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Climate Change, Water Security, and Geopolitics in South Asia: Implications for Pakistan

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Abstract

Climate change is rapidly transforming the hydrological landscape of South Asia, intensifying existing water insecurities and reshaping regional geopolitical dynamics. This article examines the intersection of climate change, water security, and geopolitics in South Asia, with a particular focus on Pakistan. It argues that climate-induced variability in water availability is emerging as a critical factor influencing interstate relations, especially between Pakistan and India. Drawing on the concept of hydro-politics and the framework of climate security, the study analyzes how changing river flows, glacial retreat, and extreme weather events are placing stress on transboundary water arrangements, particularly the Indus Basin system. The article evaluates the role and limitations of the Indus Waters Treaty in the context of climate change. It also explores the potential for both conflict and cooperation. It further assesses Pakistan's strategic vulnerabilities, including its heavy dependence on the Indus River system, weak water governance, and limited adaptive capacity. The study concludes that while climate change exacerbates geopolitical tensions, it also creates opportunities for regional cooperation, provided that institutional mechanisms are strengthened and depoliticized. The article contributes to the broader discourse on climate security by highlighting the centrality of water in shaping future geopolitical alignments in South Asia.

Keywords: Climate change, water security, hydro-politics, South Asia, Pakistan, Indus Basin, geopolitics

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1. Introduction

Water has long been a central element of geopolitics in South Asia, shaping patterns of cooperation and conflict among regional states. In a region characterized by rapid population growth, agricultural dependence, and uneven resource distribution, water scarcity has emerged as a critical concern. Climate change is now intensifying these challenges by altering precipitation patterns, accelerating glacial melt, and increasing the frequency of extreme weather events.

Pakistan, as a lower riparian state in the Indus Basin, is particularly vulnerable to these changes. Its economy and food security are heavily dependent on the Indus River system, which originates in the Himalayas and flows through India into Pakistan. Any disruption in this system—whether due to natural variability or upstream interventions—has significant implications for Pakistan's stability. Historically, water relations between Pakistan and India have been governed by the Indus Waters Treaty, widely regarded as one of the most successful transboundary water agreements. However, the treaty was designed in a context that did not fully account for the impacts of climate change. Today, changing hydrological conditions are placing new pressures on this arrangement, raising questions about its long-term sustainability.

At the same time, water insecurity is increasingly linked to broader geopolitical dynamics. Climate-induced water stress can exacerbate interstate tensions, fuel domestic instability, and influence strategic decision-making. In South Asia, where political relations are already fragile, these dynamics are particularly pronounced. This article examines how climate change is affecting water security in South Asia, explores the geopolitical implications of shifting water dynamics with particular focus on Pakistan, and assesses the extent to which existing institutional frameworks are capable of managing these emerging challenges.

The article argues that climate change is reshaping hydro-politics in South Asia, creating both risks of conflict and opportunities for cooperation. However, without significant institutional adaptation, the region is likely to experience increasing tensions over water resources.

2. Theoretical Framework

The relationship between water and geopolitics is often analyzed through the concept of hydro-politics, which examines how water resources influence power relations between states. Hydro-politics emphasizes the strategic importance of rivers, particularly in transboundary contexts where upstream and downstream states have competing interests.

In South Asia, hydro-politics is shaped by asymmetrical power relations. India, as an upstream state, has greater control over water flows, while Pakistan, as a downstream state, is more vulnerable to upstream actions. This asymmetry creates a structural imbalance that influences negotiations and conflict dynamics.

Climate security offers an important analytical perspective by connecting environmental change with security outcomes. It views climate change as a threat multiplier that exacerbates existing vulnerabilities rather than generating entirely new conflicts. In terms of water security, climate change reduces water availability, increases variability in river flows, and intensifies competition over scarce resources.

The integration of hydro-politics and climate security allows for a comprehensive analysis of how environmental changes intersect with geopolitical dynamics. It highlights the importance of both physical factors (such as water availability) and political factors (such as institutional arrangements and power relations).

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3. Climate Change and Water Dynamics in South Asia

South Asia is among the regions most vulnerable to climate change, particularly regarding water resources, as its hydrological system depends heavily on monsoon rainfall, glacial melt from the Himalayas, and seasonal river flows. Climate change is increasingly disrupting these interconnected systems, altering precipitation patterns, accelerating glacier retreat, and creating greater uncertainty in water availability across the region.

3.1 Glacial Retreat and River Flows

The Himalayan glaciers, often called the "water towers of Asia," are a vital source of freshwater for major river systems such as the Indus, Ganges, and Brahmaputra. Rising temperatures are accelerating glacial melt, resulting in short-term increases in river flows but posing serious risks of long-term water decline. For Pakistan, this creates a paradox of heightened flood risks in the near term alongside reduced water availability in the future, making water management more complex and increasing uncertainty in long-term planning.

