

# WATER SCARCITY IN SOUTH ASIA: CHALLENGES, IMPACTS, AND COOPERATIVE PATHWAYS TOWARD WATER SECURITY

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## ABSTRACT

Water shortage has become one of the most significant development, security and environmental issues in South Asia. The region has a population of almost a quarter of the global population yet very limited proportion of renewable freshwater resources that is produced in the year, which creates a structural imbalance between demand and supply. This paper reviews the causes, effects, and policy actions linked to water shortage in South Asia by summarizing emerging peer-reviewed literature and institutional evidence published primarily during the period between 2020 and 2025. Based on a qualitative document-analysis design, the article assesses the variability of climatic conditions, changes in glaciers and snowmelt, groundwater depletion, urban water consumption, industrial pollution, vulnerability of people-health, and transboundary rivers governance. The results reveal that scarcity in South Asia is not merely a hydrological shortfall, but also a governance and equity issue. Dependence on irrigation, exploitation of non-renewable groundwater, deteriorating municipal infrastructure, ineffective pollution management, and poor collaboration at the basin-wide level exacerbate water insecurity. The article claims that climate-resilient integrated water resources management, agricultural water-use reform, wastewater treatment and reuse, inclusive city water planning, and enhanced regional collaboration along the Indus, Ganges, and Brahmaputra basins are durable solutions. The research adds a policy-based model of enhancing water security by harmonizing national reforms and diplomacy at the basin level.

**Keywords:** water scarcity, South Asia, climate change, groundwater depletion, transboundary rivers, IWRM, water governance

## Introduction

Water scarcity in South Asia has become one of the key policy issues, as it is at the confluence of climate change, food security, population health, urbanization, and peace in the region. Nearly one-quarter of the global population is in the region, which supplies almost 4 percent of renewable water resources per year globally, and estimates suggest that by 2050, between 1.5 and 1.7 billion individuals in the region will be

vulnerable to water shortage (World Bank, 2023). Such an imbalance between population, economic demand, and renewable supply puts South Asia among the most water-vulnerable areas in the world.

It is not just a matter of the lack of rain or decreased river flow. South Asia is home to some of the largest river systems in the world, such as the Indus, Ganges, and Brahmaputra, but there is a lack of uniformity in the availability of water

over seasons, social groups, sectors, and national boundaries. Monsoon water abundance is usually accompanied by drought periods in dry months and floods are common in neighborhoods that subsequently run short of drinking-water. The outcome is a trend of hydro-climatic variability where there is the excess and deficiency of water that endanger lives, infrastructure, and health (WMO, 2024).

Agriculture is the greatest consuming water in the area and is still very reliant on irrigation, ground water pumping, monsoon rain and the melt water that originates in Hindu Kush Himalayan system. Recent simulation reveals that irrigated farming in South Asia will most probably become more reliant on meltwater and groundwater as climate change alters the timing and quantity of water delivery (Lutz et al., 2022). This is especially important to the Indus and Ganges basins, in which food production and rural job opportunities are tightly connected to irrigation demand.

The second strain is urbanization. Cities in South Asia are expanding at an alarming rate and water supply, storage facilities, sanitation and wastewater-treatment systems have failed to keep up. Sathre et al. (2022) note that urban water security issues in South Asia comprise increased household demand, closure of river basins, groundwater depletion, leakage, and unequal access to water by the low-income population. Thus, urban scarcity is both physical and institutional; water might be available, but households do not have safe, affordable, and consistent access to it.

Human-security implications are another effect of the crisis. According to UNICEF (2023), South Asia has the highest number of children exposed to high or extremely high-water shortages, with 347 million children therein. Child health, nutrition, education, and protection are affected when water scarcity occurs. Water scarcity

weakens the risk of waterborne diseases, places families in a situation of financial crisis, and, in many cases, water scarcity adds a time burden to women and girls. Water insecurity in this sense is not just a development and justice issue but an environmental issue.

Lastly, a regional governance issue is water scarcity. Most of these rivers in the region cut through borders, and national policies are usually bilateral, fragmented, and influenced by political distrust. Recent literature emphasizes that climate-resilient development in South Asia requires transboundary cooperation and joint river-basin management, but the exchange of data, adaptive water-sharing, and basin-wide governance is poor (Arfanuzzaman, 2025). The present article thus explores water scarcity as a multi-dimensional issue that needs combined, collaborative, and just measures.

