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Waters of Control: A Historical–Political Account of Flooding in Panjab

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Abstract

This article examines flooding in Panjab through the intersecting lenses of biopolitics and hydropolitics, arguing that floods are not merely natural hazards but outcomes shaped by legal, political, and infrastructural systems. It traces the historical transformation of Panjab's rivers from shared ecological resources into administratively governed spaces through colonial canalisation, the 1947 Partition, and post-1960 water governance, including the Indus Waters Treaty, the Bhakra–Beas Management Board, and Pakistan's Water Apportionment Accord. The article demonstrates how treaties, boards, allocation rules, and technical instruments such as reservoir operations, embankments, risk mapping, and compensation regimes organise exposure to flooding and distribute protection unevenly across populations.



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Drawing on the concepts of biopolitics and hydropolitics, it argues that contemporary flood governance extends beyond managing water to regulating populations, agricultural production, and territorial authority. The history of flooding in the two Panjabs therefore reveals how law and infrastructure continue to produce differentiated patterns of vulnerability, making flood risk a consequence of governance as much as hydrology.

Keywords: Panjab; Hydropolitics; Biopolitics; Water Governance; Legal Hydrology.

Introduction

Flooding is defined as a hydrological hazard that involves the temporary inundation of usually dry land, typically caused by excessive rainfall, river overflow, storm surges, or surface runoff (Chaudhary & Piracha, 2021). Floods are among the most frequent and destructive natural hazards, producing significant social, economic, and environmental impacts that can escalate into disasters when they strike populated areas and infrastructure, thereby amplifying exposure and vulnerability (Chaudhary & Piracha, 2021; Vijender, 2019). Hydrological hazards like floods have killed millions and displaced billions across the world, with disproportionately higher impacts in developing countries, where limited capacity and resources add to the risk (Chaudhary & Piracha, 2021). Floods account for the highest number of deaths globally each year, yet most countries fail to systematically record or map flood events for a range of reasons (Vijender, 2019). As climate change triggers more severe hydrological events, the processes of flooding have become increasingly significant for risk management, preparedness, and effective disaster management.

The flooding in Panjab, a geopolitical, cultural and historical region in South Asia, has to be seen not as a purely "natural" catastrophe, but rather as hydrological hazards that turned into disasters through their interaction with law, infrastructure, and bureaucratic habits. From colonial canal works to post-

Partition treaties and boards, law and infrastructure have redistributed control over rivers and floodplains, creating patterned exposure and differentiated protection. Most previous literature on flooding in the Panjab region has examined the topic from the perspectives of hydrology, engineering, climate change adaptation, disaster management, and intercountry water conflict (Biswas, 1992; Bhatti, 2020; Sidhu & Chopra, 2022). The research has advanced knowledge about the issues of river basin management, irrigation facilities, treaties and agreements, and flood control. However, they consider flooding mainly a technical or environmental issue rather than examining the production of flood vulnerability from legal, political, and historical perspectives.

This article makes three major contributions to scholarship on water governance studies in Panjab. Firstly, this study reinterprets the phenomenon of floods by treating it as a socially produced event rather than a natural disaster. Secondly, it uses an approach that combines biopolitics and hydropolitics to show how the governance of water controls both river regimes and people. Third, it develops the concept of legal hydrology to explain how colonial and postcolonial legal institutions transform rivers into administrative objects whose governance produces unequal exposure to flood risk, water scarcity, and access to compensation.

Theoretical Framework: Biopolitics and Hydropolitics

Biopolitics, introduced by Michel Foucault, is defined as the "art of government" and represents a development of his earlier concept of governmentality (Foucault, 2009). Biopolitics refers to the control of life, specifically focusing on the biological, social, and economic management of populations. It refers to the political administration of life itself, with biological life as a central target of regulation (Coleman & Grove, 2009). Biopolitical power combines disciplinary mechanisms and governmental techniques to optimise populations' productivity, health, and well-being, shifting attention from the sovereign power of death to the regulation of life (Jessop, 2007).

When applied to water governance, biopolitics highlights the state's regulation of its populations not only through legislation but also through resource management, which is vital to sustaining life. The distribution of water, irrigation practices, crop scheduling, and emergency response plans thus emerge as technologies for organising productivity, wellbeing, mobility, and economic survival. Consequently, water governance is not merely a technical exercise in resource allocation but a political technology through which states regulate populations, organise economic life, and shape differential access to security and vulnerability.