3.2 Changing Monsoon Patterns

Climate change is increasingly disrupting monsoon dynamics, making rainfall patterns more erratic and unpredictable. This has led to a higher frequency of floods, prolonged periods of drought, and significant disruptions to agricultural cycles, all of which directly undermine food security and economic stability across the region.

3.3 Extreme Weather Events

The increasing intensity of extreme weather events, such as floods and heat-waves, further exacerbates water insecurity. These events not only damage infrastructure but also strain governance systems and increase competition over resources.

4. The Indus Basin and Regional Hydro-politics

The Indus Basin serves as the lifeline of Pakistan's economy and society, underpinning key sectors such as agriculture—which employs a significant portion of the population—along with energy production and urban water supply. At the same time, as a transboundary river system shared with India, it holds critical geopolitical importance, making water management not only an economic concern but also a central issue in regional relations.

4.1 Structure of the Indus Waters Treaty

The Indus Waters Treaty governs the allocation of the Indus Basin's waters between India and Pakistan, assigning the eastern rivers (Ravi, Beas, and Sutlej) to India and the western rivers (Indus, Jhelum, Chenab) to Pakistan. While the agreement grants Pakistan primary rights over the western rivers, it also permits India limited non-consumptive use of these waters, particularly for purposes such as hydropower generation.

4.2 Strengths of the Treaty

The Indus Waters Treaty has demonstrated several notable strengths, including its resilience in surviving multiple conflicts between India and Pakistan, its provision of a structured legal framework for dispute resolution, and its establishment of mechanisms for data sharing and sustained communication between the two countries.

4.3 Emerging Challenges

Despite its strengths, the Indus Waters Treaty faces significant challenges in the context of climate change, as it does not adequately account for shifting water availability, lacks clear mechanisms for climate adaptation, and is increasingly strained by disputes over infrastructure development and river management projects.

5. India–Pakistan Water Relations in a Changing Climate

Water relations between India and Pakistan have historically been shaped by a complex interplay of cooperation and competition. While the Indus Waters Treaty has provided a stable

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framework for managing shared water resources, the broader political relationship between the two countries has remained contentious. Climate change is now introducing new uncertainties into the already fragile dynamic, raising concerns about the future of water cooperation in the region.

5.1 Structural Asymmetry and Strategic Vulnerability

A defining feature of India–Pakistan water relations is the structural asymmetry between the two states. India, as the upstream country, possesses greater control over the headwaters of the Indus Basin, while Pakistan, as the downstream state, is heavily dependent on uninterrupted water flows.

This asymmetry creates a persistent sense of vulnerability in Pakistan, where water is closely linked to agricultural productivity, food security, energy generation, and overall economic stability. From a geopolitical perspective, this dependence translates into a strategic concern. Any perceived or actual disruption in water flows—whether due to natural causes or upstream interventions—can be interpreted as a potential security threat.

Climate change intensifies this asymmetry by increasing uncertainty in water availability. As river flows become more variable, it becomes more difficult to distinguish between natural fluctuations and deliberate actions, potentially fueling mistrust between the two countries.

5.2 Hydropower Projects and Emerging Disputes

In recent years, tensions between India and Pakistan have increasingly focused on India's construction of hydropower projects on the western rivers allocated to Pakistan under the treaty. Projects such as dams and run-of-the-river installations have raised concerns in Pakistan regarding reduced downstream water flows, manipulation of river timing, and long-term impacts on irrigation.

India, on the other hand, maintains that these projects are within the provisions of the treaty, which allows for non-consumptive uses of water.

Climate change complicates this issue further. As water availability becomes more uncertain, the stakes associated with these projects increase. Even minor variations in water flow can have significant consequences, making disputes more frequent and more difficult to resolve.

5.3 Climate Change and the Politicization of Water

Climate change has the potential to transform water from a managed resource into a highly politicized issue. In the context of India–Pakistan relations, this politicization is already evident in political rhetoric and public discourse.

Water is increasingly framed not only as an economic resource but also as a strategic asset. This framing has several implications: It elevates water issues within national security agendas. It increases the likelihood of disputes being interpreted in zero-sum terms. It reduces the space for cooperative solutions.

In times of political tension, water can become a tool of coercive diplomacy, even if actual disruptions are minimal. The perception of vulnerability is often as significant as the reality.