#### **Research Objectives**

1. To assess the socioeconomic, environmental, and human-security impacts of water scarcity in South Asia.
2. To evaluate existing policies and strategies used to address water scarcity, including agricultural, urban, environmental, and transboundary governance measures.
3. To propose sustainable and cooperative options for improving water security in the region.

#### **Research Questions**

1. How does water scarcity affect the socioeconomic and environmental fabric of South Asia?
2. What policies and strategies have been adopted to address water scarcity, and what gaps remain?
3. What sustainable measures can improve water security in South Asia under climate and demographic stress?

**Table 1**  
*Research Questions, Analytical Themes, and Evidence Base*

<i>Research question</i>	<i>Analytical theme</i>	<i>Primary evidence used in the article</i>
RQ1	Socioeconomic, environmental, and human-security impacts	UNICEF evidence on children; urban-water studies; climate and agricultural water-demand research
RQ2	Policy and governance effectiveness	Recent literature on IWRM, wastewater management, groundwater governance, and transboundary river-basin cooperation
RQ3	Sustainable solutions	Peer-reviewed studies and institutional reports on climate-resilient infrastructure, efficient irrigation, wastewater reuse, data sharing, and basin-level cooperation

*Note.* The table organizes the article's qualitative synthesis and aligns each research question with the relevant evidence stream.

## Literature Review

### Water Security and Development Pressure in South Asia

Water security is described as the predictable access to acceptable quality water to support livelihoods, health, ecosystems, economic activity as well as disaster resilience. The issue of water security in South Asia is limited to a presence of vast population density, unequal geographical distribution of water, over-use, water contamination, and vulnerability to climatic extremes. The 2024 United Nations World Water Development Report highlights that prosperity and peace are direct results of water management in areas where water competition moves against poverty, displacement, and weak governance (UNESCO WWAP, 2024). South Asia is a good example of this interaction since water is both an economic factor of input and a social-health need and also a political issue.

The water challenge in the region has been termed as a supply problem, but recent scholarship has proposed that demand increase and failure to manage them are all of importance. Baig et al. (2025) claim that the unequal access to water, lack of sanitation, climate vulnerability,

and the absence of integration of water and climate policies limit the progress of SDG 6 and SDG 13 in South Asia. This implies that enhancing water security should not just be by merely creating new supply systems but by institutional restructuring that will integrate climate change adaptation, sanitation, agriculture, and urbanization.

The South Asian region is also historically rich in the localized as well as nature-based water governance. Hewawasam and Matsui (2022) demonstrate that the tank cascade system in Sri Lanka was a multifunctional irrigation, storage, flood control, and community involvement system. Even though the current crisis is of an even greater magnitude, these systems show that water security can be enhanced in a situation where the infrastructure is integrated into the local ecological knowledge and participatory management and is not considered a purely engineering issue.

### Climate Change, Cryosphere Change, and Irrigation Demand

Climate change is exacerbating the water-security issue in South Asia by changing the amounts of

precipitation, enhancing the hydrological variability, altering the snow and glacier melting, and intensifying the occurrence of floods and droughts. According to WMO (2024), the world's hydrological systems are under heavy pressure, and the abnormal river flows, the loss of glacier mass, and the emergence of water-related disasters are becoming more important. This is important to South Asia as the main river systems rely on the snow and melt of the Himalayan glaciers, and the agricultural calendars are still monsoon-linked.

Lutz et al. (2022) illustrate that South Asian irrigated agriculture relies on the monsoon rainfall, meltwater, and groundwater, and that climate change alters the time of the sources and their composition. Their model demonstrates that previous melt peaks may enhance the meltwater draws in the Indus during the onset of the cropping period, whereas greater peak irrigation demand may enhance the non-renewable groundwater pumping in the Indus and the Ganges basins. Similarly, Ahmad et al. (2023) show that changes in crop growth stages due to climate impacts on wheat and rice production in the Indus, Ganges, and Brahmaputra basins affect irrigation requirements for these crops, necessitating more crop- and phase-specific water planning.

These studies show that climate change is not only lowering the reliability of water but also altering the timing of water availability regarding the time required by crops. A basin can receive a greater amount of precipitation each year but still experience scarcity when the water falls during periods of non-crop growth or when the water is not captured by the infrastructure. Hence, the strategies of adaptation should concentrate on the seasonal storage, forecast, crop calendar, and demand management, and not on aggregate annual water availability alone.

