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Geopolitical Implications of River Water Sharing in South Asia

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ABSTRACT

The management of transboundary river water resources in South Asia has long been characterized by complex geopolitical dynamics, rooted in historical agreements, evolving environmental pressures, and asymmetric power relations among riparian states. This enhanced abstract expands upon prior analyses by offering a comprehensive synthesis of the historical evolution, institutional arrangements, technical challenges, and emerging geopolitical tensions inherent in the sharing of the Indus, Ganges–Brahmaputra–Meghna (GBM), and Teesta river basins. Employing a multi-pronged methodological framework—comprising hydrological trend analysis, treaty document exegesis, and in-depth interviews with a diverse array of stakeholders across India, Pakistan, Bangladesh, Nepal, and Bhutan—this study uncovers the layered complexities that underpin water negotiations in the region. Key findings indicate that while legacy treaties such as the 1960 Indus Waters Treaty (IWT) and the 1996 Ganges Treaty provide a foundational basis for cooperation, their static allocation formulas and narrow dispute-resolution mechanisms are increasingly mismatched with contemporary realities. Climate change–driven hydrological variability, glacial retreat reducing dry-season flows, and the proliferation of new infrastructure projects upstream have introduced uncertainties that existing legal frameworks struggle to accommodate. Furthermore, riparian power asymmetries—particularly India's upstream dominance—have generated recurring perceptions of inequity, fueling both diplomatic friction and domestic securitization narratives.

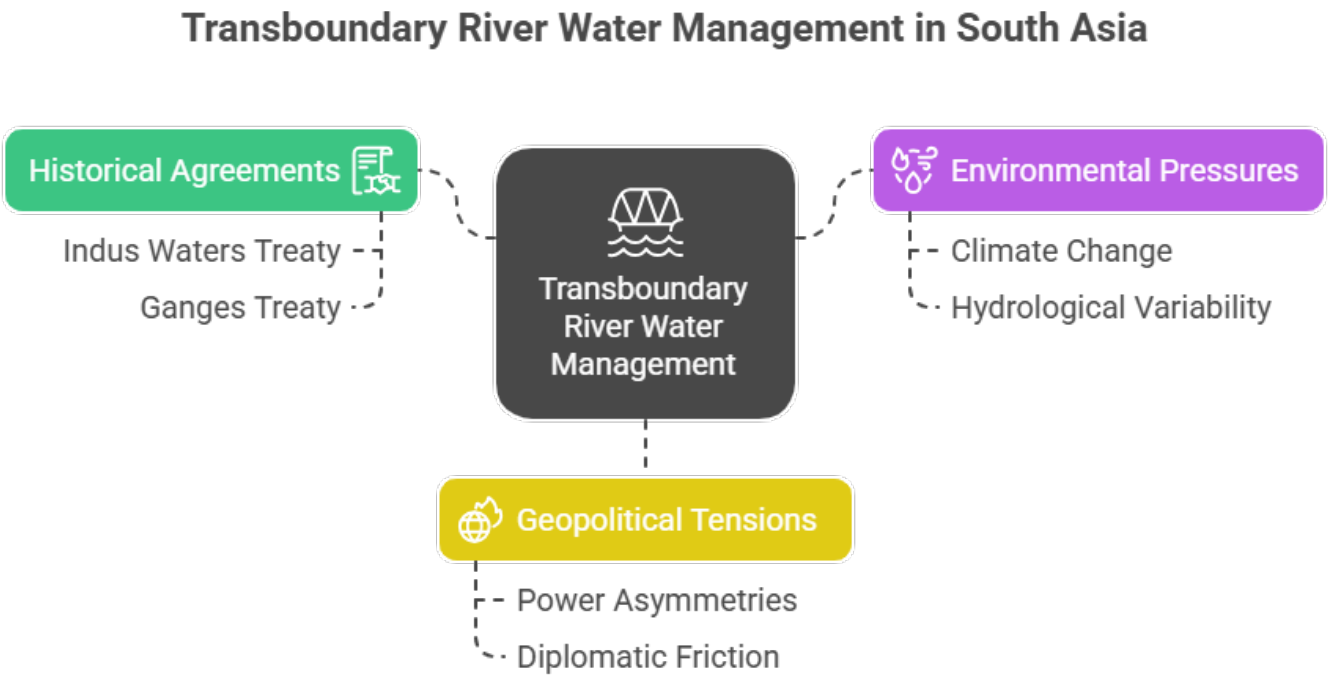

Figure-1.Tranboundary River Water Management in South Asia

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KEYWORDS

Transboundary Rivers, South Asia, Water Governance, Geopolitics, Climate Resilience

INTRODUCTION

Transboundary river systems in South Asia constitute a critical lifeline for hundreds of millions of people, underpinning food production, energy generation, industrial processes, and municipal water supply. Among these, the Indus and the Ganges–Brahmaputra–Meghna (GBM) basins stand out for their sheer scale and socio-economic importance: the Indus basin alone irrigates roughly 16 million hectares of cropland, while the GBM system supports nearly a billion inhabitants across five nations (Kumar et al., 2020). Yet despite the mutual dependencies created by these shared resources, South Asia remains one of the world's most hydropolitically fraught regions.