5.4 Treaty Resilience under Climate Stress

The Indus Waters Treaty has demonstrated remarkable resilience over the decades, surviving multiple wars and periods of heightened political tension. However, climate change introduces new types of stress that the treaty was not designed to handle.

Key limitations include: Static Allocation: The treaty allocates water based on historical flows, without accounting for future variability. Lack of Flexibility: There are limited provisions for

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adapting to changing climatic conditions. Technical Disputes: Increasing disagreements over project design and compliance.

These challenges raise important questions about the long-term viability of the treaty. While it remains a critical mechanism for managing water relations, it may require adaptation to remain effective in a changing climate.

5.5 Risk of Conflict vs. Potential for Cooperation

A central debate in the study of water geopolitics is whether scarcity leads to conflict or cooperation. In the South Asian context, both outcomes are possible. Conflict risks increased competition over limited water resources, heightened mistrust due to variability in river flows, and politicization of water in bilateral relations. Cooperation opportunities shared vulnerability to climate change, mutual interest in sustainable water management, and existing institutional framework provided by the treaty.

While the risk of conflict is often emphasized, historical evidence suggests that water disputes are more likely to result in negotiation than outright conflict. However, this does not diminish the importance of proactive measures to prevent escalation.

5.6 Water Security as a Strategic Issue for Pakistan

For Pakistan, water security is increasingly intertwined with national security. The country's dependence on the Indus Basin means that any disruption—whether climatic or geopolitical—has far-reaching implications. Climate change amplifies this challenge by increasing variability in water supply, reducing predictability in planning, and intensifying competition at both domestic and international levels. As a result, water security is no longer a purely technical issue but a strategic concern that requires integration into broader geopolitical thinking.

5.6 The Role of Perception and Miscalculation

An important but often overlooked aspect of hydro-politics is the role of perception. In a context of political rivalry, actions related to water management can be interpreted in ways that exacerbate tensions. For example: Natural reductions in river flow may be perceived as deliberate actions. Infrastructure projects may be viewed as strategic threats. Data gaps can lead to suspicion and mistrust. Climate change increases the likelihood of such misperceptions by introducing greater variability and uncertainty. This creates a risk of miscalculation, where actions taken for legitimate purposes are interpreted as hostile.

5.8 Synthesis: Climate Change as a Geopolitical Multiplier

The analysis above suggests that climate change acts as a geopolitical multiplier in South Asia. It does not create new conflicts in isolation but intensifies existing tensions and vulnerabilities. In the case of India and Pakistan: Pre-existing political rivalry provides the context. Water dependence creates structural vulnerability. Climate change amplifies uncertainty and competition. This combination creates a complex and potentially volatile dynamic, where environmental and political factors interact in ways that are difficult to predict.

6. Pakistan's Internal Water Crisis: Climate Stress and Structural Vulnerabilities

While regional hydro-politics plays a critical role in shaping Pakistan's water security, the country's internal dynamics are equally significant. Climate change does not operate in isolation; its effects are mediated through domestic governance structures, resource management practices, and socio-economic conditions. In Pakistan's case, internal vulnerabilities significantly amplify the external risks associated with transboundary water dynamics. This section argues that Pakistan's water insecurity is not solely the result of upstream pressures or climatic changes, but also a consequence of structural weaknesses in water governance, inefficient resource management, and growing demand pressures. These internal factors interact with regional geopolitics to create a multidimensional water crisis.

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6.1 Dependence on the Indus Basin System

Pakistan is one of the most water-dependent countries in the world, with the vast majority of its water resources derived from the Indus Basin. This dependence creates a high degree of vulnerability, as the country has limited alternative sources of freshwater.

The Indus Basin supports approximately 90% of Pakistan's agricultural production, a significant portion of its energy generation (hydropower), and water supply for major urban centers. This level of dependence means that even minor disruptions in water flow can have cascading effects across multiple sectors. Climate change exacerbates this vulnerability by introducing greater variability in river flows, making water availability less predictable.

6.2 Agricultural Pressure and Water Mismanagement

Agriculture remains the backbone of Pakistan's economy, employing a large share of the population. However, the sector is characterized by inefficient water use and outdated irrigation practices. Key issues include over-reliance on flood irrigation methods, cultivation of water-intensive crops such as rice and sugarcane, and limited adoption of modern irrigation technologies.

These practices contribute to excessive water consumption and reduce the overall efficiency of the system. As water availability becomes more uncertain due to climate change, these inefficiencies become increasingly unsustainable. In addition, groundwater extraction has increased significantly in recent decades. While this provides a short-term solution to water shortages, it has led to declining groundwater levels, degradation of water quality, and long-term sustainability concerns.

