Ghosh, Nilanjan; Ghosh, Ambar Kumar

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Revamping water governance in India : the pathway to a new national water policy

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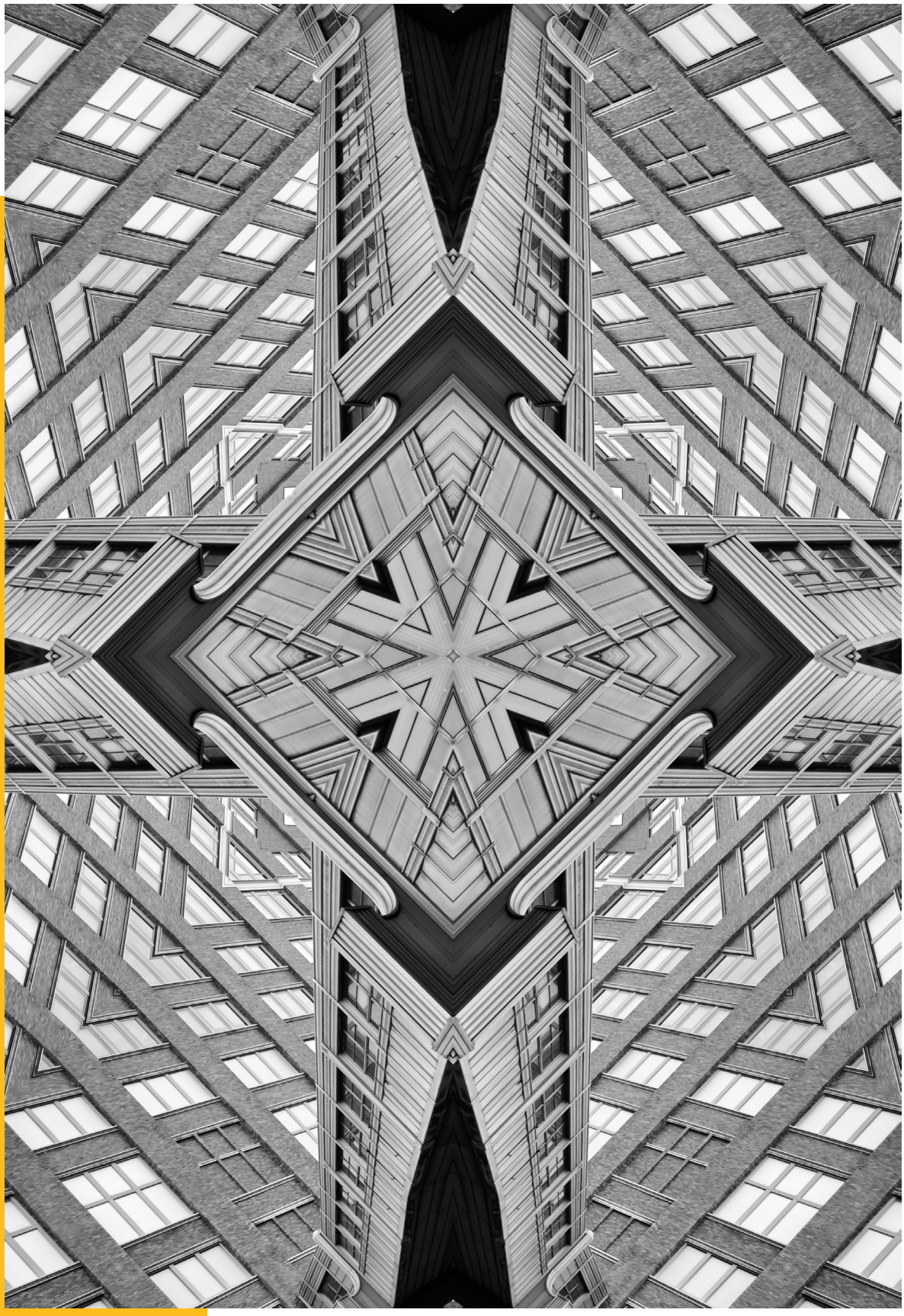

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Revamping Water Governance in India: The Pathway to a New National Water Policy

Nilanjan Ghosh and Ambar Kumar Ghosh

Abstract

Despite the call for a global paradigm shift in water governance—from the traditional reductionist engineering approach to the more holistic integrated river basin governance framework—a change is not yet perceptible in India's water governance architecture. The hesitation to change has led to ecological problems and conflicts at various levels. This paper identifies the knowledge gaps that inhibit the paradigm shift and explores the lacunae in the existing institutional mechanisms and statutes. It attempts to chart a path to combat the emerging challenges in water governance in India by identifying the broad contours of a new national water policy.

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Introduction

Water governance faces a multifaceted challenge due to the elusive nature of water, which transcends boundaries. Though the traditional definition of "transboundary waters" entails waters crossing international political borders, state-of-the-art definitions broaden the scope of the notion to include waters crossing any form of boundary, ranging from the international level to the smallest societal units and sectoral divisions.[1] This expanded perspective includes interstate waters within a country. Notably, the latest manifestation of transboundary water conflicts arises between the economic and ecosystem sectors over water allocation.[2] Human interventions, driven by the pursuit of short-term economic gains, often disrupt flow regimes, resulting in significant downstream ecosystem losses.

Despite recognising river basins as optimal natural units for planning and managing surface water resources,[3] there is a pervasive historical tendency to fragment basins into separate units for governing the river systems. This fragmentation has two origins: first, it makes managing the resources easier, and second is the respect for political or geographical jurisdictions.[4] This is a reductionist approach of treating water as a mere stock of resources within a region to be used for human convenience as per the need.[5] The frequent disputes over water resources between Indian states, as well as between the central and state governments, can be attributed to this reductionist approach and the decentralised governance structure inherent in the federal nature of the Indian democracy.[6]

India encompasses 25 major river basins and 103 sub-basins, many extending across multiple states. Each riparian state claims jurisdiction over these basins by the federal distribution of powers outlined in the Indian Constitution.[7] The conflicts arising from utilising water resources stem from the fragmented governance of a naturally interconnected water system rather than being solely driven by the physical scarcity of the resource.[8] The decentralisation of authority over water use to the state level has led to intense political disputes, characterised by conflicting perceptions of property rights concerning transboundary waters.[9] This approach of fragmented water governance is inextricably linked to the dominance of traditional structural interventions and a reductionist approach in water

Introduction

governance that has defined India's water management architecture. This has shaped the evolution of hydrological projects, the management of water resources for irrigation networks that are linked with the country's food security measures, and the management of interstate water resources and potential disputes between states.