Hydropolitics is the study of how power and politics organise the allocation, management, and utilisation of water, especially when rivers and aquifers cross national borders. It addresses the authoritative allocation of water and power relations that underlie it (Cascão & Zeitoun, 2010). It asks the classic question of "who gets what, when, where, and why" and explores how asymmetries of geography, material resources, bargaining power, and ideas structure conflict and cooperation (Cascão & Zeitoun, 2010).

Although hydropolitics initially emerged to explain interstate conflict and cooperation over shared river basins, more recent scholarship has extended the concept to examine how water governance operates within states. Decisions concerning dams, canal systems, reservoirs, embankments, flood zoning, and water allocation are not merely technical or engineering choices; they are political decisions that privilege particular regions, economic sectors, and communities while exposing others to greater environmental risk (Cascão & Zeitoun, 2010).

While each framework offers important insights, neither is sufficient on its own. Biopolitics explains how states govern populations through techniques that regulate life but pays comparatively less attention to the material infrastructures through which environmental resources are controlled. Conversely, hydropolitics explains how power shapes the allocation and governance of water but has generally focused on territorial competition and institutional arrangements rather than the governmental regulation of

populations. Bringing these perspectives together makes it possible to analyse how rivers function simultaneously as environmental systems, political infrastructures, and technologies through which states organise social life.

Building on Foucault's concept of biopolitics and scholarship on critical hydropolitics (Coleman & Grove, 2009; Cascão & Zeitoun, 2010; Jessop, 2007), this article develops the concept of legal hydrology. I define legal hydrology as the process through which rivers are transformed from ecological systems into administrative objects governed through legal rules, engineering standards, bureaucratic procedures, and institutional decision-making. Rather than viewing floods or droughts as purely natural phenomena, legal hydrology demonstrates how legal and administrative regimes shape the distribution of water, environmental risk, and access to compensation. This concept extends both biopolitics and hydropolitics by placing law at the centre of the production of hydrological vulnerability.

From River Ecologies to Legal Hydrology: Canalisation, Partition, and the Indus Waters Treaty

From communal water practices to treaty rule-books, Panjab's rivers were transformed into governable objects before 1960 through colonial surveys, cadastral mapping, canal colonies, and administrative codification that made land and people legible to the state and laid the groundwork for post-Partition legal hydrology.

The British completely re-engineered the rivers of Panjab. After annexation in 1849, they built a gigantic canal-and-embankment system to convert seasonal overland flows into periodic irrigation and tax-yielding production (Talbot, 2011). Canal colonies were excised from grid-patterned towns, with headworks, distributaries, and village planning designed to mastermind supply, labour, and revenue (Talbot, 2011). This hydraulic authority curtailed the natural breadth of floodplains, channelled river flows, and supplanted community-based water practices with bureaucratically managed timetables and water entitlements. In doing so, it rendered rivers legible to the state,

functioning as objects of control serving administrative, security, and agricultural imperatives (Talbot, 2011). Law and policy then institutionalised this regime of control.

Access to land and water was linked to loyal rural intermediaries, with market credit threatening the passage of land (and hence canal rights) to urban moneylenders. The state intervened through legislation, such as the 1900 Alienation of Land Act, to protect agricultural landowners and to serve as a recruiting base for the colonial army (Talbot, 2011). Custom law was institutionalised to consolidate rural hierarchies, and selected elites were conferred with authority in the colonies to anchor it. The result was a hydrological order built for order and extraction, such as significant agricultural surpluses, planned towns (such as Lyallpur), and a routinised water supply, along with debt, social engineering, and periodic anarchy (most notoriously the 1907 canal colony protests) (Talbot, 2011). British domination transformed water from a shared river ecology into a tool of the state, recasting who benefited from irrigation and who was vulnerable to flood risk.

The partition in 1947 tied sovereignty with hydraulic control. The Radcliffe Line was imposed on a landscape that was already reorganised by canals and headworks; thus, the location of the control points was as crucial as demography. India had major headworks such as Ferozepur and Madhopur, but West Panjab had vast command areas fed by the Upper Bari Doab and Dipalpur systems, which created structural dependence downstream (Bhatti, 2020; Xu, 2023). In a matter of months, this disparity became apparent. After an interim standstill in releases, East Panjab closed its supplies on 1 April 1948, prompting hasty negotiations and the Delhi Joint Statement of 4 May 1948 to reopen flows on altered terms (Bhatti, 2020; Xu, 2023). The cutoff affected municipal water and power around Lahore, illustrating how a slight adjustment at a gate could remap work, agriculture, and settlement downstream. That is, bureaucratic discretion in headworks became an interstate bargaining tool, and flood/shortage control departed from local convention into intergovernmental negotiation, a clear-cut instance of hydropolitics at work.

