

Strategic Analysis Paper

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The Indus River and Agriculture in Pakistan

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Key Points

- Agriculture is the second-largest sector of the Pakistani economy, accounting for approximately 21 per cent of GDP.
- It is highly dependent upon the Indus River system as farmland is mainly irrigated by water from the Indus River and its tributaries.
- The low cost of water from the country's irrigation system contributes to the over-exploitation of water resources and makes it challenging to maintain.
- Solutions that address the overuse of water will not be easy to carry out, suggesting they are unlikely to be implemented in the near-term.

Summary

Even though Pakistan has limited land suitable for farming, the agricultural sector is a major component of its economy. While Pakistan has an arid to semi-arid climate, it is not physically water-scarce. Its water problems are caused by inefficiencies, waste and mismanagement, all of which are especially present in the agricultural sector. The majority of farmland is irrigated through a canal system that has, historically, provided ample water. In recent years, however, the situation has changed. Pakistan is now facing increased pressure from dwindling water supplies. Supply-side solutions could provide a short-term solution, but long-term solutions necessitate a reduction in the amount of water lost through poorly maintained infrastructure and finding other ways to conserve water.

Analysis

By 2030, Pakistan is expected to transition from being water stressed to water scarce. Water availability is likely to decline from between 500 and 1,000 cubic metres per capita per year to below 500 cubic metres per capita per year within this timeframe. Such a transition, if it occurs, will have a considerable impact upon the natural environment, economy and society.

Increased demand for water, food and fibre crops, driven by a growing population, will be partly responsible for heightened water insecurity. By 2025, demand for water in Pakistan is projected to reach 274 million acre-feet (MAF) per year, while supply will likely remain relatively unchanged at 191 MAF. Unless demand and wastage is curtailed the water crisis will grow in severity.

Pakistan is reliant upon the Indus River and its tributaries. Agricultural production would not be possible in large tracts of the country without the network of canals and associated irrigation systems that tap into the river. The irrigated area covers about 80 per cent of the total area under cultivation. This area also supplies 90 per cent of the country's food and fibre requirements. The remaining cultivated land, the larger part of which is located in the Pothohar Plateau, northern mountains and north-eastern plains of the country, is rain-fed.

The Indus River originates in the Himalayas and flows towards the Arabian Sea, where it forms a 600,000 hectare delta. Dam construction for irrigation and power has reduced the flow of the river, decreasing the availability of fresh water downriver. The river also powers two major hydropower facilities, at Tarbela and Mangla Dams, upstream from the main farming regions. Several more hydropower facilities are either planned or under construction. Due to large withdrawals from the river the flow rate has declined to levels significantly lower than occur naturally. As a result, saline seawater is [intruding](#) into the delta region.

Water is not evenly distributed throughout the country, leading to disputes between provinces over water rights. Regions within the Indus Basin have significantly greater access to water resources than those in the east of the country. The Indus Basin covers about 520,000km², or 65 per cent of the Pakistani landmass. The entirety of Punjab province lies within the basin while the majority of Baluchistan province, in the country's west, lies outside of it. Many of those living in the south of the country also believe that those in the north take too large a share of the river's water, leaving them with comparatively less. The potential for interprovincial disputes increases as pressure mounts on the country's water supply.

Agriculture in Pakistan

Agriculture is the [second-largest](#) component of the Pakistani economy, after the services sector, and accounts for approximately 21 per cent of GDP. With 45 per cent of the labour force engaged in agricultural activity, it is the country's largest employer. Due to the climatic conditions of the country, the agricultural sector is also the largest consumer of water.

Significant agricultural production occurs in all parts of the country but is most heavily concentrated in the Indus River plain in Punjab and Sindh. About 60 per cent of the country

is unsuitable for forestry or agriculture as it contains desert, mountainous terrain or urban settlements.

Changing climatic conditions have an impact upon the river and the agricultural system that it sustains. Residents in the mountainous northern areas of the upper Indus Basin have [welcomed](#) the warmer weather of recent years believed to have been brought about by climate change. Farmers in the Gilgit-Baltistan region report that they can now grow a wider variety of crops in more productive fields.