This paper identifies the knowledge gaps that inhibit the paradigm shift and explores the lacunae in the existing water-related institutional mechanisms and statutes. It also attempts to chart a path for combating the emerging challenges of water governance in India by identifying the broad contours of a new national water policy.

> "The conflicts arising from utilising water resources stem from the fragmented governance of a naturally interconnected water system rather than being solely driven by the physical scarcity of the resource."

Paradigms of Water Governance

India and other countries worldwide are experiencing a conflict concerning two contrasting paradigms of water governance[a]—between choosing traditional structural interventions rooted in colonial-era engineering and adopting a more comprehensive and holistic water management system. This conflict emerged as Western nations recognised the detrimental effects of extensive dam construction and structural interventions, which were found to fragment river systems and cause irreversible damage to ecosystems on a basin scale. In 2000, the European Union (EU) responded to this by adopting the Water Framework Directive, leading to the decommissioning of numerous dams across Europe. Since then, approximately 5,000 such structural interventions have been dismantled in countries like France, Sweden, Finland, Spain, and the UK.[10] The directive also requires EU member states to enhance the ecological conditions of water bodies, resulting in a shift towards restoring natural hydrological flow regimes by maintaining water instream. Similarly, in the US, which experienced significant dam construction between the 1920s and 1960s, over 1,000 such structures have been dismantled in recent decades to rejuvenate basin ecosystems.[11]

India, however, has yet to truly embrace the transition to Integrated Water Resource Management (IWRM).[b] India's hydro-technocratic sector has continued to abide by outdated concepts of water resource development, prioritising immediate economic gains even at the expense of neglecting long-term sustainability issues. Furthermore, there has been resistance to any departure from the existing status quo.[12]

Still, over the last decade, India has undertaken specific initiatives to adopt a comprehensive water governance framework. In 2016, two bills were proposed (the Draft National Water Framework Bill and the Model Bill for the Conservation, Protection, Regulation, and Management of Groundwater), and a report titled *'A 21st Century Institutional Architecture for India's Water Reforms'*[13] was published. All three were drafted by committees chaired by economist and water and rural development expert

a Here, the term paradigm is used in the manner referred to by Kuhn (1969) while explaining changes in the structure of scientific knowledge in general. See Thomas Kuhn, The Structure of Scientific Revolutions. (Chicago: University of Chicago Press, 1969).

b IWRM focuses on demand management, keeping water instream, and ecosystem restoration.

Mihir Shah.[c] In 2019, the Ministry of Jal Shakti set up a committee of independent experts led by Shah to draft a new National Water Policy. Despite the report being submitted in 2021, the draft policy is yet to be tabled for consideration in parliament.

To be sure, the advancement of modern civilisation is characterised by humanity's capacity to construct larger engineering structures capable of altering water flow patterns through storage and diversion. The widespread use of large dams, accompanied by the implementation of more powerful pumping technologies to manage aquifers, enabled substantial control over surface water. These dams served the dual purpose of flood control and the generation of hydroelectric power and were beneficial during seasonal water shortages and in addressing disparities in water availability across regions. The introduction of irrigation canals facilitated the cultivation of crops in new areas and also extended the growing seasons for agricultural produce. Over time, water scarcity was predominantly viewed as *spatial*, with the idea that water could be diverted from water-rich zones to water-scarce ones through appropriate supply augmentation plans. For water to be distributed equitably, the supply should be expanded through interventions in the natural hydrological flows.[14] While these approaches successfully delivered increased water resources to regions facing scarcity, the challenges evolved into more than just mere water scarcity. Pursuing a strategy solely focused on intensifying interventions in the hydrological cycle became counterproductive, causing adverse effects on basin ecosystems. Research has established that the conventional 'business-as-usual' approach to water management is no longer sustainable, and will likely result in significant stress and provoke conflicts among stakeholders.[15] Instead, the narrow and engineering-focused water governance paradigm should be replaced by a fresh, holistic, and interdisciplinary approach (the IWRM[d]).[16]

c Shah is also a former member of the erstwhile Planning Commission.

d The Global Water Partnership defines IWRM as "… a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment". With the three pillars of IWRM being social equity, economic efficiency and environmental sustainability, it presents a set of guiding principles to promote a holistic governance of water at various scales including those of the basins.

Integrated Water Governance at the Basin Scale

Acknowledging that a comprehensive approach is essential for water management and the governance of river basins,[17] many countries have enacted policies to decommission dams and implement alternative approaches to preserve river waters. For instance, Australia has established water markets over the Murray-Darling Basin, which is regulated by the Murray-Darling Basin Authority. This enables farmers to enhance water productivity and contribute to sustainable water management.[18] In Chile, the National Water Code (1981) established a transferable system of water rights independent of land use and ownership. Water markets in Chile often involve transactions such as the 'renting' of water between neighbouring farmers with different water needs.[19] In December 2019, water derivatives trading have commenced at the Chicago Mercantile Exchange to mitigate water availability risks in the western US.[20] This marked a noteworthy shift towards demand management following years of structural interventions that impacted river courses in the western US.[21]

However, India has yet to put in place any such market practices. Although academic literature has discussed water markets as an important institution for demand management in India during scarcity,[22,23] there are debates on whether water future markets will be beneficial in the Indian context.[24,25] In 2022, reports suggested the NITI Aayog planned to place a draft recommendation paper of various instruments for water trading in bourses in the public domain for consultations; spot trading, derivative instruments like futures trading, and tradable licences were some of the instruments under consideration.[26] Currently, the NITI Aayog has presented a document on exchanging treated wastewater rights and entitlements through a transparent platform.[27] The pivotal role of water markets is efficient price discovery that can reflect on the *scarcity value* of the resource. This is never the case, with ad-hoc water charges often set by governments or water regulators. Water demand management can happen efficiently only when the market price signals the physical availability or future scarcity. This presents a clear case for India to consider such markets for efficient water governance.