### **Groundwater Depletion and Agricultural Dependence**

Groundwater has emerged as the invisible buffer of South Asia in relation to unreliable surface water and precipitation. When dry spells lead to decreased yields in farms, farmers resort to tube wells, and when cities have their piped supply cut

off. However, this resilience is becoming more precarious due to the extraction in most regions being higher than recharge. Jasechko et al. (2024) demonstrate that the quick groundwater-level decreases are common worldwide, especially in arid areas with large cropland, and that certain decreases are increasing at a faster rate. South Asia is a significant issue in this global trend since groundwater irrigation is strongly coupled with food security and rural livelihoods.

Maina et al. (2024) offer basin-specific evidence that the decline in groundwater through irrigation in the Ganges-Brahmaputra can decrease the streamflow into the Bay of Bengal regardless of precipitation. The discovery is important since it demonstrates that groundwater pumping is not a one-dimensional problem of the subsurface world; it can influence the flow of rivers, the availability of fresh water in deltas, the intrusion of seawater, and the ecological situation downstream. Agricultural choices upstream and water-quality and livelihood risks downstream are thus linked by groundwater depletion.

Reform in agriculture is challenging because ground water is a politically sensitive issue as well as directly related to food production, income of farmers and poverty among rural people. Pumping policies that limit it without alternatives can be detrimental to smallholders. As such, sustainable groundwater management should integrate crop-diversification, effective irrigation, energy-pricing reform, controlled aquifer recharge, conjunctive utilization of both surface and groundwater, as well as subsidizing farmers who switch to less water-intensive crops.

### **Urban Scarcity, Pollution, and Public Health**

The causes of urban water scarcity in South Asia are the increasing demand, inadequate infrastructure, leakages, reliance on groundwater and degradation of water quality. Sathre et al. (2022) suggest that most South Asian cities have closed or almost closed river basins, little possibility to increase surface-water extraction, and declining groundwater tables. Meanwhile, water supply is frequently sporadic, non-revenue water is also considerable, and poorer families may pay more per liter with informal vending

compared to richer families that have access to piping.

Pollution transforms the available water into water that cannot be used. Untreated domestic wastewater, industrial effluent, agricultural effluent and solid waste compromise the system of rivers and make treatment more expensive. Chakraborty et al. (2021) indicate that untreated or poorly treated wastewater is a serious issue in the Indus-Ganga-Brahmaputra river basin and correlate the lack of sanitation with the susceptibility of the population to health. Singh et al. (2025) also demonstrate the impact of industrial effluents on the Ganga water pollution and that the biochemical oxygen demand, chemical oxygen demand, total dissolved solids, and other pollutants differ significantly among the industrial sectors.

There is a disproportionate health burden of scarcity and pollution. According to UNICEF (2023), children in South Asia are extremely vulnerable to water scarcity and low water quality. The absence of water, poor water management, climate change, and over-exploitation of groundwater contribute to vulnerability. This is particularly true of girls and women who might be burdened with tasks of water collection, household water management, and care. Therefore, urban water policy needs to be measured by not just the liters provided but also by affordability, reliability, water quality, gendered burdens, and water access in informal settlements.

### **Transboundary Water Governance**

Indus, Ganges, and Brahmaputra basins unite the South Asian countries with the same hydrology but separate them with their national boundaries and geopolitical interests. Upstream-downstream asymmetries, hydropower development, flood-control infrastructure, food-security needs, and climate uncertainty complicate transboundary water governance. Arfanuzzaman (2025) argues that joint river-basin management is central to climate-resilient development in South Asia since climate change poses a threat to water, energy, food, and environmental security across borders. Vicca et al. (2021) demonstrate that the analysis of water, energy, and food-system planning can

help to reduce costs and achieve better sustainable development results in the case of cooperation in the Indus basin. This result is significant since it repositions transboundary water governance as a zero-sum allocation issue into a cooperation issue whereby there are shared benefits. Gains at the basin level can be achieved by integrated storage, hydropower scheduling, flood forecasting, environmental flow protection and data sharing.

Nevertheless, collaboration is still a political challenge. The bilateral water-sharing agreements in South Asia have been of historical significance and in most cases, these agreements were not developed to withstand the present level of climate variability, reliance on groundwater, basin contamination, and demand. It is thus required that the region should have adaptive agreements that can respond to climate shocks, the incorporation of transparent data-sharing guidelines, integration of groundwater and surface water, and the establishment of dispute-resolution mechanisms that must work even when there is political tension.