The Indus Waters Treaty of 1960 legitimised this shift from river ecologies to legal hydrology. Negotiated under the facilitation of the World Bank, the treaty gave India the Eastern rivers (Sutlej, Beas, Ravi) and Pakistan the Western rivers (Indus, Jhelum, Chenab). A ten-year transition period (1 April 1960–31 March 1970) required continual supplies to Pakistan while a replacement works programme, financed through donors, was developed, including principal storages (Mangla, Tarbela), link canals to re-plumb the basin, and new barrages to compensate for eastern waters Pakistan would be deprived of (Biswas, 1992). Financing was provided by the Indus Basin Development Fund, the majority in the form of grants/loans, as a consortium of states. India paid ₹62 million in annual instalments of replacement costs over a period of ten years, and additional foreign exchange was introduced later to assist in completing the works (Biswas, 1992).



Figure 1. *Indus River System Showing the Eastern and Western Rivers Under the Indus Waters Treaty (1960).* **Note.** Map created by the author using OpenAI ChatGPT (GPT-5.5 image generation) based on historical cartographic information,

Also significant were the treaty's routine operational routines. Article VI specified routine river and canal data exchanges, Article VIII provided the Permanent Indus Commission, where two senior engineers meet at least annually, conducting site visits and fault-finding implementation and Article IX instituted a ladder of grievances cascading from the Commission to a Neutral Expert and, if required, to a Court of Arbitration, with elaborate procedures in the annexes (Biswas, 1992). By codifying data formats, inspections, operational schedules, and a graduated dispute process, the treaty shifted day-to-day exposure from ad hoc executive discretion to a rule-governed regime and, in the process, institutionalised the geography of power created by infrastructure and location (Biswas, 1992).

From the perspective of legal hydrology, these developments represent more than the legal allocation of rivers between two sovereign states. Through the treaty and its institutions, rivers have been reconceptualised as administrative things whose actions have become increasingly regulated via legal requirements, technical criteria, reporting and institutional oversight. No longer have floods, scarcity and seasonality been regulated through local ecological understanding or traditional sharing of water, but rather through procedures that determine the timing of water release, exchange of information and conflict resolution. In this way, the law of hydrology can provide an account of how hydrological processes became interwoven with legal power, illustrating that vulnerability to flooding and water insecurity was increasingly shaped by institutional rules rather than by physical hydrology alone (Biswas, 1992; Foucault, 2009; Cascão & Zeitoun, 2010).

These arrangements did not end with decolonisation, as they continue to reproduce themselves within the policies, metrics, and projects of the present. Research on Panjab's hydrosocial assemblage shows how grids and logics of the colonial canal persist in the discourse of scarcity, groundwater substitution, and adaptation planning; eligibility rules, performance metrics, and improvement scripts organise who gets counted as vulnerable and who receives aid, credit, or infrastructure first (Aijaz, 2023). On the ground, classes of development such as beneficiary, encroacher, and marginal farmer map onto earlier irrigation geographies, so that risk and opportunity follow the canals and embankments built a century ago (Aijaz, 2023).

Rural Pakistani ethnography traces how canal-colony infrastructures and cadastral grids continue to ground property and labour politics, and how tenancy contracts and military–state estates assume the spatial logics of earlier irrigation, producing recurring struggles over enumeration, rent, and eviction (Rizvi, 2013). Canal tail villages or those surrounding trained river beds are susceptible to waterlogging, backflow, or controlled breaches. Meanwhile, record-keeping needs such as proof of loss, land ownership, and inclusion on "affected" lists determine who is compensated and on whose timeline. Thus, biopolitics (the management of populations via lists, rules, and thresholds) and

hydropolitics (the governance of flows via gates, canals, and bargains) continue to organise everyday life, controlling who is insured, who subsidises, and who waits (Rizvi, 2013).

