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Suspension of the Indus Waters Treaty: An Analysis of Water Stress, and Agricultural Vulnerability in Pakistan

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Abstract
Since 1960, the Indus Water Treaty (IWT) has worked like key pillar of water collaboration between India and Pakistan, sustaining the country's agriculture sector. However, the recent suspension and restriction to the treaty have aggravated water shortage, with broad requisition for Pakistan food security and agriculture production. This study investigates the overall impacts of suspension of Indus Water Treaty on Pakistan's agricultural sectors. Likewise, it highlights problems facing by Pakistan's irrigation dependent farming communities by generally analyzing the new water pressures and susceptibilities in pivotal agricultural areas. The findings analyze that the outdated irrigation methods and unfair distribution of water due to suspension of the Indus Water Treaty have led to financial risks, especially for middle- and lower-class farmers.

Key Words
Indus Waters Treaty, Water Scarcity, Agricultural Vulnerability, Trans boundary Water Conflict, Food Security in Pakistan.

Introduction

Water is a vital resource for maintaining life and encouraging socio-economic development. Water plays an important role in the lives of humans for their survival as Civilizations have developed along bodies of water throughout history[1]. While helping the agricultural and trade system of Pakistan, rivers have influenced regional cultural and political identities. This prudent importance of freshwater resources has been boosted in modern times, most specifically in areas were trans boundary rivers cross political boundaries. These conflicts often arise because of conflicting national interests between river states, population growth, climate change, and industrial demands.[2] These constraints have increased the need for shared water governance and long-term resource management.

[1] Ghani, U. (2009). Transboundary waters—Perspective of Indus Water Treaty-1960.
[2] Arif, K. M. (2024). *Estranged neighbours: India, Pakistan, 1947–2010*. World Cat. https://www.worldcat.org/

In addition to its agricultural economies and dense populations, South Asia is an ideal example of the problems related to trans boundary water management. Both India and Pakistan depend on the Indus River system, which comprises the Indus and its tributaries, the Jhelum, Chenab, Ravi, Beas, and Sutlej. After the partition of British India in 1947, the Indus Basin became an international river system, demanding legal agreements to regulate its flow equitably.

The Indus treaty resolved water sharing disputes that arose after partition. Under the treaty, India was given more rights over the eastern rivers Ravi, Beas and Sutlej, while Pakistan was given rights over the western rivers, Indus, Jhelum and Chenab[3]. It also established organizations such as the Permanent Indus Commission (PIC) and dispute settlement mechanisms such as Neutral Experts and an Arbitration court. The treaty endured for over 60 years and is generally regarded as an effective water sharing arrangement, despite political disputes between the two countries. Effective dispute resolution mechanisms and clearly defined water rights are the basis of its resilience.

With per capita availability decreasing rapidly from 5,260 cubic meters in 1951 to 908 cubic meters in 2022 far below the worldwide scarcity threshold Pakistan today faces a serious water scarcity problem. Agriculture, which uses 93 percent of freshwater and contributes significantly to the country's GDP and food security, is negatively affected by this shortage. These complex impacts illustrate how crucial it is for Pakistan to implement comprehensive water governance changes.

Despite its capability to endure multiple conflicts, IWT has faced difficulties; some issues have been solved through mediation. Underlying tensions remain, exacerbated by geopolitical factors and distrust between the parties. Water supply disruptions can have serious socio-economic impacts as agriculture accounts for a large portion of Pakistan's GDP and employs a large portion of its workforce. It is evident from a study that almost over 70% of Pakistan's population is dependent either directly or indirectly on agriculture, restriction to water flow can cause severe socio-economic instability.

Considering these dynamics, the IWT remains a pivotal but controversial groundwork for managing shared water resources in the context of Pakistan and India. The treaty's prospect to embrace and boost cooperative water governance is increasingly being tested with the prominent shift and change in climate and geopolitical disorder. While vigorous, its guiding rules and regulations are currently under unrivaled pressure. India's recent suspension of the Indus Water Treaty in 2025, a move that presents a notable upsurge in bilateral water disputes, heighten regional insecurity, and raises urgent questions about the future of water security,

[3] Ali, M., Akram, M. M., Silverman, E., Habib, H. U., Mohsan, M., Ahmad, M., & Rehman, S. (2022). On-farm water management in Pakistan – An overview. International Journal of Water Resources Engineering, 11, 52–56.

agricultural stability, and diplomatic engagement in Pakistan has been a major challenge for the region.