### **Methodology**

The research design of this article is a qualitative document analysis and narrative review. The approach is suitable since the research questions are aimed at explaining the drivers, assessing the response of the policies, and formulating the recommendations instead of quantifying one causal variable with the use of primary field data. The analysis is based on the synthesis of peer-reviewed articles, policy reports, and institutional data to create an integrated, policy-based description of water shortage in South Asia.

The evidence base includes new peer-reviewed journal articles and institutional reports that were written in the recent past (2020-2025). Preference was provided to the articles of reputed journals and publishing houses such as Nature Climate Change, Nature Sustainability, Communications Earth and Environment, Climatic Change, Environmental Science and Pollution Research, World Development Perspectives, Gondwana Research and CivilEng, and institutional evidence of UNICEF, UNESCO, WMO, and the World Bank. Sources that were older than 10

years old were not used unless there was a need to know the history; in this case, current historical studies were used.

The analysis was done in three steps. The first step was to find the thesis themes, which included climate variability, agriculture and groundwater, urbanization, pollution, public

health, and transboundary governance. Second, each theme was updated and supported by the latest literature. Third, the results were compiled into a cohesive policy framework, which connects water supply, demand management, water quality, equity, and regional collaboration.

**Table 2**  
*Drivers, Mechanisms, Impacts, and Strategic Responses*

Driver	Mechanism of scarcity	Major impacts	Strategic response
Climate variability	Erratic monsoon, droughts, floods, glacier and snowmelt shifts	Unreliable supply, crop-water stress, disaster losses	Forecasting, storage, climate-resilient WASH, early-warning systems
Agricultural demand	Water-intensive crops, flood irrigation, subsidized pumping, weak groundwater regulation	Aquifer decline, energy stress, food-security tradeoffs	Drip/sprinkler irrigation, crop diversification, recharge, conjunctive water management
Urbanization	Rising domestic and industrial demand, leakages, informal settlements, aging infrastructure	Intermittent supply, inequity, higher household costs	Network rehabilitation, metering with lifeline protections, wastewater reuse, pro-poor service design
Pollution	Untreated sewage, industrial effluents, agricultural runoff	Reduced usable water, disease risk, higher treatment costs	Effluent enforcement, sewage treatment, pollution monitoring, circular water reuse
Transboundary tensions	Upstream-downstream asymmetries, limited data sharing, rigid agreements	Diplomatic friction, inefficient basin planning, vulnerability to shocks	Adaptive treaties, basin commissions, shared hydrological data, joint disaster-risk systems

*Note.* Drivers are interdependent; for example, climate variability can increase irrigation pumping, which then reduces groundwater and streamflow.

## Findings and Discussion

### Finding 1: Water Scarcity Is a Hydro-Social and Governance Problem

The initial observation is that the water shortage of the South Asians cannot be explained as a mere lack of natural water. Scarcity in the region is a result of hydrological pressures being compounded by social inequality, inadequate infrastructure and fragmentation of governance. The structural supply-demand gap is demonstrated by the estimation made by the World Bank that South Asia hosts around a quarter of the global population, but only 4% of

the yearly renewable water resources (World Bank, 2023). But the lived reality of scarcity lies in the storage, treatment, distribution, pricing, governance, and fair sharing of water.

This is a policy difference. A supply-only strategy can cause governments to favor dams, inter-basin transfers, or deeper groundwater pumping without considering leakage, pollution, growth of demand, inequity, and ecosystems deterioration. A hydro-social approach acknowledges that institutional, infrastructural, cropping, urban planning, and power relations are all active in the production of water scarcity. Thus, it is probable

that the most effective solutions would be the combination of physical infrastructure and governance reform, the involvement of the population, and demand control.

### **Finding 2: Climate Change Is Reshaping Water Timing More Than Water Quantity Alone**

The second observation is that climate change is changing the time, predictability, and the volume of water availability. Hydrological stress in South Asia is more of a seasonal than an annual phenomenon. During the monsoon a basin can get a lot of rain but during the dry season it can dry up. The study by Lutz et al. (2022) indicates that the existence of earlier melt peaks and higher variability may lead to more reliance on meltwater and groundwater, whereas Ahmad et al. (2023) reveal that the phases of crop growing in Indus, Ganges, and Brahmaputra basins are sensitive to the changes in irrigation demand that are caused by climate.