6.3 Urbanization and Rising Demand

Rapid urbanization is placing additional pressure on Pakistan's already strained water resources. Major cities such as Karachi, Lahore, and Islamabad face chronic water shortages, inequitable distribution of water, and infrastructure deficits. Urban water management is further complicated by population growth and inadequate planning. Informal settlements often lack access to reliable water supplies, leading to increased reliance on private water markets and unsafe sources. Climate change intensifies these challenges by increasing demand during heat-waves, disrupting supply through extreme weather events, and straining aging infrastructure.

6.4 Provincial Disputes and Internal Hydro-politics

Water scarcity is not only an international issue but also a source of internal political tension within Pakistan. Disputes between provinces—particularly over the distribution of Indus waters—have been a recurring feature of domestic politics. The Indus River System Authority (IRSA) is responsible for managing water allocation among provinces, but its effectiveness is often limited by political interference, lack of trust among stakeholders, and disagreements over data and measurement.

Climate change exacerbates these tensions by reducing overall water availability and increasing competition. During periods of scarcity, provinces may accuse each other of overuse or unfair distribution, leading to political friction. These internal disputes weaken Pakistan's ability to present a unified position in regional water negotiations, further complicating its geopolitical situation.

6.5 Climate-Induced Variability and Planning Uncertainty

One of the most significant impacts of climate change is the increase in variability and unpredictability. Traditional water management systems in Pakistan are based on historical patterns of river flow and rainfall. However, these patterns are becoming less reliable due to climate change. Key challenges include difficulty in forecasting water availability, increased

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risk of both floods and droughts, and uncertainty in agricultural planning. This unpredictability undermines long-term planning and increases the risk of crisis-driven responses. Without reliable data and forecasting systems, policymakers are often forced to react to events rather than anticipate them.

6.6 Infrastructure Deficits and Storage Limitations

Pakistan's water infrastructure is insufficient to cope with the challenges posed by climate change. One of the most critical issues is the lack of water storage capacity. Compared to many other countries, Pakistan stores a relatively small proportion of its annual water flow. This has several consequences like excess water during floods cannot be effectively stored, limited reserves during drought periods, and increased vulnerability to seasonal variability. In addition, existing infrastructure is often outdated and poorly maintained. Sedimentation in dams reduces their storage capacity, while aging irrigation systems lead to significant water losses.

6.7 Governance Challenges and Institutional Weaknesses

Water governance in Pakistan is characterized by fragmentation and inefficiency. Multiple institutions are involved in water management, often with overlapping responsibilities and limited coordination. Key governance challenges include: Lack of integrated water management strategies, weak enforcement of regulations and limited transparency and accountability. These issues hinder effective policy implementation and reduce the ability of the state to respond to emerging challenges.

6.8 Linking Domestic Vulnerabilities to Geopolitics

Pakistan's internal water crisis has direct implications for its geopolitical position. Domestic vulnerabilities increase dependence on external water flows, reduce resilience to external shocks, and limit strategic flexibility in negotiations. For example, inefficiencies in water use mean that Pakistan requires more water to sustain its economy, increasing its sensitivity to upstream changes. Similarly, internal disputes weaken the country's negotiating position in regional forums. Climate change acts as a bridge between domestic and international dynamics, amplifying the impact of internal weaknesses on external relations.

6.9 Human Security Implications

Water insecurity has profound implications for human security in Pakistan. It affects food availability, livelihoods, and public health. Rural communities are particularly vulnerable, as their livelihoods depend heavily on agriculture. Water shortages can lead to crop failures, loss of income, and increased poverty. In urban areas, water scarcity contributes to inequality and social tensions. Access to water often depends on economic status, leading to disparities in living conditions. Climate change intensifies these challenges, increasing the risk of displacement and migration. This, in turn, places additional pressure on urban centers and can contribute to social instability.

6.10 Synthesis: A Multi-Layered Water Crisis

The analysis above highlights that Pakistan's water crisis is multi-dimensional; involving environmental stress (climate change), structural weaknesses (governance and infrastructure), socio-economic pressures (population and agriculture), and political dynamics (provincial and regional disputes). These factors interact to create a complex and evolving challenge. Addressing water security in Pakistan therefore requires a comprehensive approach that integrates domestic reforms with regional cooperation.

7. Policy Recommendations: Toward Resilient Water Governance and Regional Stability

The preceding analysis demonstrates that climate change is reshaping water security and geopolitics in South Asia, with profound implications for Pakistan. Addressing these

challenges requires a comprehensive strategy that integrates domestic reforms with regional cooperation. This section outlines key policy recommendations aimed at enhancing resilience, reducing vulnerability, and promoting stability.