Integrated Water Governance at the Basin Scale

The key here is recognising the necessity for the systems approach[e] to water governance, encompassing both general water management and, more specifically, the governance of river basins. River basins operate as integrated systems where every component is interconnected, and alterations in one part can affect others across both space and time. These alterations may arise from either natural processes or human activities.[28] River flows encompass not only water with dissolved chemicals, particularly in the conditions observed in India, but also carry sediments, energy, and biodiversity. Disturbing any of these elements will have repercussions on all others. Activities occurring in one segment of the basin, such as the disposal of wastewater or the deforestation of watersheds, will impact all downstream areas.[29] For instance, the construction of the Farakka barrage on the lower Ganges in India, established in 1975, has impeded sediment flow into the delta, thereby limiting soil formation. The sediment accumulation behind the barrage has also been linked to subsequent flood damages in Bihar.

While the principles of an integrated approach on a basin scale continue to develop, the following summarised points (based on existing literature) are key:[30]

- Water should be perceived as a dynamic element integral to the eco-hydrological cycle, rather than merely a stock of material resources to be utilised based on human needs and convenience.

- Economically, water possesses value in all its competing uses, including those for ecosystems, which should be acknowledged by valuing ecosystem services associated with water and flow patterns. Consequently, water should be recognised as an economic asset within a broader ecological-economic framework. Socially, this recognition should not overlook affordability and equity criteria.

- The river basin should serve as the primary unit of governance.

e The systems approach acknowledges the inter-relation and inter-dependency of various sub-components of an integrated system. It is only through a dynamic interaction of the inter-related and interdependent the unitary yet complex whole of the system is delineated. This is exactly the situation of a water system or a river basin, where an intervention at one part of the system can cause severe perturbations in other parts.

- The continual increase in water supply is not a prerequisite for sustained economic growth or food security. Instead, emphasis should be placed on exploring water-saving technologies.
- There is a necessity for a comprehensive evaluation of water development projects within the framework of the entire hydrological cycle.
- A transparent and interdisciplinary knowledge base is essential for understanding the social, ecological, and economic roles played by water resources.
- Droughts and floods should be considered within the broader context of associated ecological processes.
- An integrated approach to policymaking, decision-making, and cost-sharing is crucial across various sectors in the basin, including industry, agriculture, urban development, navigation, and ecosystems. Poverty reduction strategies should be considered.
- It is important to establish a robust foundation and repository of multidisciplinary knowledge about the river basin and the natural and socioeconomic forces influencing it.
- Gender considerations are vital, as highlighted in the Dublin Statement,[f] which recognises that "women play a central part in the provision, management, and safeguarding of water."[31]

While these points are merely indicative and not exhaustive and can be refined further with disciplinary progress, they provide the foundational elements for shaping the contours of the emerging paradigm.

f The Dublin Statement on Water and Sustainable Development (also known as the Dublin Principles) is the declaration following a meeting of water professionals and experts on global water problems in January 1992 at the International Conference on Water and the Environment in Dublin, Ireland. The statement acknowledges that the increasing water scarcity results from the different competing uses and overexploitation of water, which is often treated as a free and abundant resource.

Tracing the Genesis of the Problem

Water conflicts in India can be attributed to the narrow perspective that guides plans for increasing water supply that are driven by traditional engineering and neo-classical economic thinking. This reductionist approach, termed as 'arithmetic hydrology,' simplifies governance challenges and their resolutions into a few numerical values, neglecting crucial variables and resulting in subsequent water management issues.[32] Environmental security concerns in India regarding transboundary Himalayan waters have largely arisen from this reductionist thinking, influenced by the structural engineering paradigm introduced by British colonial engineers who had limited knowledge of water dynamics in the Himalayan terrain.[33] The application of a uniform technology in water resource planning and management, devoid of the broader sustainability science, has been a major cause for concern.[34] This approach has been a defining feature of the existing water technocracy in India (discussed in subsequent sections).

For instance, the proposed river link project is an example of the reductionist 'arithmetic hydrological' paradigm, emphasising mechanisms for increasing water supply to address water scarcity. The project involves the establishment of a comprehensive system for storage and long-distance water transfer, primarily from the perceived "water-surplus" Ganges-Brahmaputra-Meghna basin to the "water-deficit" peninsular river basins. This includes constructing nine large dams, 24 small dams, and excavating approximately 12,500 km of canals. The classification of "surplus" and "deficit" river basins[g] was derived from an unpublished document by A.D. Mohile, former Chairman of the Central Water Commission,[35] as adopted by the National Commission for Integrated Water Resources Development Plan.[36] However, the project lacks scientific validity in terms of sustainability, equity,[37] and ecological-economic viability.[38] Beyond concerns about the ecological and cost-related implications that may exacerbate interstate water disputes, there are apprehensions that the project could worsen the international hydro-political situation in South Asia.[39]

g The methodology simply concerns itself with a few numbers on the supply side depending on 50-75 percent dependability, and maps these with economic demand without any concern for the broader ecosystem needs or flows needs.

Tracing the Genesis of the Problem

Hydropower Projects in the Himalayas

Major calamities in the state of Uttarakhand in the Himalayas in 2013 and 2021 have prompted questions about the prudence of constructing hydropower projects in a seismic-prone zone profoundly affected by global warming. The exclusive focus on exploiting hydropower, driven by short-sighted economic gains, often leads to a complete disregard for potential threats that manifest as social costs, exacerbating the impact of disasters and resulting in loss of lives and properties. Scientists have long warned about the risks associated with glacial melt and the implementation of development projects in such regions.[40]

This holds true for numerous hydropower projects in the Himalayas. While multipurpose projects are frequently conceptualised for flood control, storage facilities in upstream hydropower reservoirs, employment generation, and boosting services and tourism, they inevitably incur broader and long-term ecological costs.[41] Structural interventions alter flow patterns, trap sediments, disrupt ecosystem structures and functions, and ultimately affect ecosystem services. These services significantly impact downstream livelihoods, with many impoverished populations relying on them.[42] These costs are often omitted from the initial cost-benefit analysis of projects; if considered, such projects will likely be deemed unfeasible.