In the long-term, however, warmer climates are likely to have negative consequences for the region. The Himalayan, Hindu Kush and Karakorum mountain ranges intersect in north Pakistan, forming part of the largest reservoir of ice outside of the poles. Surplus water is stored in Tarbela and Mangla Dams, but, due to increased demand and irregular rainfall, it is [unlikely](#) to last more than 30 days. To overcome the shortfall, irrigators rely upon water from snowmelt during the growing season. A warmer climate is likely to reduce the amount of snowmelt present in the region and contribute to greater water stress.

The majority of agricultural production takes place in Punjab province. It is home to roughly 55 per cent of the population and most industrial and commercial centres are based in the province. The five rivers - Jhelum, Chenab, Ravi, Sutlej and Beas - that feed into the Indus River all converge in Punjab province. Perhaps due to its relative agricultural bounty and the perception that it has an ample supply of water, many in Sindh province, located to the south of Punjab, accuse its irrigators of overdrawing water and leaving them with less to sustain their own agricultural production. Tension between the two provinces over water resources could potentially sour inter-province relations with potential ramifications for the political stability of the country and the wider region.

Khyber Pakhtunkhwa and Baluchistan have more limited agricultural sectors that receive little water from the Indus River system. The majority of Khyber Pakhtunkhwa is located in a temperate zone that receives enough rainfall to make cultivation possible. Its areas of mountainous terrain that are often covered by heavy snowfall, however, limit agriculture to a few fertile valleys. Despite being water scarce, agriculture and livestock remain major sources of income for the majority of the population of Baluchistan, in western Pakistan. For the past 30 years, the province has faced a severe water crisis driven mainly by population growth as a result of migration from neighbouring Afghanistan. The province receives little water from the Indus and the Zhob, Bolan and Mulla Rivers are more important surface water sources. The agricultural sector has traditionally relied upon groundwater, but there are [fears](#) that in parts of the province this will be depleted within ten to 12 years. Few crops are grown and the majority of its population are nomadic herders who raise camels, sheep and goats.

Agriculture is a major component of the Pakistani economy that is heavily dependent upon water from the Indus River system. Any disruption to this supply could have serious economic and social implications for the country.

Agricultural Water Use

Pakistan has the fourth-highest rate of water use in the world and the amount of water used per unit of GDP, the water intensity rate, is the [highest in the world](#). This suggests that water use practices in the country are highly inefficient as the water that is used brings limited economic benefit compared to other countries.

The low cost of water sourced from the irrigation system contributes to the over-abstraction of water by the agricultural sector. According to an International Monetary Fund [report](#), charges for the use of canal water are only able to cover 25 per cent of annual operating and maintenance costs. It was not always this way, however, as the Canal and Drainage Act 1873 included a water tax, known as the *abiana*, on farmers using the irrigation system. The *abiana* kept the system profitable until the early 1970s when Zulfikar Ali Bhutto imposed a limit on future increases to the *abiana*.¹ Currently, agriculture is one of the least-taxed sectors in the country as it accounts for less than one per cent of total tax revenue. Increasing the price of water taken from the irrigation system could assist in reducing wastage and generate profits that could then be reinvested into the system.

Flood irrigation is widely practiced within Pakistan. This is the most inefficient means to irrigate fields as only a small portion of the water is utilised by the crop, most of it is lost to evaporation or surface runoff. Replacing this inefficient practice with micro-irrigation systems, such as drip irrigation, which supplies water straight to the roots of crops rather than flooding entire fields, can provide water savings of up to 90 per cent. Such water saving systems are not suitable for regions that depend on surface water sources, such as most of Pakistan, however, due to the high silt content of the water. In these conditions, particulate matter in the water can clog the system, making it labour intensive and costly to maintain.

Most irrigators are unlikely to adopt systems that are more difficult and costly to operate. Addressing Pakistan's water security challenges by promoting alternative forms of irrigation are therefore unlikely to have widespread impact. Charging more for the use of water, so that the system can be better maintained, however, could go some way towards improving water security.

Supply-Side Challenges: Dams in Pakistan

Pakistan receives the majority of its annual rainfall in a few weeks during the annual monsoon season. For most of the year, the country is relatively dry. Such climatic conditions necessitate the storage of water and effective flood management.