Post-Treaty Governance in the Two Panjabs: Allocations, Boards, Accords, and Disputes

Since 1960, the governance of the two Panjabs has been organised through treaties, boards, and accords that determine who controls the gates, how storage is operated, and who ultimately bears the brunt of floods or scarcity. In India, the federal architecture shifted inter-state rivers from a largely provincial domain into a centrally managed legal arena. Article 262 and the Inter-State River Water Disputes Act (ISRWD) empower the Union government to constitute tribunals, suspend ordinary court jurisdiction over river disputes, and require states to litigate through specialised forums in which hydrological data, command-area statistics, and projected demands serve as the core evidentiary currency (Malik, 2015). These design features reframe rivers as national administrative objects governed by doctrines such as equitable apportionment and community of interest rather than strict riparian right, and they enable the centre to sequence procedures (reference, interim orders, awards, reviews) that bind states to technical timelines (Malik, 2015). For Panjab, this has meant that claims over the Ravi–Beas are reopened within Union institutions, where tribunal terms of reference, rather than provincial legislation, define the scope of argument (Malik, 2015; Singh, 1992).

This institutional shift is clearest in the long Panjab–Haryana contest around the Sutlej–Yamuna Link (SYL). Post-Partition allocations in 1955, 1976, and 1981 progressively treated “Panjab’s share” as an administratively determined quantity subject to cross-basin transfer, which SYL sought to operationalise by moving Ravi–Beas waters east toward the Yamuna (Singh, 1992). The juridical career of SYL, committees, references, tribunal phases, presidential references to the Supreme Court, and recurrent enforcement petitions shows how engineering proposals become legal objects shaped by standards of proof,

interim relief, and compliance monitoring (Singh, 1992). Probabilistic modelling of the dispute indicates that, under high stakes and uncertainty, settlement trajectories are dominated by third-party involvement and structured bargaining; when closure is achieved, bilateral agreements are the likeliest route (Singla, Duraisamy, & Saravanan, 2020). In practice, once a river share is constructed as an allocable administrative quantity and a transfer canal exists on paper, resolution turns less on local hydrology than on the design of negotiation forums, evidentiary thresholds, and credible enforcement tools (Singh, 1992; Singla et al., 2020).