Several documented instances[43] illustrate how the unchecked construction of successive hydropower projects along the Teesta River (a Brahmaputra River tributary) has severely impacted the river.[44] The substantial decrease in dry season flows and the ensuing water conflict between Bangladesh and India can be attributed to the presence of over 25 hydropower projects in Sikkim and West Bengal. Despite claiming to be 'run-of-river,' these projects lead to a decline in water flow during lean seasons, necessitating the storage of water for extended periods to operate turbines and generate hydropower. This not only renders investments in hydropower economically unviable, resulting in numerous private players exiting the market, but also disrupts the integrity of the flow regime, degrading the basin ecosystem's structure, processes, and functions.[45]

Tracing the Genesis of the Problem

Interstate Water Governance and Conflictual Federalism

Interstate (river) water disputes are a persistent challenge for federal water governance in India. Indeed, India's interstate rivers have become sites of contestation, fuelled by conflicting perceptions of property rights, flawed economic instruments for food security, the lack of an integrated ecosystems approach, and the prevalence of reductionist hydrology for water resource development.[46] Such conflicts over the possession and control of river water have persisted since the inception of the Indian republic, with prolonged delays in resolution due to historical, institutional and political factors.[47] Federalism is a foundational and unalterable principle of the Indian nation.[48] In the established federal structure, legislative powers related to water are divided between the central government and the states, aiming to ensure the optimal utilisation of this valuable resource while balancing state interests. Schedule VII of the Indian Constitution delineates the distinction between intrastate water use and the regulation of interstate waters. It grants authority to the parliament (Entry 56 of List I—Union List) to enact laws for regulating interstate rivers, while states retain the prerogative to determine water usage for purposes such as supply, irrigation, canals, drainage, embankments, water storage, and waterpower (Entry 17 of List II—State List), subject to the provisions of Entry 56 of List I.

Traditionally, the justification for this arrangement is based on the understanding that interstate rivers transcend political or administrative boundaries, preventing any state from claiming exclusive rights at the expense of others. However, it is crucial to note that while the Union List explicitly mentions 'interstate water,' the State List uses the term 'water' without specifying 'intra-state'. Consequently, states possess full legislative authority over matters in Entry 17 of List II, even if the river source or tributaries extend into another state.[49] This authority can only be overridden by parliament through legislation in the broader public interest. The lack of clarity in the constitutional framework allows the states substantial control, limiting parliament's enforceability, even for interstate rivers.

Tracing the Genesis of the Problem

Consequently, the Union government has generally refrained from proactively adopting a basin-wide approach and has instead relied on ad-hoc methods for dispute resolution. The absence of a reliable policy mechanism for interstate collaboration can be attributed to a policy ecosystem geared towards contingency-driven responses.[50] Notably, acts such as the Inter-state River Water Disputes Act, 1956, have been amended and used frequently, while others like the River Boards Act, 1956, which empowers the Centre to establish boards for interstate cooperation, remain untouched. The existing constitutional ambiguity and the prevailing policy environment undermine confidence in interstate cooperation, as the Union government hesitates to exercise its constitutional role in regulating interstate waters. This situation is characterised as 'conflictual federalism of interstate water,' hindering the adoption of an integrated river basin management approach as the primary framework for river basin governance in India.[51]

In 2019, the Lok Sabha approved an amendment to the long-standing Inter-state River Water Disputes Act, aimed at expediting the dispute resolution process by establishing a specific timeframe for completing adjudication and subsequent referral. Additionally, it granted the central government the authority to create a dispute resolution committee to facilitate effective negotiation before the dispute is referred to an interstate river water disputes tribunal. The tribunals also underwent significant changes, becoming a permanent fixture in the country's judicial landscape, with multiple benches across the country. Furthermore, the amendment envisioned enhancing adherence to the tribunal's awards by making them final and binding on the disputing parties. It also mandated the central government to develop schemes to implement these decisions.[52] This amendment addresses various shortcomings in the adjudication and dispute resolution process to improve mechanisms to deal with interstate water disputes in India.

Tracing the Genesis of the Problem

Interstate River Disputes: Cauvery Water Conflict as a Case Study

The dispute over the Cauvery basin involving Karnataka and Tamil Nadu reflects the disjointed and incremental approach of India's water governance structure.[53] The designation of water as a state subject in the Indian Constitution contributes to the fragmented utilisation of the basin, intensifying the conflict, a phenomenon termed as "conflictual federalism."[54] A more in-depth economic analysis indicates that the rising minimum support prices, favouring the cultivation of water-intensive paddy, have further escalated the competition for water between these two states.[55] The 2007 award by the Cauvery Water Tribunal (CWT) exemplifies what is known as 'arithmetic hydrology'. In February 2018, a Supreme Court ruling introduced some alterations to the water allocation between the states. This adjustment acknowledged urban water usage by reducing the annual allocation of Cauvery Waters for Tamil Nadu from 192 TMC to 177.25 TMC. The remaining 14.75 TMC was then assigned to Karnataka to cater to the needs of an expanding Bengaluru. While, to some extent, this ruling emphasises the need for improved agricultural water management in Tamil Nadu, the fundamental structure of the CWT award remains largely unchanged, and the underlying issues related to the ecosystem remain unaddressed.

