten years, average withdrawals by Punjab, Sindh and Balochistan and NWFP were 19.87 MAF, 16.06 MAF and 1.46 MAF, respectively. A further 41.6 MAF is pumped annually from the groundwater reservoirs, of which more than 90% is used for irrigation.

Water Source Distribution of Irrigated Area (1999-2000)



4.0 DISTRIBUTION OF AREA AND WATER

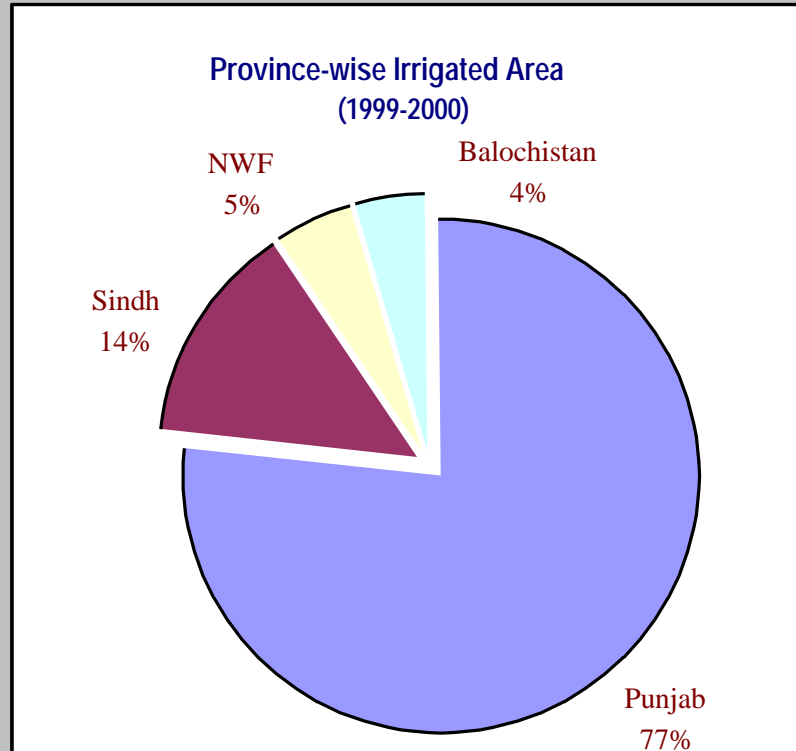
During the year 1999-2000, the total irrigated area from all the sources, including private canals, schemes, wells and tubewells and publicly owned infrastructure was of the order of 18.06 million hectares. About 77.4% of the total irrigated area of Pakistan falls in Punjab, 2.8% area falls in NWFP and 19.8% in Sindh/ Balochistan.

Based on the statistics of the last 10 years, the area irrigated by canals has increased slowly by an aggregate of 6% but its share in irrigated area has remained constant due to the continuous increase in the number of tubewells which now irrigate 20% more area than 10 years ago.

DISTRIBUTION OF IRRIGATED AREA (1999-2000)

Province	Total Mha	Govt. Canal %	Canal Tubewells %	Private Canals %	Tubewells %	Canal Wells %	Wells %	Other %	Total %
Punjab	13.84	28.4	50.5	.....	19.1	0.7	0.9	0.4	100
Sindh	2.52	94.8	.....	.....	5.2	.....	.....	.....	100
NWF	0.89	43.8	.....	41.6	6.7	.....	4.5	3.4	100
Balochistan	0.81	49.4	.....	11.1	28.4	.....	2.5	8.6	100
National	18.06	39.4	38.7	2.5	17	0.5	1	0.9	100

5.0 PROVINCIAL IRRIGATION SETUPS



Punjab

The public irrigation infrastructure in the Punjab consists of 13 barrages, 2 siphons across major rivers, 12 link canals and 23 major canal systems over an aggregate length of 34,500 km.