This has significant impacts on agricultural planning. Conventional water calendars might prove unreliable, and irrigation systems created based on historic patterns of the monsoon will not be in tandem with the future water demand. Water management based on climate-resilience ought to involve seasonal forecasts, decentralized water storage, aquifer recharge, drought contingency plans, and changing crop calendars based on evolving hydro-climatic realities. The policy dilemma is to transform reactive responses to drought and floods to proactive water management.

### **Finding 3: Groundwater Is the Region's Buffer and Its Greatest Risk**

The third observation is that groundwater has become the buffer on which South Asian cities and agriculture are getting by as surface water becomes unreliable, but it is becoming less sustainable. The extraction of groundwater enables farmers to deal with drought and aid the production of food, but over-extraction of groundwater depletes water tables and raises energy expenses. Jasechko et al. (2024) present international evidence based on global groundwater-level depletion, which is frequently linked with agricultural drylands, and Maina et al. (2024) demonstrate that the depletion of

groundwater through irrigation can decrease the Ganges-Brahmaputra streamflow into the Bay of Bengal.

There are also long-term risks that are not easy to counteract and are caused by the depletion of groundwater. Declining water tables have the potential to dry wells, harm the storage of aquifers by subsidence, enhance seawater intrusion in coastal areas, and decrease environmental flows. Since groundwater is shared among millions of individual or semi-privatized users, it is politically and administratively difficult to regulate. A sustainable groundwater policy must comprise incentives, monitoring, communal aquifer management, crop diversification, efficient irrigation, renewable-energy protection, and managed recharge.

### **Finding 4: Urban Water Scarcity Reflects Infrastructure, Equity, and Quality Failures**

The fourth is that urban water scarcity is not a mere consequence of increasing populations but also service-delivery failures. Megacities in South Asia have become the centers of rapid growth, non-revenue water, intermittency, unequal access, lack of wastewater treatment, and reliance on informal private suppliers. Sathre et al. (2022) demonstrate that South Asian cities are faced with physical constraints to water expansion and significant possibilities to further improve by distribution efficiency, industrial water-use efficiency, and wastewater reuse.

The reforms in the city should be pro-poor. Meter and tariff reform could be good at efficiency but also detrimental to low-income households in the absence of affordability protections. Likewise, new treatment facilities might not enhance access to informal settlements unless they relate to the distribution networks and tenure-sensitive planning. Urban water security thus needs a comprehensive package: reduction of leaks, 24/7 pressure regulation (where possible), lifeline water supplies, recycling of wastewater to non-potable purposes, rainfall harvesting (where possible), and rigorous control of groundwater extraction by commercial consumers.

**Finding 5: Pollution Intensifies Scarcity by Reducing Usable Water**

The fifth conclusion is that water pollution is a multiplier of scarcity. Where rivers and aquifers are found to have water, the water may be contaminated to such an extent that it is not safe to drink, irrigate, take a bath, fish, or use the water in the ecosystem. Chakraborty et al. (2021) relate untreated wastewater in the Indus-Ganga-Brahmaputra basin to the risks in the health of the population and the necessity of wastewater monitoring and sanitation. Recent empirical evidence of the contribution of industrial effluents to Ganga pollution is presented by Singh et al. (2025), which indicates that the sector requires sector-specific monitoring and enforcement.

Controlling pollution should be considered as a policy of water supply. Increasing supply without safeguarding water quality merely transfers expenditures to households, utilities, and health systems. The governments require discharge standards that are enforced, water-quality monitoring in real-time, public reporting, pre-treatment of industrial waste, municipal wastewater treatment, and water reuse incentives. These interventions can increase efficient supply by reusing polluted water to usable water.

**Finding 6: Transboundary Cooperation Is Necessary but Underdeveloped**

The sixth insight is that the transboundary water governance in South Asia is not adequate to the magnitude of the existing climate and development demands. The bilateral arrangements that exist have served to prevent some conflicts, but do not tend to cover ground water depletion, pollution, ecological flows, sediment, glacial hazards and flexible allocation due to climate unpredictability. Arfanuzzaman (2025) notes that integrated governance and adaptive frameworks are the necessary but absent ones in South Asian river basins.