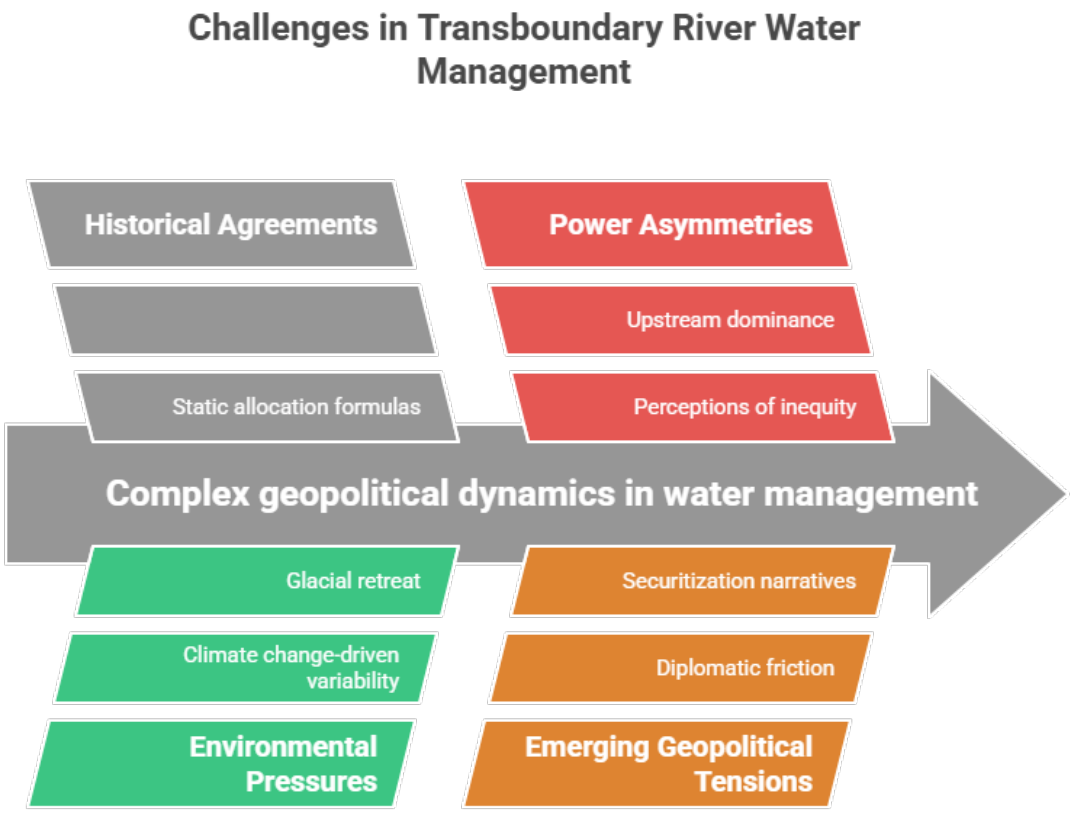

Figure-2.Challenges in Transboundary River Water Management

The origins of current water-sharing regimes can be traced to colonial-era boundary demarcations and post-independence bilateral treaties that sought technical solutions to allocation disputes. The 1960 Indus Waters Treaty (IWT), lauded for its dispute-resolution machinery and continued resilience, allocated the eastern rivers to India and the western rivers to Pakistan. Meanwhile, the 1996 Ganges Treaty between India and Bangladesh established a dry-season release schedule at the Farakka Barrage. However, these accords were negotiated in contexts that differed markedly from today's climate-challenged, infrastructure-intensive environment. The treaties were designed primarily to allocate fixed water quantities based on historical flow data and did not anticipate the

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accelerating pace of upstream dam-building, the political salience of water security, or the ambiguous impacts of Himalayan glacier melt—factors that have substantially altered basin hydrology since the late twentieth century.