The award, in its evaluation, neglected to account for the changing precipitation patterns in South Asia, impacting the seasonality and volume of flows in the Cauvery basin.[56] The viability of the proposed schedule recommending increased releases during July-September is questionable, considering the potential for greater variability in precipitation patterns. From the standpoint of an integrated basin governance approach, the allocations for "quantity reserved for environmental protection" (10 TMC) and "quantity determined for inevitable escapages to the sea" (4 TMC) raise concerns. These allocations do not seem to align with any scientific assessment of ecosystem-based water use, and appear to be arbitrary. The award appears to overlook the growing global literature on environmental flows and the benefits of free-flowing rivers, which are increasingly recognised as essential components of integrated basin governance.[57]

Tracing the Genesis of the Problem

The Supreme Court's directive to establish the Cauvery Water Management Authority/Board (CWMA) in line with the CWT's final order should also be scrutinised. The design of the CWMA, as outlined in the 2007 CWT award, lacks acknowledgment of the multidimensionality of the basin system and the formation of a multidisciplinary team with both disciplinary expertise and inter-disciplinary understanding of river basins. According to the award, the composition of the CWMA leans heavily towards engineering professionals, including the full-time chair, an irrigation engineer of chief engineer rank, and the secretary. This mono-track and mono-disciplinary composition contradicts global best practices, emphasising the necessity of a multidisciplinary approach to water governance.[58] Scientific research underscores that complex issues such as the Cauvery dispute cannot be resolved solely through traditional engineering and agricultural solutions, as proposed by the CWT. Instead, it necessitates the inclusion of various stakeholders at different levels, including those representing ecosystems, to adopt a bottom-up approach, akin to the Mekong River Commission.[59]

Gaps in Food Security Definition and Irrigation Networks

In the context of food security, India's approach has also been resource-intensive, primarily relying on reductionist engineering-based strategies for supply augmentation. Initiatives like the Green Revolution in the late 1960s, the introduction of the minimum support price (MSP) mechanism in the late 1970s, and government procurement policies framed food security through the lens of the production and procurement of major water-consuming foodgrains, specifically rice and wheat. While the Green Revolution resulted in increased yield levels, the MSPs for rice and wheat were raised at a much faster rate than the less water-consuming millets, aiming to promote their production and facilitate procurement. The MSP functioned as a financial derivative instrument for hedging, acting like a "put option".[60] In the event that prices fell below the MSP, there was the option to sell rice/wheat to the state at the MSP. Over time, MSP evolved into the "floor" price-setter for rice and wheat. Whenever the Commission for Agricultural Costs and Prices raised MSPs for rice and wheat, traders responded with higher bids, consequently raising market prices for these foodgrains.

Tracing the Genesis of the Problem

This shift in pricing dynamics significantly favoured rice and wheat over competing crops like millets, altering the terms of trade (defined as the ratio of prices between two competing crops) in favour of water-consuming staples. This led to the displacement of drier millets, which require only 10-20 percent of the water needed for paddy. This phenomenon was observed in various parts of India, such as the Krishna and Cauvery basins and the Upper Ganges in Uttarakhand and Uttar Pradesh. In these regions, irrigated wheat and/or paddy became the dominant crops during non-monsoon summer months, often produced as the third crop of the cropping year. This trend resulted in a substantial increase in groundwater extraction and surface water diversions.

While agricultural economists argue that irrigation in India is largely groundwater-dependent, it is essential to note that groundwater depletion due to overuse exerts pressure on surface flows. Simultaneously, it is frequently overlooked that groundwater feeds and sustains surface flows. In many parts of southern India, canal irrigation became widespread, adversely affecting surface flows. The Cauvery basin, for instance, experienced a significant expansion of agricultural area for summer paddy cultivation, fully irrigated, during the 1990s. Similar cases of water conflicts arose in regions like Haryana and Punjab, where high-yielding variety of water-intensive crops increased water demand, and in the transboundary Teesta river conflicts between Bangladesh and India, where the acreage of summer paddy extensively expanded. These examples illustrate how the 'agricultural economic' perspective, coupled with the reductionist engineering approach to water management through large irrigation projects, has heightened water conflicts. This is primarily due to a flawed vision of food security defined in terms of producing and procuring high-water-consuming and resource-intensive crops. This perspective contradicts global scientific literature and best practices, which argue that water and food security do not necessarily have a simple positive-linear relation.[61] Instead, there are several best-practice mechanisms of water management that can separate the two variables.[62]

Tracing the Genesis of the Problem

In large parts of South Asia, agricultural expansions have led to widespread changes that degrade ecosystems and limit their capacity to provide critical services, including food provisioning.[63] The ecological foundation of the food system has been compromised by the extensive use of fertilisers and pesticides, which impair natural soil fertility in many regions of North and South India. Additionally, large constructions impede the sediment-carrying capacity of rivers, affecting the natural soil formation function of ecosystems.[64]

> "There is a flawed vision of food security defined in terms of producing and procuring high-water-consuming and resource-intensive crops. This perspective contradicts global scientific literature and best practices, which argue that water and food security do not necessarily have a simple positive-linear relation."

The Need for an Integrated Approach

The current water governance paradigm, which relies on structural interventions to control water flows, is no longer sustainable. The prevailing water technocracy seems unwilling to implement policy reforms, and efforts to bring about change face resistance from those advocating for the status quo.[65] This resistance is evident in the reception of recent calls for change, such as the recommendations outlined in the 2016 report '*A 21st Century Institutional Architecture for India's Water Reforms*'[66,67] The report recommended establishing a multidisciplinary National Water Commission and emphasised the greater involvement of social scientists and professionals from management and other specialised disciplines. However, these recommendations met with strong criticism from the existing water technocracy.[68] Understanding this resistance requires considering deeply ingrained visions of structural interventions to govern rivers, dating back to India's colonial era. The establishment of Thompson Engineering College at Roorkee (now IIT Roorkee) during the British era propagated the vision of "training the river," and this legacy persists in civil engineering departments across India. Early British projects like the Sarada Barrage, flood control of the Kosi, and the Upper Ganges Canal near Roorkee altered the flow regime of river systems, causing irreversible changes in the basin ecosystem structures.[69]

Concerns were initially raised about the feasibility of the Farakka barrage project in West Bengal, questioning its ability to achieve the intended objective of flushing out sediments to revitalise the Kolkata Port and the associated ecosystem problems. These apprehensions proved accurate, as the Farakka has become a point of contention between Bangladesh and India. The structure is also accused of trapping sediments and hindering the soil resuscitation process of the Ganges delta.[70] However, those in the Indian technocracy who opposed the construction in the early stages were marginalised by the previous administration, leading to the continuation of this legacy.[71] Also, the fragmented nature of federal water governance architecture aggravated interstate water conflicts, which are long-standing challenges for integrated and amicable water governance in India.