The deferment of Indus Water Treaty brings emphasis to the policy gaps that still present in Pakistan's framing for water management. There are problems and issues like incompetent irrigation techniques, lack of base framework to store water, and inadequate international water mediation drives have further intensified the country's vulnerability[4]. Disintegration, deficient application of rules and regulations, and lack of investment in current water technologies all contribute to these difficulties. Periodical water deficiency, glacier melting of berg floe icecap, and capricious rainfall patterns are all consequences of the precariousness of water flows due to climate change. To ensure water defensibility, these complicated problems call for a resilient and vigorous water governance system, as well as ameliorated inter-provincial teamwork and long-term policy planning.

Confessing the far-reaching implications of the suspension of the Indus Water Treaty (IWT) is pivotal for both academic research and establishment of policies. It analyzes the ways in which the major problems of water are collateral to insufficiency, gender inequality, and rural subsistence, demonstrating the miscellaneous nature of the crisis. The current study aims to elucidate:

i. Restriction of water flow and its impact on food security and agricultural productivity in Pakistan.

ii. Effects of reduced irrigation systems on the socio-economic sensitivity of farming communities.

iii. How effectively water management strategies can attenuate agricultural menace related to trans boundary water conflicts

The study is based on a qualitative approach by relying majorly on secondary sources, including books, articles, newspapers, academic journals, and institutional reports. This approach is regulated by two research designs: descriptive and historical. Meanwhile, the descriptive design helps to accurately and methodologically elucidate the socio-economic impacts, policy gaps, and the current state of water governance.

Findings and discussion

The findings of this study highlight an extensive analysis of effects of suspension of Indus Water Treaty on the agricultural sectors of Pakistan. Based on secondary data

[4] Ghani, U. (2009). Transboundary waters—Perspective of Indus Water Treaty-1960.

sources, the study investigates how restricted water flow due to suspension results in risk of crop productivity financial situation of farming communities and food security. Each point analyzes the general difficulties due to outdated irrigation structures and unpredictable changes in climate. The discussion further assesses the techniques of managing water potential that would be considered to foster resilience. The analysis revolves around the research questions on which the study is based upon, calming to make study evidence-based insights into problem which is contemporarily suffering by Pakistan.

In South Asian global politics, where water constituted once a symbol of solidarity, however, now instantly becomes militarized as a tool of diplomatic influence. India's termination of Indus Water Treaty in April 2025 signals a historic turning point. A hazardous alteration in the region's bilateral approach is brought out by India's decision to declare treaty

in "abeyance" of the Pahalgam attack and its apparent correlation of treaty compliance with demands regarding terrorism.

India could still not possess the resources to permanently close off or to redirect the western rivers, but the unexpected suspension of standard information trade, flood warnings and sediment flushing steps has brought about an extent of uncertainty that is negatively impacting Pakistan's irrigation-based economy. The absence of such obscured regulations drastically raises the chance of flash floods, delayed sowing or missed harvesting windows threats that predominantly impact small scale farmers. These regulations are even more critical during the monsoon season. Although approximately 80% of Pakistan's water supply is obtained from the Indus Basin, the interruption of IWT is going to have a problem of socioeconomic instability. Farmer's yearly preparation has already begun to be complicated by the inconsistent water flows, notably in areas with water shortages like southern Punjab and interior Sindh. Meanwhile India's initiation of new hydroelectric projects on the Chenab River without authorized intervention or debate indicates an eventual long term plan scheme to exercise dominance of upper riparian hydrology[5].

Impacts of Disrupted Water Flow on Agricultural Productivity and Food Security in Pakistan

Declining Crop Yields and Food Insecurity

Pakistan’s already vulnerable agricultural sector has been severely strained since India suspended the Indus Waters Treaty (IWT) in April 2025. Water flows from the western rivers, Indus, Jhelum and Chenab, are essential to the Indus Basin

[5] Abbas, M. (2025, May 18). Troubled waters: The weaponization of the Indus Waters Treaty. The News International. https://www.thenews.com.pk/print/1171792-troubled-waters- the-weaponization-of-the-Indus-waters-treaty

Irrigation System, which supports 80-92% of Pakistan's production.[6] Major crops such as wheat, rice and cotton which collectively comprise of more than 70% of the agricultural GDP have suffered substantial production losses as their supply is cut or disrupted. The World Bank anticipates that by 2025, Pakistan's per capita water availability will fall below 800 m3, well below the water scarcity threshold.