In order to conserve water for use during the dry season, Pakistan constructed a series of dams on the Indus River, with most of them built between 1960 and 1975. The largest of these are the Mangla and Tarbela. These dams are subject to their own challenges, however, mainly due to the build-up of sedimentation. The water flowing through rivers carries silt

¹ Daanish Mustafa, Majed Akhter and Natalie Nasrallah, 'Understanding Pakistan's Water-Security Nexus', *United States Institute of Peace*, p. 22, <http://www.usip.org/sites/default/files/PW88_Understanding-Pakistan's-Water-Security-Nexus.pdf>.

and other indissoluble material that becomes trapped behind dam walls. As this material increases in the dam, its capacity to store water decreases. The Indus River is particularly laden with silt and other detritus making the dams located on it particularly susceptible to sedimentation.

Tarbela Dam, which provides water for irrigation, power generation and flood control, has [lost 30 per cent](#) of its capacity through sedimentation since it was commissioned in 1976. Mangla Dam has lost a similar amount of storage capacity for the same reason.

To address declining dam storage capacity, the government has proposed, at great cost, the construction of more dams. These proposals are often the source of interprovincial tensions. Ethno-nationalist movements exploit these tensions to further their own agendas. Kalabagh Dam, to be constructed in Punjab, for instance, was challenged by other provinces, particularly Sindh as residents feared that it would decrease the amount of water available to them.

It is believed that the construction of more dams will assist with future flood management. The draft national flood protection plan envisages the construction of the Kalabagh, Diamer Basha, Adhroi, Munda, Chiniot and Kurram Tangi dams. These reservoirs could go some way toward solving the country's limited water storage capacity but, since Pakistan has been unsuccessful in getting irrigation users to pay an adequate price for the provision of water, it will be difficult to operate and maintain such infrastructure. The construction of these dams will likely be funded by donors who have little to no interest in bearing operational or maintenance costs. Without institutional reform that addresses the difficulties in operating and maintaining water infrastructure, these dams are likely to achieve little in terms of resolving Pakistan's water storage problems.

It has been estimated that fixing the canals and pipes that make up the country's irrigation system would have a larger impact on its water security than the construction of dams. Simi Kamal, one of Pakistan's foremost water experts, has [suggested](#) that repairing and maintaining the existing canal network would secure 76 MAF of water per year. As such a course of action would require increasing taxes on irrigators and cost considerable political capital, however, it is therefore unlikely to appeal to the majority of Pakistani politicians.

Groundwater in Pakistan

As levels of surface water diminish in parts of the country, groundwater supplies are increasingly being used to augment supply. The agricultural sector is the main consumer of extracted groundwater as more than 90 per cent of it is used for irrigation. Farmers dig wells and purchase pumps to access aquifers, however, these water sources are rapidly depleting. In parts of Punjab and Khyber Pakhtunkhwa, where groundwater is most widely used, aquifers are receding by 16 to 55 centimetres per year, according to the Pakistan-based International Waterlogging and Salinity Research Institute.

Declining groundwater could have severe ramifications across the country but particularly in Baluchistan province. The western province is almost entirely dependent on groundwater to sustain its limited agricultural sector. Traditionally farmers in the region used *karez*es to

access groundwater. A *karez* is an underground aqueduct that passively taps the groundwater and relies upon gravity to carry water to the surface where it is channelled into irrigation ditches. Unlike modern electric pump-driven systems, it is impossible for this traditional method to completely deplete groundwater supplies. As electric pumps are becoming more widely used in the province, however, many farmers who rely on *karez*es have found that they can no longer reach the lowered water table.