Towards a New National Water Policy

In November 2019, India's Ministry of Jal Sakti set up a committee to draft a new water policy. A marked departure from past committees, this was an independent committee of experts beyond direct governmental control, and tasked with recommending innovative policies towards a more effective water governance regime in India. The committee received suggestions from various water governance stakeholders, indicating the need for a paradigm shift in water governance from the traditional constructionist thinking based on structural engineering to a more grounded, realistic and holistic thinking to combat the newer challenges of the twenty-first century.[72] The committee submitted its report in 2021, pushing strongly to move beyond the command-and-control water governance policy towards a much-needed integrated model. Some of the key recommendations of the committee are as follows:

- The policy acknowledges the constraints of continually augmenting water supply and advocates a transition towards demand management. Most importantly, addressing India's water crisis hinges primarily on crop diversification. The policy recommends diversifying public procurement practices to include nutricereals, pulses, and oilseeds. These procured crops will play a crucial role in providing children nourishment through mid-day meals and the public distribution system to provide food grains to millions of citizens. Such a measure aims to encourage and incentivise the farmers to diversify their crop choices, leading to substantial water conservation. Additionally, establishing this link can contribute to addressing health challenges, such as malnutrition and diabetes, owing to the superior nutritional composition of these crops. In this regard, initiatives under the National Water Mission, such as the 'SahiFasal' campaign[73] to nudge farmers in water-stressed areas to grow crops that are not water intensive, are significant.

- Reduce-recycle-reuse should become the foundational blueprint to ensure integrated urban water supply and wastewater management. This includes ensuring proper treatment of sewage and the eco-restoration of urban river stretches by practising decentralised wastewater management. All non-potable uses of water, such as

flushing, fire protection, and vehicle washing, must compulsorily shift to treated wastewater.

- The policy recognises that the substantial quantity of water that is stored in dams is not being utilised for irrigational purposes. It suggested that deploying pressurised closed conveyance pipelines along with the Supervisory Control and Data Acquisition systems and pressurised micro-irrigation can help in expanding irrigated areas at an affordable cost. The policy also identifies improving the water quality as a key priority area. It proposes that the water ministries at the Centre and state levels include a water quality department to ensure the effective monitoring of the possible lapses that result in the dilution of water quality. The policy emphatically advocates for adopting state-of-the-art, low-cost, low-energy, and eco-sensitive technologies for sewage treatment. It also recommends creating a task force to monitor and develop a better understanding of probable water contaminants.

- Special focus needs to be given to ensuring the supply of water through "nature-based solutions" which are sustainable, such as the rejuvenation of catchment areas that can be incentivised through compensation for ecosystem services. Specially designed 'blue-green infrastructure,' such as rain gardens and bio-swales, restored rivers with wet meadows, wetlands constructed for bioremediation, urban parks, permeable pavements, and green roofs are some of the recommended innovations for urban areas.

- The policy prioritises the sustainable and equitable management of groundwater with special emphasis on the participatory groundwater management. Sufficient information on aquifer boundaries, water storage capacities, and flows should be lucidly provided to all the stakeholders, designated as custodians of their aquifers. In this direction, the Central Ground Water Board has undertaken an Aquifer Mapping and Management Programme during the XII Plan, under the Ground Water Management and Regulation scheme, aimed at delineating aquifer disposition and their characterisation to prepare aquifer/area-specific groundwater management plans with community participation.[74]

Towards a New National Water Policy

- Predominantly, water policy in India has taken a majorly instrumentalist view of the rivers, catalysing its precipitous degradation over the years. Invoking the reverential relationship that the people of India historically have with the rivers, the new national water policy gives high priority to the imperative of river protection and revitalisation. It recommends several initiatives to restore river flows, such as the revegetation of catchments, regulation of groundwater extraction, river-bed pumping, and the mining of sand and boulders. It also advocates for drafting a Rights of Rivers Act that should include their right to flow, to meander, and to meet the sea.[75]

- Government departments at the central and state levels work in a compartmentalised manner without the much-required communication and consultation that effective water governance in a diverse federal landscape demands.[76] Institutional reforms to ensure greater synergy, coordination, and information-sharing between various governmental departments dealing with irrigation and drinking water, surface and groundwater, and wastewater is a crucial prerequisite to ensure an integrated and efficient water governance infrastructure in India.[77]

- The crux of the problem with water governance is the fragmented nature of administrative design, which is further aggravated by federal conflicts over water management. A holistic and integrated planning formulated on the ecosystems-based approach calls for greater vertical federal coordination between the Centre and the states, and horizontal coordination among the states. In addition to the creation of stronger institutions of governance, federal cooperation entails an interplay of politics since river basins are as much a political unit as they are a natural one. The course of litigation and adjudication for resolving water disputes can become extremely adversarial between conflicting states, which can result in either non-implementation or delayed/ improper implementation of the tribunal or court verdicts. As such, *federal consensus* at the institutional level[78] remains crucial for amicable and coordinated water governance in India. Also, regarding sensitive

issues like interstate river disputes, the federal consensus is often predicated upon the *electoral consensus*, which is seeking resolution of the dispute at the site of mass politics. Therefore, consensus-building, based on sustained political deliberation, must be carried out in an institutional environment that guarantees a fair representation for the states and also an adequate voice for their concerns in a bipartisan spirit, with the Centre playing the crucial coordinating role.[79]

- The new policy also recommends the creation of a unified multidisciplinary, multistakeholder National Water Commission, which would become an exemplar for states to follow. Government water departments primarily include only professionals from the civil engineering, hydrology, and hydrogeology fields. However, to foster an integrated, transdisciplinary, and multidimensional approach to water governance, interaction with other crucial experts in water management, social mobilisation, agronomy, soil science, hydrometeorology, public health, river ecology, and ecological economics is extremely important. Building durable partnerships with the primary stakeholders of water by including them in the consultation of institutional mechanisms, along with drawing from the sustainable indigenous knowledge of water conservation, are also key recommendations for a resilient water policy in India.