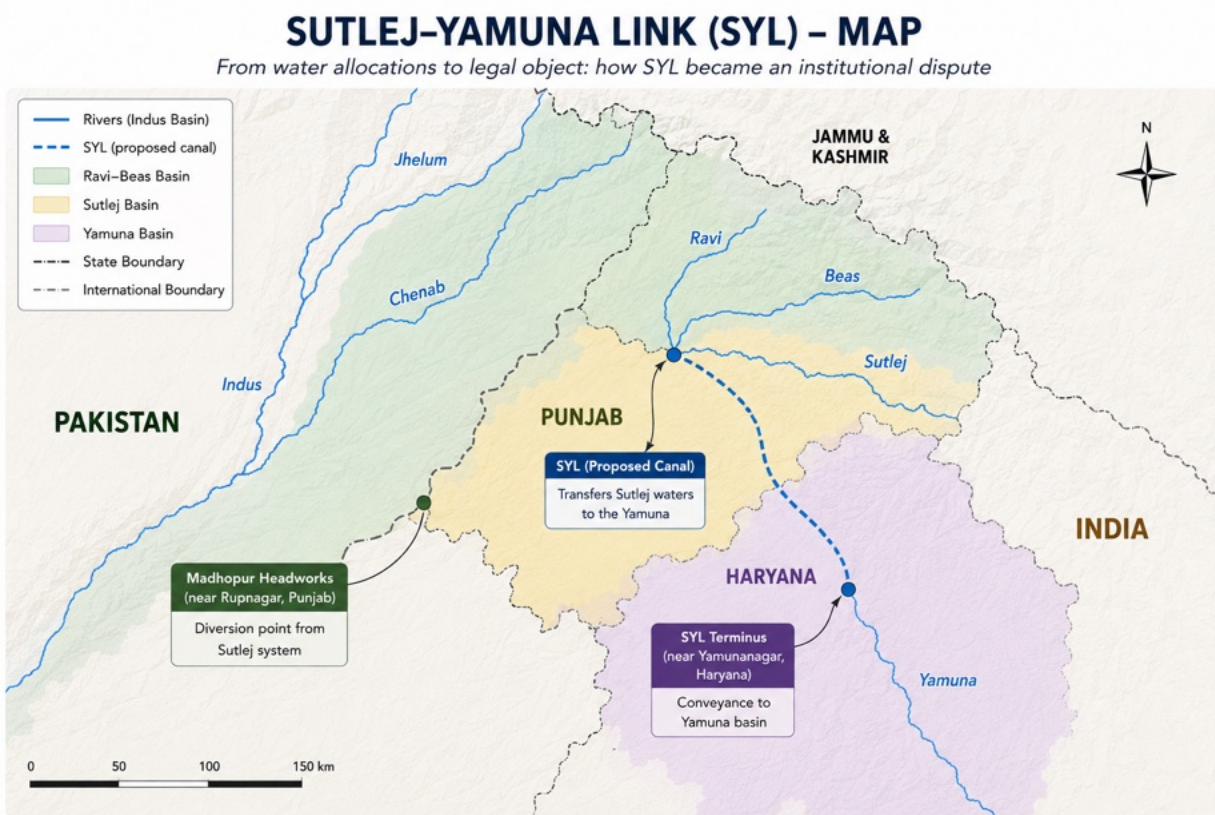


Figure 2. *Sutlej–Yamuna Link (SYL) Canal and the Ravi–Beas–Yamuna Transfer Corridor.*
Note. Map created by the author using OpenAI ChatGPT (GPT-5.5 image generation) and refined using publicly available cartographic information. The figure is a conceptual illustration showing the proposed Sutlej–Yamuna Link (SYL) Canal, India's eastern river system (Ravi, Beas, and Sutlej), the Yamuna River, and the principal state boundaries relevant to the Punjab–Haryana water dispute. It is intended for explanatory purposes and is not a survey-grade or official cartographic representation.

The engineering face of this order is the Bhakra–Beas portfolio and related trans-basin operations. Technical documentation shows how Bhakra, Pong, Pandoh, and the Beas–Sutlej Link were conceived as an integrated system to conserve monsoon surpluses, smooth seasonal flows, and deliver irrigation, hydropower, and urban supply across state boundaries (Sud & Kashyap, 2001). Operations emphasise streamflow forecasting, computer-aided reservoir scheduling, and coordination among storage systems to optimise benefits at the portfolio scale (Sud & Kashyap, 2001). This reframes surplus and priority from river-by-river to system-wide categories and directly affects distribution: peak flows can be buffered upstream and released when and where returns are highest, lean-season supplies can be channelled to designated uses, and flood routing via rule curves and embankment standards can protect some command areas while pushing inundation risk onto others (Sud & Kashyap, 2001). At the basin scale, the Indus Waters Treaty (IWT) hard-wired recurring routines regular data exchanges (Art. VI), Permanent Indus Commission inspections and annual meetings (Art. VIII), and a graded dispute ladder from the Commission to a Neutral Expert and, if needed, a Court of Arbitration (Art. IX) thereby moving day-to-day exposure from ad hoc executive discretion to a rule-bound regime that nonetheless institutionalised the geography of power created by infrastructure and location (Biswas, 1992).

Below the canals, governance increasingly works through groundwater, which serves as the de facto insurance against surface-water uncertainty in a rice–wheat system. By the 2000s, tubewells sustained most irrigated acreage in Indian Panjab, but the legal framework lagged behind the extraction process. An appraisal finds a fragmented set of statutes, weak monitoring, and incentives (especially electricity subsidies) that encouraged over-pumping and deepened aquifer stress (Sidhu & Chopra, 2022). The Punjab Preservation of Sub-soil Water Act, 2009 responded by mandating a later paddy transplanting window to reduce pre-monsoon drawdown. The measure saved water at scale by using calendar rules applied to the entire farming population, rather than volumetric entitlements or aquifer-based rights; it steered behaviour by time

and procedure (Sidhu & Chopra, 2022). As a result, groundwater became a household buffer for canal politics, shifting hydrological risk onto farmers at canal tails or in poorly served blocks while leaving property relations over land and water intact (Sidhu & Chopra, 2022).

Pakistan's Water Apportionment Accord (1991) fixed provincial allocations and established the Indus River System Authority (IRSA) to manage distribution. A system evaluation demonstrates that, relative to the pre-Accord period, reliability at tail barrages declined, particularly during the Rabi season, due to increased upstream diversions; environmental flows remained poorly protected (Hassan et al., 2019). Provinces with stronger storage portfolios could better buffer variability, while tail districts and the Indus delta bore greater exposure in dry spells (Hassan et al., 2019). Recent practice, therefore, emphasises trust architectures: stakeholder-facing allocation models, scenario tools, and joint data platforms are being used to reduce informational asymmetry, build confidence in seasonal planning, and limit litigation within Pakistan's irrigation system (Ahmad et al., 2023). The point is not to depoliticise water, but to redesign decision instruments so that variability is governed transparently and verifiably (Ahmad et al., 2023).