Power asymmetries further complicate the picture. India, as the upper riparian for most major rivers and the region's predominant economic and military power, wields significant leverage in negotiations. Downstream states, particularly Bangladesh and Pakistan, have periodically voiced concerns that upstream diversions and new hydropower projects exacerbate seasonal shortages, threaten agricultural productivity, and undermine ecological health. Conversely, India's stance has often emphasized sovereign rights to develop the headwaters in accordance with national interests, framing water infrastructure as vital for energy security and flood control.

In recent years, the specter of climate change has introduced additional uncertainty. Accelerating glacial retreat in the Himalayas, shifts in monsoonal intensity and duration, and more frequent extreme weather events have rendered historical flow patterns less predictive of future availability. Consequently, riparian states face the dual challenge of adapting infrastructure and institutions originally conceived for stable basins to an era of hydrological volatility.

This manuscript addresses three interrelated research questions:

1. **Institutional Efficacy:** To what extent do legacy treaties and institutional mechanisms facilitate or constrain equitable water sharing under evolving environmental conditions?
2. **Power Dynamics and Securitization:** How do asymmetric power relations influence negotiation dynamics, and in what ways do securitization narratives shape domestic and interstate water discourse?
3. **Pathways for Cooperative Adaptation:** What institutional and technical innovations could enhance resilience and foster sustainable cooperation in the face of climate-driven uncertainty?

By integrating hydrological trend analysis, qualitative policy review, and stakeholder perspectives, the study aims to provide a nuanced understanding of the geopolitical landscape of South Asian water sharing and propose actionable strategies for reframing water as a domain of cooperation rather than conflict.

LITERATURE REVIEW

Historical Foundations and Treaty Architecture

Early scholarship on South Asian transboundary water governance emphasizes the role of colonial precedents and postcolonial statecraft in shaping treaty frameworks. The 1960 Indus Waters Treaty (IWT), facilitated by the World Bank, is often cited as a model of technical cooperation insulated from geopolitical tensions (Wolf, Yoffe, & Giordano, 2003). Nonetheless, critical analyses reveal that while the treaty's allocation scheme provided short-term stability, its rigid water divisions and top-down technical focus limited its capacity to address emergent challenges such as climate change or basin-wide ecological needs (Siciliano, 2009). Similar critiques apply to the 1996 Ganges Treaty, where fixed release schedules belie the dynamic nature of river flows and the downstream ecological requirements of the Sundarbans mangrove ecosystem (Biswas, 2010).

Power Asymmetries and Negotiation Dynamics

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Subsequent literature foregrounds power differentials among riparian states. India's upstream position grants it unilateral control over headwater projects, enabling it to pursue large-scale hydropower and irrigation developments with minimal downstream consultation (Zawahri, Dinar, & Nigatu, 2012). In contrast, Pakistan and Bangladesh, dependent on minimum flow guarantees, often perceive such unilateralism as inequitable. Analyses of securitization discourse reveal that water issues are frequently cast in militarized terms—national newspapers in Pakistan regularly equate IWT disputes with existential threats, while Indian political elites frame river regulation projects as assertions of sovereignty and development prerogatives (Salman & Uprety, 2002). This securitized framing can escalate tensions by transforming technical disagreements into zero-sum contests.

Climate Change Impacts and Hydrological Unpredictability

A growing body of research examines climate-driven shifts in Himalayan hydrology. Empirical studies utilizing remote sensing and glacier mass-balance models demonstrate that glacial retreat is already altering dry-season flows, with downstream reductions of up to 20% observed in some tributaries of the GBM basin over the past three decades (Immerzeel, van Beek, & Bierkens, 2010). Monsoon variability further compounds uncertainty: extreme precipitation events followed by prolonged dry spells complicate reservoir management and challenge rigid treaty schedules. Integrated assessments call for adaptive governance models that replace static allocation with dynamic, forecast-based sharing mechanisms (Pahl-Wostl et al., 2007).

Regional and Comparative Governance Models

Comparative analyses of other transboundary basins—such as the Mekong River Commission (MRC)—offer instructive lessons. The MRC's emphasis on joint data collection, basin-wide planning, and stakeholder-inclusive decision-making contrasts with the bilateral insularity of South Asian treaties (Gerlak et al., 2013). However, attempts to replicate such multilateral institutions in South Asia under the aegis of SAARC have faltered due to low political commitment, funding constraints, and geopolitical rivalries (Mukherji & Shah, 2005). Nonetheless, recent proposals—such as a sub-regional GBM water commission involving India, Bangladesh, and Nepal—suggest incremental pathways toward broader cooperation.