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Conclusion

Structuralist interventions during the colonial and post-colonial periods largely neglected important considerations, including eco-hydrology (which involves treating floods and droughts as integral components of the eco-hydrological cycle), hydro-meteorology (which involves understanding the relationship between meteorological variables and extreme events), seismic science (which involves making structures resistant to earthquakes), and holistic WEBS perspective of river systems, acknowledging that a river system is not just a flow of water (W) but a dynamic equilibrium of flows of sediments (S), energy (E), and water to sustain basin-scale biodiversity (B).[80]

Notably, the global shift from traditional construction-focused engineering to IWRM is not without conflicts, and this is true for India as well. The IWRM's principles, while still evolving and not comprehensive, serve as guidelines at various levels. The dynamic nature of IWRM, as outlined in this paper, allows for continuous updates, enhancements, and revisions to adapt to the increasingly complex challenges of water governance. Hydrologist Malin Falkenmark's definition of IWRM emphasises the integration of land, water, and ecosystems, aiming to balance social equity, economic efficiency, and environmental sustainability.[81] Given the risks of global warming and climate change, the integration must consider these threat points. As such, integrated water management at the scale of the river basin needs to consider the adaptation capacity of the basin ecosystem, given the pressures created by climate change (whether changes in the hydrological cycle caused by glacial melt, or land subsidence at the mouth caused by depleting freshwater flow and simultaneous rise in the sea-level). The IWRM calls for integration at all levels (temporal, sectoral, and spatial) and across various disciplines, keeping the challenges in view.

However, there is some global resistance to the IWRM, primarily because it is perceived as overlooking the political aspects of water management, which involve contestation, conflict, and negotiation. Critics argue that the IWRM neglects social complexities, institutional contexts, and power dynamics, reducing the water management discourse to a simplistic model, and ignoring the realities of politics and power.[82] These criticisms, although highlighting contradictions in various theoretical frameworks, often fail to offer practical alternatives for policy development. It is

Conclusion

important to recognise that IWRM is not a rigid operational framework but a flexible guide for the evolving field of water governance, adaptable to new knowledge and changing circumstances over time.

Critics consistently draw from seemingly conflicting discourses stemming from diverse theoretical paradigms, yet they fail to present constructive policy alternatives to IWRM. Consequently, global water policy documents often outline their guidelines within the broader principles outlined by IWRM. The EU Water Framework Directive also recognises the central role of IWRM. In countries like South Africa, Australia, and Russia, significant attention has been devoted to addressing social and ecological concerns within the context of water governance, acknowledging the intricate trade-offs between competing water uses within an integrated framework. This underscores the necessity for a systems approach to water governance, particularly in river basins, where each component responds to changes in other parts over both space and time.

Notable instances include influential policy documents in India as well. The National Water Mission 2009, one of the eight missions established under the National Action Plan for Climate Change, emphasises action points, including promoting basin-level integrated water resources management. However, this concept seems lacking in practical implementation within the water technocracy in India. On the other hand, the idea of a multidisciplinary approach to water governance, as proposed in the 2016 draft bills and report ('A 21st Century Institutional Architecture for India's Water Reforms'), appears to align well with the Ministry of Jal Shakti. The recommendations laid down by the 2019 committee on the new national water policy provide an opportune moment to replace the reductionist colonial engineering paradigm with a more interdisciplinary approach that combines engineering with social and ecological sciences. Whether the recommendations of the new water policy drafting committee can materialise to play a transformative role in this ongoing paradigm shift towards an integrated approach to water governance in India remains to be seen.

Nilanjan Ghosh *is Director of ORF's Centre for New Economic Diplomacy, and ORF Kolkata.*
Ambar Kumar Ghosh *is an Associate Fellow at ORF Kolkata.*

Endnotes

1 Heather. L. Beach et al., *Transboundary freshwater dispute resolution: Theory, practice, and annotated references* (New York: United Nations University Press, 2000)

2 Nilanjan Ghosh, "Challenges to Environmental Security in the Context of India–Bangladesh Transboundary Water Relations," *Decision* (Springer) 42, No. 2 (April 28, 2015): 211–28 https://doi.org/10.1007/s40622-015-0082-4

3 E. H. Lloyd, "Book Review," review of *Design of Water-Resource Systems: New Techniques for Relating Economic Objectives, Engineering Analysis, and Government Planning*, by Arthur Maass, *Journal of the Royal Statistical Society, Series A (General)* 126, No. 3 (1963): 480, https://doi.org/10.2307/2982245.

4 Chuck Howe, "The Return to the River Basin: The Increasing Costs of Jurisdictional Externalities," *Journal of Contemporary Water Research & Education* 131, No. 1 (May, 2009): 26–32, https://doi.org/10.1111/j.1936-704x.2005.mp131001005.x.

5 Jayanta Bandyopadhyay, "Criteria for a holistic framework for water systems management in India," in *Integrated water resources management: Global theory, emerging practice and local needs* (SAGE Publications Pvt. Ltd, 2006), 145–71, https://www.cabdirect.org/abstracts/20073119034.html

6 Sayanangshu Modak and Ambar Kumar Ghosh, "Federalism and Interstate River Water Governance in India," *ORF Occasional Paper*, January 2021, https://www.orfonline.org/research/federalism-and-interstate-river-water-governance-in-india

7 Harish Salve, "Inter-State River Water Disputes," in *The Oxford Handbook of the Indian Constitution*, ed. Sujit Choudhry, Madhav Khosla and Pratap Bhanu Mehta (Oxford University Press, 2017), 502–20. https://doi.org/10.1093/law/9780198704898.003.0028

8 Nilanjan Ghosh and Jayanta Bandyopadhyay, "A Scarcity Value Based Explanation of Trans-Boundary Water Disputes: The Case of the Cauvery River Basin in India," *Water Policy* 11, No. 2 (April 1, 2009): 141–67, https://doi.org/10.2166/wp.2009.017.