The whole irrigation infrastructure lies within the Indus Basin System. It serves an area of 8.58 million hectares. In addition, there are 135 surface drainage systems including over 670 drains, with an aggregate length of about 6,600 km, which drain an area of about 5.79 million hectares, within the 23 canal commands.

During the year 1999-2000, the total irrigated area, using all sources available in the Punjab, was of the order of 13.8 million hectares. This included 11 million hectares in the canal commands. The private tubewells and wells irrigated 6.8 million acres during the same period.

Sindh

Sindh has 14 publicly owned irrigation systems, which receive water from three barrages across the River Indus. These systems, with an aggregate length of 18,000 km of canals, serve an area of about 5.38 million hectares. There are 13 existing surface drainage systems in Sindh, which serve a total area of over 3.5 million hectares and have an aggregate length of about 4,800 km. New drains are also being constructed in the province.

During the year 1999-2000, the total irrigated area, using all sources in Sindh, was of the order of 3.52 million hectares. This included 2.39 million hectares of

irrigated land in the canal commands. The private tubewells and wells irrigated 0.13 million hectares during the same period.

NWFP

NWFP has five publicly owned irrigation systems in the Indus Basin, which serve a total area of 0.34 million hectares. These systems receive water from two headworks across River Swat and Warsak Dam. In addition, there are six other canal systems, which serve a total of 0.13 million hectares of land.

NWFP has over 200 canals called `civil canals`, which are community or privately owned. These irrigate an aggregate area of 0.83 million hectares. There are four surface drainage systems in NWFP comprising of 456 drains. These serve a total area of 0.37 million hectares.

During the year 1999-2000, the total irrigated area, using all the sources in NWFP was of the order of 0.89 million hectares. This included 0.39 million hectares of land in the canal commands. Private canals, tubewells and wells irrigated 0.47 million hectares during the same period.

Balochistan

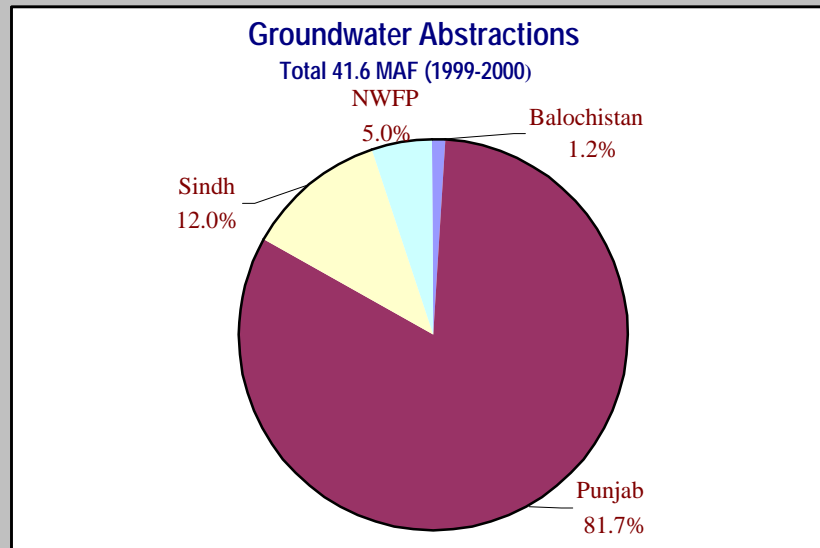
Balochistan has two canal systems, which receive water from the Indus Basin System through Guddu Barrage and Sukkur Barrage, located in Sindh. These canal systems serve a total area of 0.33 million hectares. One of these, the Pat Feeder Canal System, has been improved recently. In addition, there are 431 independent publicly owned small irrigation schemes, which serve 0.14 million hectares. There are a few privately owned small irrigation schemes too.

During the year 1999-2000, the total irrigated area, using all the sources in Balochistan, was of the order of 0.81 million hectares. This included 0.4 million hectares in the canal commands. Private tubewells and wells irrigated 0.34 million hectares during the same period. Balochistan also has one large drainage system called the `Hairdin Drainage System`, which drains 0.07 million hectares.