7.1 Reforming Domestic Water Governance

A critical priority for Pakistan is the reform of its domestic water governance framework. Effective management of water resources requires: Establishing an integrated national water management system, enhancing coordination among federal and provincial institutions and strengthening regulatory frameworks and enforcement mechanisms. Institutional clarity is essential to reduce overlap and improve efficiency. The development of a centralized coordination mechanism can facilitate better communication and decision-making across different levels of government.

7.2 Improving Water Use Efficiency in Agriculture

Given that agriculture consumes the majority of Pakistan's water resources, improving efficiency in this sector is essential. Key measures include: Promoting modern irrigation techniques such as drip and sprinkler systems, encouraging crop diversification toward less water-intensive crops, and reducing water losses through improved canal management. These measures can significantly reduce water demand and enhance resilience to climate variability.

7.3 Expanding Water Storage and Infrastructure

To address variability in water availability, Pakistan must invest in expanding its water storage capacity. This includes: Constructing new reservoirs and dams where feasible, rehabilitating existing infrastructure, and addressing sedimentation issues in current storage facilities. Improved storage capacity will enable the country to better manage seasonal fluctuations and reduce vulnerability to both floods and droughts.

7.4 Strengthening Data Systems and Climate Forecasting

Reliable data is essential for effective water management. Pakistan should prioritize: Developing advanced hydrological monitoring systems, enhancing climate modeling and forecasting capabilities, and improving data sharing between institutions. Accurate and timely information can support proactive decision-making and reduce uncertainty in planning.

7.5 Enhancing Provincial Coordination

Internal water disputes weaken Pakistan's overall water security and geopolitical position. Strengthening mechanisms for inter-provincial coordination is therefore essential. This includes: Reforming the role and functioning of water allocation institutions, establishing transparent data-sharing practices, and building trust among provincial stakeholders. A unified domestic framework will strengthen Pakistan's ability to engage in regional negotiations.

7.6 Adapting the Indus Waters Treaty to Climate Realities

While the treaty remains a cornerstone of regional water governance, it requires adaptation to address the challenges posed by climate change. Potential areas for reform include: Incorporating provisions for climate variability, enhancing mechanisms for joint data sharing and monitoring, expanding cooperation on flood management and disaster response. Rather than replacing the treaty, the focus should be on evolution and adaptation, ensuring its continued relevance in a changing environment.

7.7 Promoting Regional Cooperation

Climate change presents an opportunity for cooperation as well as conflict. Pakistan should actively pursue regional initiatives aimed at: Joint water management, shared climate adaptation strategies, and scientific collaboration on glacial and hydrological research. Cooperation can help reduce mistrust and create mutually beneficial outcomes.

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7.8 Integrating Water Security into National Security Planning

Water security must be fully integrated into Pakistan's broader national security framework. This requires: Recognizing water as a strategic resource, aligning water policies with security and economic planning, and enhancing coordination between civilian and security institutions. Such integration will ensure that water issues receive the attention and resources they require.

8. Conclusion

This article has examined the intersection of climate change, water security, and geopolitics in South Asia, with a particular focus on Pakistan. It has argued that climate change is fundamentally altering the region's hydrological systems, intensifying water scarcity, and reshaping geopolitical dynamics. At the regional level, the relationship between Pakistan and India remains central to understanding hydro-politics in South Asia. The Indus Waters Treaty continues to provide a framework for cooperation, but it faces increasing pressure from climate-induced variability and growing demand for water resources. While the treaty has demonstrated resilience, its long-term effectiveness will depend on its ability to adapt to new realities. At the domestic level, Pakistan's water crisis is driven not only by external factors but also by internal vulnerabilities. Inefficient water use, weak governance structures, infrastructure deficits, and rising demand all contribute to the country's water insecurity. Climate change amplifies these challenges, creating a complex and multi-layered crisis. The analysis highlights that water security in Pakistan cannot be understood in isolation. It is deeply interconnected with regional geopolitics, domestic governance, and global environmental change. Addressing these challenges requires a holistic approach that integrates multiple levels of analysis. Importantly, the article underscores that climate change acts as a geopolitical multiplier, intensifying existing tensions rather than creating entirely new ones. This means that the risk of conflict over water is not inevitable, but it increases in the absence of effective governance and cooperation. At the same time, shared vulnerability to climate change creates opportunities for collaboration. Strengthening institutional frameworks, enhancing transparency, and promoting dialogue can help transform potential conflicts into avenues for cooperation. In conclusion, Pakistan's future water security will depend on its ability to adapt to a changing climate, reform its domestic institutions, and engage constructively with regional partners. The choices made today will shape not only the country's water security but also the broader geopolitical landscape of South Asia.

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