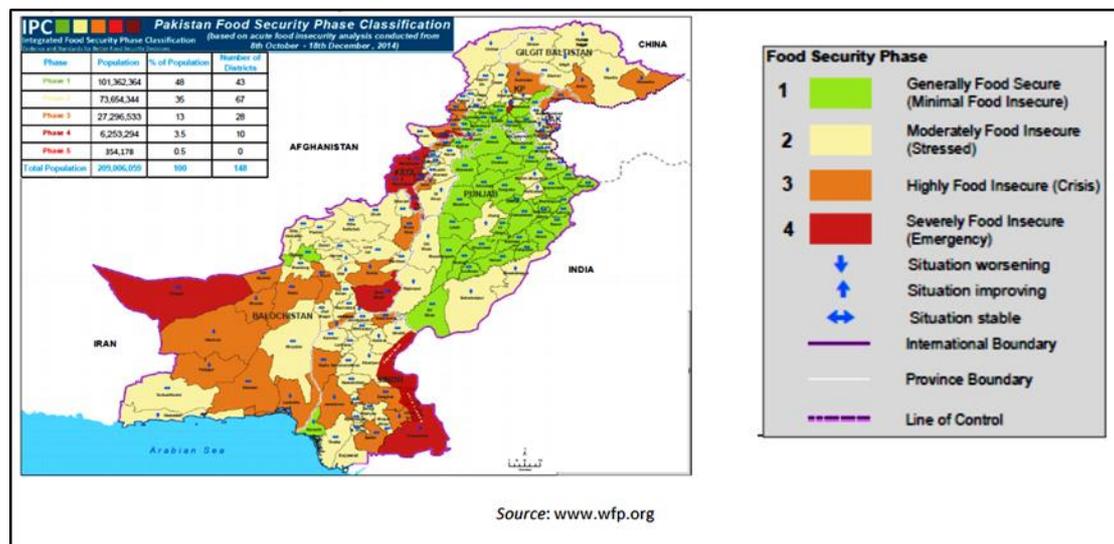
Unless sources of surface water are conserved, groundwater is likely to come under increased pressure. In regions of the country where surface water is limited, such as Baluchistan, addressing demand is vital as alternatives to groundwater will be difficult to implement.

Food Security in Pakistan

Increased water stress will have an impact upon food security in Pakistan. A general link can be drawn between the availability of water and the food security of a particular region within the country.

The Sustainable Development Policy Institute, an independent non-profit organisation based in Islamabad, has suggested that the availability and accessibility of food could become increasingly difficult for 60 per cent of the populace within the next decade unless immediate steps are taken to recharge aquifers.

Unsurprisingly, the parts of Pakistan that are most food secure are adjacent to areas of generally high water availability. Punjab is predominately food secure, while the western province of Baluchistan, located furthest from the Indus River and with the lowest agricultural output, is one of the most food insecure regions of Pakistan.



Access to food in the country has not significantly improved since 1990, according to the [Global Hunger Index](#). The proportion of the population that is undernourished has declined from 25 per cent in 1990 to 22 per cent in 2015 while the prevalence of stunting among children under five has increased over the past 15 years. These statistics suggest that Pakistan has had limited success in addressing food-related issues over the past 25 years.

Agricultural production and its associated supply network will need to become more efficient if further progress is to be made.

Conclusion: No Easy Solutions to Pakistan's Water Woes

Pakistan has traditionally focused on supply-side solutions in attempting to rectify water shortages. These usually involve increasing storage capacity and diverting water. The construction of dams could go some way toward solving the water supply challenges faced by the country, but this is not without its problems. It has the potential to heighten tension between provinces and disrupt internal political stability. Dams are also highly susceptible to sedimentation due to the large amount of silt carried by the Indus River. This shortens the period in which they can be used and, as dams are expensive to build, calls into question the economic utility of their construction.

Focusing solely upon supply-side solutions is unlikely to remedy the long-term challenges faced by Pakistan. Increasing supply does nothing to repair or maintain the leaky canals and pipes that carry irrigation water, nor does it address the wasteful practices that many in the agricultural sector currently engage in.

Demand-side solutions also need to be implemented. As the vast majority of water in Pakistan is used by the agricultural sector, it would be prudent to focus conservation efforts here. Inefficient agricultural practices need to be replaced with measures that conserve water. These measures are likely to be costly and unpopular, however, making them unlikely to be implemented.

In order to ensure that its agricultural sector continues to sustain its economy and guarantee its future food security, Pakistan needs to rectify problems in the supply and demand of water. Doing so, however, will not be straightforward and is likely to be fraught with socio-political challenges. For these reasons, it is unlikely a solution will be found in the near-term.

Any opinions or views expressed in this paper are those of the individual author, unless stated to be those of Future Directions International.