6.0 GROUNDWATER USAGE FOR IRRIGATION

An estimated 41.6 MAF of groundwater is pumped annually in Pakistan. According to a study, more than 90% of the extracted groundwater is used for irrigation purposes. Groundwater reservoirs are recharged from the rivers as well as the seepage losses from the canals, watercourses, farm channels and the fields.

Most of the ground water abstraction occurs in the Punjab. This was of the order of 34 MAF in the year 1999-2000, followed by Sindh, estimated at 5 MAF, Balochistan at 0.5 MAF and NWFP at 2.1 MAF.



In the last 25- 30 years, ground water has become a major supplement to canal supplies, especially in the Upper Indus Plain. In this region, the ground water quality is good. The groundwater resources of Pakistan extend from the Himalayan foothills to the Arabian Sea and are contained in the alluvial deposits of the Indus Plains.

Large scale tubewell pumpage for irrigation began in the early sixties. The number of private tubewells grew steadily with time. There are presently about 550,000 tubewells in the IBIS and the annual pumpage in all canal command areas has been estimated to be 41.6 MAF.

7.0 SALINITY AND WATERLOGGING

Pakistan has an agriculture-based economy, which is mainly dependent on irrigation through canal supplies. Before the introduction of the irrigation system, the water table was sufficiently deep. However, due to a lack of drainage facilities and improper water management, the water table rose, resulting in waterlogging and salinity.

About 25% of the irrigated area of Pakistan is affected by waterlogging and salinity/ sodicity problems. In addition to other measures like the Irrigation System Rehabilitation, Command Water Management and On-Farm Water Management programs taken up by different government departments, WAPDA completed 57 Salinity Control and Reclamation Projects (SCARPs) at a total cost of Rs. 26.48 billion. These cover a gross area of 7.81 million hectares. Projects worth Rs. 26.9 billion are also in progress. Surveys have indicated that waterlogging has reduced from 42% in the 60s to about 25% in 1977-79. Similarly, saline, saline-sodic and sodic soils were reduced from 6, 27 and 11% to 11, 24 and 3% respectively, in the same period of time.

The National Drainage Programme (NDP) was launched in 1998, incurring a cost of US\$ 785 million. The programme will continue for 25 years. The major activities envisaged include remodeling/ extension of existing surface and new drains, rehabilitation/ replacement of saline groundwater (SGW) tubewells, installation of pipe drains in new areas, lining of watercourses in SGW areas,

construction of interceptor drains, reclamation of waterlogged areas through biological drainage and transfer of fresh groundwater tubewells.

Many measures have also been suggested in the Ninth Five Year Plan to uplift the agro-based economy of the country by maximizing crop production. In addition to this, the Vision 2010 program will have Rs. 584.6 billion for water sector.

8.0 IRRIGATION EFFICIENCIES

Pakistan, despite being an agrarian country, has demonstrated extremely low irrigation efficiencies, creating problems related to water conservation and waterlogging and salinity.

The crop yield in Pakistan is on the lower side. The current estimated irrigation efficiency in Pakistan is 35.5%. This means that only 35.5% of the water that reaches the fields is actually used by the crops. Irrigation efficiency is a compound of three efficiencies i.e. canal-head efficiency, watercourse efficiency and farm efficiency.

9.0 ESCAPAGE TO THE SEA

On an average, about 39.4 MAF of water flows to the sea annually. Most of this flow occurs during the *kharif* season when 36.94 MAF or 93.8% goes to the sea. In the *rabi* season, on average about 2.44 MAF flows into the sea, and most of that is in the first few weeks of the season. For several months in the winter, there is no flow into the sea.

During the last 25 years, a total flow of 984.75 MAF of river water has flowed into the sea. This is equivalent to more than 9 years of average canal withdrawals during the same period.

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