Likewise, more than 50% of canal water is lost before it arrives at the fields, making it challenging for farmers to sustain productivity due to inefficiencies in irrigation systems. Food insecurity is a direct result of this water stress. The decline in local crop production has led to Pakistan becoming more dependent on food imports, putting pressure on foreign reserves and increasing the prices of essential commodities. In 2023 alone, wheat prices increased by 40%, while rice and vegetable prices increased by 25-35%[7]. Climate events further increase the country's vulnerability. For example, the 2022 floods damaged 80% of Sindh's kharif crop and submerged a third of the country. Approximately 38% of Pakistan's population are currently experiencing moderate to severe food insecurity because of a combination of climate shocks, damage to irrigation infrastructure, and river flow disruptions[8].

Soil Degradation and Desertification

In the areas of Sindh and Baluchistan Pakistan's land degradation and desertification are impacted by poor irrigation management and excessive groundwater extraction. Approximately 50% of Punjab's agricultural water requirements are fulfilled by groundwater, leading to salinity on over 4.5 million hectares which includes specifically in the irrigated plains of the Indus Basin. Moreover, about 1 million hectares of agricultural land have been ruined by massive waterlogging due to the discharge of canals that are not properly lined[9]. The use of low-quality saline groundwater and falling water tables has increased land degradation, in which land fertility has been compromised. Such a type of problem is particularly acute in Sindh, where rising groundwater tables cause intensified salinity. The inadequate drainage systems and excessive irrigation are the main causes of secondary salinity in the region, which reduces crop yields. Furthermore, the increased stress on

[6] Briscoe, J., Qamar, U., Contijoch, M., Amir, P., & Blackmore, D. (2005). Pakistan's water economy: Running dry. World Bank.

[7] FAO. (2024). Water management practices for sustainable agriculture in South Asia. Food and Agriculture Organization of the United Nations.

[8] World Food Programme. (2023). Hunger Map: Pakistan. https://hungermap.wfp.org/

9.Zahra, S. M., Shahid, M. A., Misaal, M. A., Zaman, M., Imran, M., Azam, S., & Hussain, F. (2023). Sustainable water management in Indus Basin and vulnerability due to climate change. Environmental Sciences Proceedings, 25, 36. https://doi.org/10.3390/ECWS- 7-14203

surface and groundwater resources has worsened the process of soil degradation by climate change, including evaporating berg floe icecap and water loss due to rising temperatures.

These problems are further exacerbated by Pakistan's inadequacy to control seasonal water flows due to its low water storage capacity, which is about 150 m^3 per capita compared to 2000-5000 m^3 in India. Therefore, there is an urgent need for improved water management, canal lining, and methods to reduce salinity, as both agricultural production and environmental sustainability are facing serious threats[10].

Socio-Economic Vulnerability of Farming Communities Due to Reduced Irrigation

Economic Hardship and Rural Migration

In Pakistan farmers face socioeconomic susceptibility due to economic hardship, specifically in rural Punjab. It is analyzed that about an average of 57.7% of food alone constitutes household expenses, indicating the disproportionate financial burden borne by small farmers. Districts such as Toba Tek Singh and Sialkot's proportion of food expenditure is striking, which suggests that very little is allocated to health and education. The opportunities for climbing the corporate ladder are inhibited by poverty across generations. Moreover, only 21.35% of farming families have their own tractors which are a key asset for agricultural production while a significant proportion of households rely on renting or sharing. This lack of automation poses a lucrative potential constraint, especially when water shortages are common and when efficient farming equipment is crucial[11].

Inequitable Water Distribution and Social Inequality

There is a long-standing injustice in Pakistan's irrigation system that has been now intensified by the termination of the Indus Water Treaty. It has increased the discrepancy and misalignment between head-end (upstream water recipients) and tail-end (downstream water recipients) farmers. On the other hand, floating downstream regions like Sindh are facing severe shortages. Perhaps the interference of controlled flow of western rivers is administered by upstream provinces like

[10] Watto, M. A., & Mugera, A. W. (2016). Groundwater depletion in the Indus Plains of Pakistan: Imperatives, repercussions and management issues. International Journal of River Basin Management, 14(4), 447–458. https://doi.org/10.1080/15715124.2016.1204154

[11] Pervaiz, B., Li, N., Manzoor, M. Q., & Yaseen, M. (2017). Socio-economic characteristics of farming community and food security situation in Punjab, Pakistan. Journal of Agricultural Science, 9(8), 130–142. https://doi.org/10.5539/jas.v9n8p130

Punjab as they have more control over the declining water supply. Arguably, access to irrigation for tail-end farmers has been severely bound throughout the planting and harvesting seasons, notably in rural Sindh and parts of southern Punjab. Middle class and lower-class farmers lack the funds to install alternative irrigation systems or private tubewells, which has been most severely impacted by this widening gap in water distribution. As they cannot afford it because of this reason, they are now susceptible to crop failure and debt due to their inability to obtain timely and adequate water and ultimately, their productive capacity has been reduced. But access to water and market productivity is still dominated by wealthy farmers who possess land near canal headworks or hold greater political clout[12].