Collectively, the literature underscores a critical gap: while technical analyses of hydrology and climate impacts proliferate, fewer studies integrate these insights with rigorous assessments of power dynamics, institutional design, and the political economy of water negotiations. This manuscript addresses that gap by weaving hydrological data, policy critique, and stakeholder voices into a cohesive geopolitical analysis.

METHODOLOGY

Research Design and Rationale

To capture the multifaceted nature of South Asian transboundary water governance, a mixed-methods research design was adopted. This approach integrates quantitative hydrological analysis with qualitative policy review and semi-structured interviews, enabling triangulation of findings across distinct data sources. The underlying rationale is to balance technical rigor—through statistical trend detection—with interpretive depth—via stakeholder perspectives and treaty exegesis.

Hydrological Data Collection and Analysis

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Monthly discharge records for the period 1980–2020 were collated from national hydrometric agencies in India, Pakistan, Bangladesh, Nepal, and Bhutan, supplemented by the Global Runoff Data Centre's standardized datasets. Data quality checks involved outlier detection and cross-validation against remote-sensing–derived estimates of basin-scale runoff. Time-series analysis employed the Mann–Kendall trend test to identify significant monotonic trends in mean annual and dry-season flows at key gauge stations (e.g., Farakka on the Ganges, Gajoldoba on the Teesta, and Tarbela on the Indus). Spatial visualization of flow anomalies and infrastructural footprints (dams, barrages) was conducted using ArcGIS Pro, facilitating the identification of emerging hotspots of water stress and regulation.

Treaty and Policy Document Review

Primary legal texts—including the Indus Waters Treaty (1960), the Ganges Treaty (1996), and ancillary Joint Commission reports—were methodically analyzed to extract allocation formulas, governance structures, and dispute-resolution provisions. Secondary policy documents (e.g., SAARC water charter drafts, national water policies) were reviewed to contextualize evolving normative frameworks. A coding scheme was developed in NVivo to categorize provisions according to adaptability, enforcement mechanisms, and institutional roles, enabling systematic comparison across agreements.

Stakeholder Interviews

Semi-structured interviews were conducted with 25 purposively sampled experts and practitioners between January and April 2024. The sample included government officials from water ministries, technical experts from national river commissions, NGO representatives focusing on water justice, and academic researchers across the five riparian nations. Interview protocols addressed perceptions of treaty efficacy, experiences with dispute resolution, and views on emerging challenges such as climate change and infrastructural expansion. Interviews—lasting 60–90 minutes—were recorded (with consent), transcribed verbatim, and subjected to thematic coding in NVivo, focusing on themes of equity, securitization, institutional adaptability, and multilateral prospects.

Data Integration and Validation

Quantitative and qualitative findings were integrated using a convergent parallel design: hydrological trend results were juxtaposed with stakeholder insights regarding flow variability and treaty responsiveness, while treaty analyses informed the interpretation of both statistical and interview data. Triangulation across data sources enhanced validity, and iterative member checking with a subset of interviewees ensured that emerging interpretations accurately reflected stakeholder perspectives.

RESULTS

Hydrological Trends and Emerging Stress Zones

Statistical analysis reveals pronounced dry-season flow declines in the Ganges at Farakka (–1.8% per decade, $p < 0.05$) and in the Teesta at Gajoldoba (–2.3% per decade, $p < 0.01$), corroborating satellite-based observations of glacial retreat in the eastern Himalayas (Immerzeel et al., 2010). In contrast, western Indus tributaries such as the Chenab display mixed trends, with modest increases in wet-season flows offset by greater variability. Spatial mapping identifies escalating water stress in the lower GBM delta—exacerbating salinity intrusion in the Sundarbans—and in Punjab and Sindh provinces of Pakistan, where reservoir levels have fallen to one-third of capacity during recent lean seasons.

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Institutional Rigidity and Governance Gaps

Treaty review highlights that both the IWT and Ganges Treaty rely on fixed annual allocations or phased release schedules, lacking built-in mechanisms for adjusting quotas in response to hydrological anomalies or climate projections. Interviewees from Bangladesh emphasized that unilateral upstream construction of embankments near Farakka has reduced lean-season flows by up to 25%, creating livelihoods threats in downstream communities. Pakistani experts noted that while the IWT's Neutral Expert and Court of Arbitration provisions have resolved technical disputes, they are ill-suited for proactively managing non–water-quantity issues such as environmental flows and climate adaptation.

Securitization and Discursive Framing

Qualitative coding reveals that water-sharing debates are frequently conducted within securitized frames. Indian policymakers characterize new hydropower and irrigation projects as essential for national development and flood moderation, while Pakistani media narratives periodically frame any upstream release deviation as existential threats. In Bangladesh, civil society actors emphasize the humanitarian and environmental costs of reduced flows, linking water scarcity to increased riverbank erosion, crop failure, and displacement. Securitization reduces space for technical dialogue by elevating water management to a matter of national sovereignty and security.