From the perspective of legal hydrology, such systems of governance that developed after 1960 demonstrate the continuous production of hydrological effects through law rather than their mere regulation. Water allocation regimes, tribunals' rulings, regulation of dam operations, groundwater laws, compensation mechanisms, and administrative categories together define how flood risk, scarcity, and environmental protection are allocated across space and among populations (Biswas, 1992; Malik, 2015; Sidhu & Chopra, 2022). As a result, legal institutions can be considered hydrological agents on equal footing with dams, canals, and rivers, producing distributions of exposure through legal decisions regarding infrastructure, resource allocation, and disaster management. This means that legal hydrology adds to biopolitics and hydropolitics the understanding that the governance of water is at the same time the governance of law, as legal rules constitute the hydrological reality they govern.

This governance structure also illustrates both biopolitical and hydropolitical rationalities in operation. Biopolitically, state regulation over life occurs through the management of populations, cropping cycles, and resources, making water management an instrument of economic regulation and social discipline (Foucault, 2008). The Punjab Preservation of Sub-soil Water Act 2009 is a good illustration. Rather than assigning volumetric entitlements, the Act controls conduct through time-regulated rules of transplanting that govern agricultural practice and synchronise biological cycles with hydrological necessities (Sidhu & Chopra, 2022). In the process of such temporal control, farmers' discretion, crop calendars, and risk exposures are subject to state control, inscribing the state into the everyday reproduction of agrarian life.

Hydropolitically, the inter-scalar architecture of treaties, tribunals, and technical institutions from the Indus Waters Treaty and Water Apportionment Accord to the Ravi-Beas tribunals and Sutlej-Yamuna Link litigation transmutes rivers into administrative and geopolitical artefacts (Biswas, 1992; Malik, 2015; Singh, 1992). These regimes formalise negotiation and surveillance through data exchange, modelling, and monitoring of compliance, enabling the state to manage uncertainty through rule-governed procedures rather than local ecologies (Ahmad et al., 2023; Hassan et al., 2019; Sud & Kashyap, 2001). Such hydropolitical orders convert hydrological variability into a domain of power, where the capacity to define baselines, allocate shares, and enforce rules reflects underlying asymmetries of geography and infrastructure. Together, these dynamics show how governance in both Panjabs has shifted from water as a communal and ecological resource to water as a biopolitical instrument and hydropolitical strategy, in which managing flows, scarcity, and floods also entails managing populations, productivity, and political order (Foucault, 2008).

Conclusion

The historical trajectory of water governance in the two Panjabs reveals that flooding, irrigation, and scarcity are not merely hydrological phenomena but

outcomes of legal, bureaucratic, and infrastructural control. From colonial canalisation to post-Partition treaties and modern accords, water has been transformed from a shared ecological resource into an administrative object managed through the logics of regulation and measurement. Instruments such as the Indus Waters Treaty, the Bhakra–Beas Management Board, and the Water Apportionment Accord show how power has been institutionalised through treaties, technical committees, and data-based surveillance. These arrangements create differentiated exposure and protection, where infrastructural position determines whose land is irrigated and whose fields are inundated.

Biopolitically, laws such as the Punjab Preservation of Sub-soil Water Act 2009 exemplify how governance reaches into the biological and economic lives of farmers by regulating cropping calendars and synchronising agricultural activity with hydrological priorities (Sidhu & Chopra, 2022). Hydropolitically, the design of treaties, tribunals, and rule curves demonstrates how the state uses technical instruments to manage uncertainty and preserve authority across scales (Biswas, 1992; Malik, 2015). Thus, flooding in Panjab cannot be reduced to a “natural disaster,” as it reflects the persistent operation of biopolitical and hydropolitical power, in which control over water equates to control over populations, productivity, and territory. Recognising this genealogy is essential to any just and transparent reform of flood governance: one that re-centres ecological integrity, local discretion, and equitable risk-sharing within the waters of control.

This article has argued that these developments are best understood through the concept of legal hydrology, which explains how law, infrastructure, and bureaucratic practice jointly produce hydrological vulnerability. In doing so, it extends existing scholarship on both biopolitics and hydropolitics by demonstrating that legal institutions are not merely instruments for regulating water after environmental events occur but are constitutive of the uneven geographies of flooding themselves.

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