Cooperation also, as seen in the evidence, can bring about common gains. Vicca et al. (2021) conclude that transboundary collaborations in the Indus basin can help decrease the cost of development and enhance sustainability when the water, energy, and food systems are developed concurrently. This implies that water diplomacy ought to step out of the volumetric shoebox allocation to benefit sharing, joint forecasting, coordinated disaster management, ecological protection and basin-level investment planning.

**Table 3**  
*Policy Gaps and Recommended Interventions for South Asian Water Security*

Policy area	Observed gap	Recommended intervention	Expected outcome
Climate adaptation	Reactive disaster response and weak hydro-meteorological integration	Basin-level forecasting, drought plans, floodplain zoning, and climate-resilient water storage	Reduced disaster losses and improved seasonal preparedness
Groundwater	Limited monitoring and politically difficult pumping controls	Aquifer mapping, recharge zones, energy-water reform, and farmer incentives	Slower aquifer decline and more reliable drought buffering
Agriculture	Water-intensive crop incentives and inefficient irrigation	Crop diversification, micro-irrigation, soil-moisture advisory services, and extension support	Lower irrigation demand without undermining food security
Urban water	Intermittent supply,	Network rehabilitation,	More reliable and

	leakage, inequitable access, and unmanaged private extraction	pro-poor tariffs, wastewater reuse, and groundwater permits	equitable municipal supply
Pollution control	Weak enforcement and low treatment capacity	Industrial pre-treatment, sewage treatment, real-time monitoring, and public disclosure	Improved water quality and reduced public-health burden
Regional cooperation	Fragmented bilateralism and limited data sharing	Adaptive treaties, river-basin commissions, shared data platforms, and joint emergency protocols	Lower conflict risk and greater climate resilience

*Note.* Recommended interventions should be adapted to national contexts, but their effectiveness depends on coordination across sectors and borders.

### Toward an Integrated Framework for Sustainable Solutions

Five pillars of mutually reinforcing policies and actions should underpin a sustainable solution to South Asia's water problems: climate-resilient supply, demand management, water-quality protection, equitable service delivery, and transboundary cooperation. The pillars are consistent with the idea that water security is not a single ministry, sector, technology, or treaty. Rather, it needs to involve the ministries of agriculture, urban utilities, environment, disaster management, energy, and foreign affairs.

The first pillar is climate-resilient supply. Governments should enhance seasonal forecasting, flood mitigation, water harvesting, aquifer storage and recovery, multipurpose reservoirs, and protection of wetlands and recharge areas. These measures should be aimed at managing both floods (in the wet season) and droughts (in the dry season). Green infrastructure, such as wetlands restoration and watershed management, can also be used.

The second key component is managing demand. Agricultural water use must increase productivity through better irrigation, diversification, soil-moisture retention, and water advice. Urban and industry sectors should also embrace demand management through leakage, metering, recycling, and efficiency measures. But demand-side measures need to be socially inclusive to

prevent the poor and small farmers from bearing the cost of structural water scarcity.

The third pillar is water-quality protection. The issue of pollution needs to be considered as a fundamental element of the policy of scarcity since polluted water cannot be used safely to sustain human or natural requirements. The industrial areas should be mandated to have pre-treatment systems installed and to be subject to open monitoring. Cities must focus on sewage collection, decentralized treatment in areas where centralized networks are not feasible, and on the reuse of treated wastewater in industries, landscaping, and agriculture.

The fourth pillar is service delivery, which is equity-based. Water policy must be evaluated not only by the amount supplied but by the recipient(s), the price, reliability, and quality of water. Children, informal settlements, rural households, women, and low-income residents of drought prone areas should be given special attention. The available evidence provided by UNICEF on children living in high water scarcity indicates that water security cannot be separated concerning health, education, nutrition, and social protection (UNICEF, 2023).

Transboundary cooperation is the fifth pillar. Countries in South Asia are to reinforce basin-level institutions, exchange hydrological and water-quality information, coordinate early warnings of disasters, and establish adaptive water sharing regulations which can be run in the

face of climate uncertainty. There must be a framing of cooperation in terms of common benefits: less loss of life and property in floods, better hydropower scheduling, food security, environmental flows, and less diplomatic tension.

This is aligned with the current research that demonstrates the importance of joint river-basin management as being central to climate-resilient development (Arfanuzzaman, 2025; Vinca et al., 2021).