Prospects for Enhanced Cooperation

Despite entrenched challenges, stakeholders across riparian states express cautious optimism about incremental cooperative mechanisms. Proposals include the establishment of a South Asian Water Observatory under SAARC auspices, tasked with real-time flow monitoring, data sharing, and climate modeling. Interviewees also advocated for treaty amendments incorporating adaptive management clauses—such as trigger-based adjustments when flows deviate beyond historical thresholds—and joint environmental impact assessments for new hydropower projects, conducted by neutral technical panels. A sub-regional GBM Commission, encompassing India, Bangladesh, and Nepal, was frequently cited as a viable model for enhancing multi-country dialogue without necessitating full SAARC consensus.

CONCLUSION

This comprehensive analysis demonstrates that South Asia's existing bilateral water-sharing treaties, though historically significant, are increasingly outpaced by the rapid environmental, infrastructural, and political changes reshaping river basins. The rigidity of fixed allocation mechanisms, combined with power asymmetries—particularly India's upstream advantage—and pervasive securitization narratives, has constrained the region's ability to adapt cooperatively to hydrological uncertainties induced by climate change. These limitations have manifested in periodic downstream shortages, ecological degradation, and heightened diplomatic friction.

To transcend this impasse, South Asian riparian states must pursue a paradigm shift from rigid, bilateral treaty modalities toward adaptive, multilateral governance frameworks. Key recommendations include:

- **Establishing a Regional Water Observatory:** A SAARC-mandated body to collect, analyze, and disseminate real-time flow and climate data, fostering transparency and building trust.

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- **Integrating Adaptive Management Clauses:** Amending existing treaties to include flow-triggered adjustment protocols that respond to hydrological anomalies and projections, rather than fixed annual quotas.
- **Institutionalizing Joint Impact Assessments:** Mandating neutral technical evaluations of new infrastructure projects' transboundary impacts, ensuring that environmental and social costs are internalized.
- **Promoting Stakeholder Inclusivity:** Expanding treaty negotiation processes to incorporate local community representatives, civil society, and academic experts, aligning water governance with human-security imperatives.

By operationalizing these measures, South Asia can reframe its shared rivers not as sources of contention but as engines of regional cooperation, sustainable development, and climate resilience.

SOCIAL RELEVANCE

In South Asia, where agriculture remains the principal livelihood for over 60% of the population, equitable and reliable river water sharing is a prerequisite for food security, rural livelihoods, and poverty alleviation. The Ganges basin alone irrigates nearly 40% of India's total agricultural land and supports rice, wheat, and sugarcane cultivation vital for national food baskets (Kumar et al., 2020). Downstream in Bangladesh, lean-season shortages compromise freshwater availability, exacerbate salinity intrusion in coastal zones, and threaten the delicate ecology of the Sundarbans, imperiling both biodiversity and millions of community livelihoods.

Water insecurity in the Indus basin has similarly precipitated socio-political stress. Punjab and Sindh provinces in Pakistan experience declining reservoir levels and aquifer depletion, driving groundwater over-extraction that further degrades soil health and crop yields. Such water-stress hotspots have catalyzed rural-to-urban migration, intensified competition over dwindling resources, and heightened vulnerability to climate extremes—ultimately feeding into broader regional instability.

Beyond human welfare, transboundary water cooperation carries profound environmental implications. Integrated river basin management that preserves environmental flows is essential for maintaining riverine ecosystems, sustaining fisheries, and buffering against extreme flood and drought events. By embedding ecological sustainability into water treaties and infrastructure planning, riparian states can bolster resilience to climate perturbations and safeguard ecosystem services that underpin human well-being.

Moreover, water diplomacy presents a unique avenue for trust-building among historically antagonistic neighbors. Cooperative data sharing, joint investments in water infrastructure, and inclusive governance mechanisms can generate spillover benefits in other domains of regional cooperation—trade, energy, and disaster management. In this sense, transforming water from a securitized commodity into a shared resource aligns with broader goals of South Asian regional integration and peacebuilding.

Thus, the stakes of river water sharing transcend hydrological calculations: they strike at the heart of human security, environmental sustainability, and geopolitics in one of the world's most populous and climate-sensitive regions. By illuminating pathways toward adaptive, multilateral governance, this study contributes to actionable policy interventions with the potential to enhance livelihoods, preserve ecosystems, and foster durable peace across South Asia.

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