The termination of the IWT has intensified the systemic governance problems that these inequalities are not simply technical outcomes; rather, they are symptomatic. The syndicate of irrigation provision by powerful parties caused institutional neglect, provincial mistrust, and the lack of equitable and enforced water distribution arrangements. It is evident from field-level statistics from South Asia that unequal access to irrigation is a major cause of rural income disparities and agricultural stagnation [13]. As the injustice has worsened by the political vacuum left by the termination of the agreement, it has exacerbated social tensions and endangered the sustainability of agriculture in the long term.

This disparity will threaten the country's food security and rural economies, unless Pakistan implements urgent reforms such as equitable distribution of canal water, participatory irrigation governance, and dispute resolution mechanisms at the inter-provincial and international levels.

India's suspension of the Indus Water Treaty in April 2025 triggered a multifaceted crisis in Pakistan, impacting foreign relations, energy production, inter-provincial coordination, and agricultural production. The following table covers the immediate and expected sectoral impacts following the suspension of the treaty to demonstrate the impact of these interlinkages.

[12]Wudil, A. H., Ali, A., Usman, M., Radulescu, M., Sass, R., & Prus, P. (2023). Effects of inequality of access to irrigation and water productivity on paddy yield in Nigeria. Agronomy, 13(4), 922. https://doi.org/10.3390/agronomy13040922

[13] Prus, P. (2021). Institutional inefficiencies in irrigation management and their consequences for rural livelihoods. Journal of Rural Infrastructure, 12(3), 201–218.

Table: Impact of Indus Waters Treaty Suspension on Pakistan's Agricultural Sector

Category	2025 Developments	Immediate Consequences	Projected Impacts
Water Availability	India suspended the IWT in April 2025, halting regulated water releases from western rivers (Indus, Jhelum, Chenab). India is fast-tracking dam projects to divert water for its use.	Disruption in irrigation schedules; reduced water flow during critical sowing seasons.	Chronic water shortages; increased reliance on groundwater leading to aquifer depletion and land salinization.
Agricultural Output	80% of Pakistan's irrigated land depends on the Indus system. Suspension affects the sowing of water-intensive crops like rice, wheat, and cotton.	Reduced crop yields; potential food shortages; increased food prices.	Decline in agricultural GDP; increased food imports; potential famine in vulnerable regions.

Hydropower Generation	Hydropower plants like Tarbela and Mangla depend on consistent water flow from Indus rivers.	Reduced electricity generation; increased load shedding; reliance on expensive energy imports.	Energy shortages hinder industrial growth; increased energy costs are impacting the economy.
Urban Water Supply	Major cities like Lahore, Karachi, and Multan rely on the Indus River system for water.	Water scarcity in urban areas; increased cost of water supply; public unrest.	Infrastructure strain; need for alternative water sources; potential health crises due to water shortages.
Economic Impact	Agriculture contributes nearly 25% to Pakistan's GDP and employs a significant portion of the workforce.	Economic slowdown; increased unemployment; inflation due to food and energy shortages.	Long-term economic instability; increased poverty rates; potential for social unrest.

India's suspension of the Indus Water Treaty (IWT) in April 2025 has had a significant impact on Pakistan's agriculture, economy, and water security. About 80% of Pakistan's agricultural land depends on the Indus River system, which also provides employment for about 65% of the country's population and contributes to about 25% of its GDP. More than 40 million people could be affected by water shortages in urban areas such as Karachi, Lahore, and Multan, which depend on the Indus River for municipal water. Pakistan's energy sector is at serious risk as reduced water flows could result in reduced power generation at key hydroelectric

plants such as Tarbela and Mangla, which provide over 30% of the country's electricity [14].

Water Management Strategies to Mitigate Agricultural Risks Linked to Transboundary Water Conflicts

Adoption of Efficient Irrigation Technologies

Crop yields can be improved, and water loss can be reduced by shifting from traditional flood irrigation to more productive methods such as drip or spray irrigation. These techniques save up to 50-60% of water by providing water to the roots of plants. Despite the potential benefits, adoption rates in Pakistan are still low due to high costs and lack of awareness. The adoption of these technologies can be promoted through government incentives and awareness-raising measures, increasing agricultural production and water use efficiency [15].