**Table 4**  
*Integrated Water Security Framework for South Asia*

Pillar	Core actions	Lead institutions	Indicators of progress
Climate-resilient supply	Forecasting, storage, wetland restoration, recharge, floodplain management	Water ministries, meteorological agencies, disaster authorities	Reduced flood and drought losses; improved seasonal supply reliability
Demand management	Efficient irrigation, crop shifts, urban leakage reduction, industrial recycling	Agriculture departments, utilities, industry regulators	Lower non-revenue water; reduced groundwater withdrawals; higher water productivity
Water-quality protection	Effluent standards, sewage treatment, monitoring, reuse	Environmental regulators, municipalities, industrial authorities	Improved river-quality indicators; increased wastewater treatment and reuse
Equity and public health	Lifeline water access, WASH investment, gender-sensitive planning	Health ministries, education departments, utilities, local governments	Reduced waterborne disease; improved school WASH; lower household water burden
Transboundary cooperation	Data sharing, adaptive agreements, joint forecasting, basin commissions	Foreign ministries, river commissions, basin organizations	Operational data platforms; joint flood warnings; fewer water-related disputes

*Note.* The framework is designed for policy adaptation by national governments, regional organizations, and development partners.

### Implications for Policy and Practice

These results imply five implications. First, governments of South Asia need to shift to basin-wide water accounting as opposed to project-based water supply. Governments cannot manage scarcity effectively without credible data on withdrawals, recharge, wastewater, groundwater levels, and environmental flows. Second, governance of groundwater must be viewed as a food-security policy, but not as just an environmental policy. Incentives and risk protection should be used to encourage farmers to implement water-saving methods.

Third, city water security concerns must focus on rehabilitation and reuse as opposed to costly

expansion. By minimizing leakage, managing pressure, recycling industrial water, and using treated wastewater, a source of water can be developed that is not the cause of further extraction of water by rivers and aquifers in distress. Fourth, the water-supply planning should incorporate the enforcement of pollution since pollution limits the amount of water available and applicable as safe and economical. Fifth, regional cooperation must be institutionalized prior to the escalation of crises. Trust can be established between countries through data-sharing arrangements, joint flood forecasting, and technical working groups even in the face of strained formal political relations.

South Asia ought to consider basin-level climate-risk financing as well to finance infrastructure in a manner that is beneficial to both upstream and downstream communities.

### Limitations and Future Research

This paper is founded on secondary literature and qualitative synthesis. It does not introduce new hydrological modeling, household survey data, or basin-level econometric estimates. Thus, the results must be taken to mean a policy-based synthesis as opposed to a quantitative impact. South Asia is also a region discussed in the article, though water scarcity differs significantly by country, basin, city, season, class, gender, and livelihood group.

Comparative basin studies need to be carried out in the future with a combination of hydrological data, groundwater monitoring, water-quality indicators, and socioeconomic vulnerability. Field-based studies of the responses of farmers to water-saving incentives, as well as the responses of urban households to intermittent supply and the political sustainability of transboundary data-sharing mechanisms, also require investigation. The connections between water scarcity, migration, gender, and mental health should also be more focused.

### Conclusion

South Asian water scarcity is a multifaceted and growing problem that is influenced by climate change, agricultural needs, groundwater infiltration, urbanization, pollution, susceptibility of people to health, and transnational politics. The evidence examined in this article suggests that the water crisis in the region is not just a physical shortage of water. It is a governance problem pertaining to the allocation, extraction, contamination, storage, pricing, treatment and distribution of water across borders.

The most pressing threats involve the growing reliance on groundwater, climate-driven changes in the demand in irrigation, the decline of water quality, unequal access to urban benefits, and poor collaboration at the basin level. These hazards impact food security, child health, livelihoods, ecosystems and regional stability. Any policy responses centered on new supply

infrastructure will not be adequate unless it is complemented with demand management, pollution control, social equity, and adaptive institutions.

The sustainable course of action needs combined water resources management in accordance with the political and ecological realities of South Asia. At the national level, there is a need to have efficient irrigation, diversification of crops, controlled recharge of aquifers, wastewater treatment and reuse, pro-poor urban water reforms, and climate resilient WASH systems. On the regional level, there must be data sharing, adaptive water agreements, basin commissions, and joint disaster-risk management. When South Asian countries move as one and invest in infrastructure and governance, water might become a tool of strength and collaboration, instead of conflict and insecurity.

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