Rainwater Harvesting and Water Storage Infrastructure

Constructing reservoirs and small dams to capture rainfall can provide a more consistent and regulated water supply during dry periods and seasonal variations. The establishment of decentralized water storage systems is vital for improving irrigation reliability in Pakistan, considering the erratic and uneven distribution of rainfall across the various provinces of the country. The construction of decentralized water storage infrastructure is critical for enhancing irrigation dependability in Pakistan, as the distribution of rainfall is both uncertain and inconsistent throughout the provinces of the nation. According to the Pakistan Council of Research Water Resources[16], over 60 percent of the annual rainfall in the country is lost as surface runoff due to inadequate storage and harvesting systems. This results in a reduction of water capacity and an increased risk of flooding and soil erosion.

In both urban and rural settings, the implementation of rainwater harvesting systems can enhance the availability of both surface and groundwater, thereby alleviating the strain on already overburdened Indus Water Treaty (IWT) resources. Rooftop harvesting and recharge wells are instrumental in replenishing groundwater levels

[14] Vats, A. (2025, April 24). Pakistan's power supply crisis worsens after Indus Waters Treaty suspended. India Today. https://www.indiatoday.in/india/story/pakistan-power- supply-crisis-indus-waters-treaty-suspended-2713659-2025-04-24

[15] Akademos. (2024, March 15). Water scarcity in Pakistan and its impact on agriculture productivity. https://www.akademosresearch.com/blog/water-scarcity-in-pakistan- and-its-impact-on-agriculture-productivity

[16] Pakistan Council of Research in Water Resources (PCRWR). (2023). Economic costs of water scarcity.

in rural agricultural regions, while the harvested water can serve non-potable and domestic needs in urban areas, thereby diminishing dependence on municipal water supplies. As noted by the Food and Agriculture Organization, when paired with efficient irrigation practices and robust local water governance, such infrastructure significantly increases overall water availability and mitigates the effects of water scarcity on agricultural activities. There is an immediate necessity to develop resilience through alternative water storage technologies, especially given the ongoing disruptions to the Indus Water Treaty and the notable decline in river flows.

Policy Reforms and Institutional Strengthening

The necessity for a thorough reform of Pakistan's water governance framework has been underscored by the suspension of the Indus Waters Treaty (IWT) in 2025. The Pakistan Council of Research in Water Resources has developed the National Water Conservation Strategy for the years 2023-2027, which emphasizes the importance of institutional enhancement and policy reforms to tackle the intricate challenges in water resource management. To confront contemporary issues such as population growth, climate change, and transboundary water disputes, the strategy advocates for the revision of the current water policy. One of the principal recommendations of the NWCS is to bolster institutional capacity at both federal and provincial levels. This entails the promotion of integrated water resources management (IWRM) practices and the establishment of a central water data repository to facilitate informed decision-making. Furthermore, to guarantee fair

water distribution and democratic governance, the policy highlights the need to empower local water users' associations. In addressing the challenges of water theft, misuse, and pollution, the NWCS also emphasizes the necessity for legislative and regulatory reforms. To promote efficient water utilization in agriculture and other sectors, it recommends the implementation of stringent monitoring systems and the adoption of modern technology. Climate-Resilient Agricultural Practices Farming communities can become more resilient to climate shifts and water shortages by using climate-resilient agricultural practices, such as producing heat and drought-tolerant crop types. Crop diversity and the use of soil conservation measures like mulching and zero- tillage can assist in boosting long-term agricultural productivity.

Conclusion

From the termination of Indus Water Treaty in April 2025, Pakistan’s dependence on cross border water flows for agriculture, food security, and rural subsistence are clear. Decreased crop yields, prominent awareness of food insecurity, and financial weaknesses have led to increased socio-economic hazards for lower- and middle-class farmers. These are outcomes of upheaval and unsettlement of irrigation in the Indus system. In such situations, there is a major role of some points like water

variations due to weather change, incapable governance, and outdated irrigation appliances. The study underscores the need for some important measures like climate-resilient farming and storage infrastructure investments, rightful water dispersal, and institutional reforms. It is the time to resolve intra provincial disputes and being united to face the problem posed by India to make sure and to prove that being a nation Pakistanis can resolve their problems with unity which requires sustainable water management and strengthening of local water user associations. Furthermore, a collaborative debate is very crucial for Pakistan and India to solve the issue of Pahalgam attack along with the continuity of Indus Water Treaty. It is not wrong to say Pakistan's agricultural system is now at risk due to this termination and it needs urgent reforms and diplomatic action, the nation is likely to face further environmental, economic, and social instability in the coming year.

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