9 Nilanjan Ghosh, Jayanta Bandyopadhyay and Jaya Thakur, *Conflict over Cauvery waters: Imperatives for innovative policy options*, (New Delhi: Observer Research Foundation, 2018)

10 Q. Schiermeier, "Dam removal restores rivers," *Nature* 557, (2018): 290-91.

11 Wendee Holtcamp, "Fish return to undammed Elwha River," *Nature*, July 5, 2012, https://www.nature.com/articles/nature.2012.10948#:~:text=In%201992%2C%20after%20years%20of,in%20more%20than%20a%20century.

12 Nilanjan Ghosh, "New Hope for Water Governance," *Mail Today*, February 29, 2020

13 Mihir Shah et al, "*A 21st Century Institutional Architecture for India's Water Reforms*," Report submitted by the Committee on Restructuring the CWC and CGWB.

Endnotes

14 Kanuri Lakshmana Rao, *India's Water Wealth,* (New Delhi: Orient Longman, 1975)

15 *The Dublin Statement* (Geneva: WMO), 1992; William J. Cosgrove and Frank R. Rijsberman, *World Water Vision: Making Water Everybody's Business* (London: Earthscan, 2000); Peter H. Gleick, "The Changing Water Paradigm: A Look at Twenty-first Century Water Resources Development," *Water International*, Vol 25 (1) (2000): 127-38, https://doi.org/10.1080/02508060008686804; Sarah K. Jones et al., "Insights into the importance of ecosystem services to human wellbeing in reservoir landscapes," *Ecosystem Services*, 39 (2019), https://doi.org/10.1016/j.ecoser.2019.100987

16 Jayanta Bandyopadhyay, *Water, Ecosystems and Society: A Confluence of Disciplines*, (New Delhi: Sage Publications, 2000); Nilanjan Ghosh and Jayanta Bandyopadhyay, "A scarcity value-based explanation of trans-boundary water disputes: the case of the Cauvery River Basin in India," *Water Policy*, 11(2) (2009): 141-67.

17 Q. Schiermeier, "Dam removal restores rivers," *Nature*, 557 (2018): 290-91.

18 "Water Markets," *Murray-Darling Basin Authority*, Australian Government, June 2023, https://www.mdba.gov.au/water-use/water-markets.

19 R. Gazmuri, "Chilean Water Policy Experience" (paper presented at the *Ninth Annual Irrigation and Drainage Seminar,* Agriculture and Water Resources Department Washington DC: The World Bank, 1992); Robert Hearne and Guillermo Donoso, "Water Markets in Chile: Are They Meeting Needs?," In *Water Markets for the 21st Century. Global Issues in Water Policy*, ed. K Easter and Q Huang, Vol 11, (Dordrecht: Springer, 2014), https://doi.org/10.1007/978-94-017-9081-9_6

20 Nilanjan Ghosh, "Water futures market for the hydrological future of South Asia," *Expert Speak*, Observer Research Foundation, September 29, 2020, https://www.orfonline.org/expert-speak/water-futuresmarket-hydrological-future-south-asia/

21 Nilanjan Ghosh, *Economics of Hostile Hydropolitics over Transboundary waters: Scarcity Values and Interstate Water Conflicts in India and US,* (Saarbrucke: VDM Verlag, 2009)

22 Nilanjan Ghosh, "Water Scarce Economies and Scarcity Values: Can water futures trading combat water scarcity?," *Occasional Paper No. 342*, January 2022, Observer Research Foundation, https://www.orfonline.org/research/water-scarce-economies-and-scarcity-values/

23 Nilanjan Ghosh, "Conceptual Framework of a South Asian Water Futures Exchange," *Commodity Vision*, 4 (1), December 17, 2010: 8-18, https://www.indiawaterportal.org/articles/conceptual-framework-south-asian-water-futures-exchange-commodity-vision

24 Roopa Madhav and Aasheerwad Dwivedi, "Why India must be wary of trading in water futures," *Mint*, October 6, 2022, https://www.livemint.com/opinion/online-views/india-is-not-ready-to-trade-water-as-just-another-commodity-yet-11665074439986.html#:~:text=India%20is%20planning%20to%20start,of%20water%20and%20tradable%20licences.

Endnotes

25 Nilanjan Ghosh, "How liquid can water be? Possibilities with water derivatives trading in India," *India Today*, October 11, 2022, https://www.indiatoday.in/news-analysis/story/water-trading-futures-market-benefit-efficiency-sustainability-equity-issues-2283719-2022-10-11

26 Yogima Seth Sharma, "Niti Aayog Draft in the Works for Water Trading on Bourses," *The Economic Times*, September 22, 2022, https://economictimes.indiatimes.com/news/economy/policy/niti-aayog-draft-in-the-works-for-water-trading-on-bourses/articleshow/94506476.cms?from=mdr.

27 NITI Aayog, *Water Trading Mechanism To Promote Reuse Of Treated Wastewater*, Water and Land Resources Vertical: NITI Aayog, July 2023, https://www.niti.gov.in/sites/default/files/2023-07/Water-Trading-in-treated-waste-water-%26-role-of-regulatory-mechanism.pdf

28 Nilanjan Ghosh and J. Bandyopadhyay, "Sustaining the Liquid Mosaic: Longer Steps Needed," *Economic and Political Weekly* Vol 51, Issue no: 52, 2016: 20-24.

29 Jayanta Bandyopadhyay, "Towards a synergy-based approach to river basin governance," *ORF Issue Brief No* 308, Observer Research Foundation, August 27, 2019, https://www.orfonline.org/research/towards-a-synergy-based-approach-to-river-basin-governance

30 Nilanjan Ghosh, "Water, Ecosystem Services, and Food Security: Avoiding the costs of ignoring the Linkage," in *Low Carbon Pathways for Growth in India, ed. R Kathuria* (New Delhi: Springer, 2018), 161-76

31 "The Dublin Statement on Water and Sustainable Development," *International Conference on Water and the Environment (ICWE)*, Dublin, Ireland, organised on 26–31 January 1992, http://www.wmo.int/pages/prog/hwrp/documents/english/icwedece.html

32 Nilanjan Ghosh and Jayanta Bandyopadhyay, "Governing the Ganges and Brahmaputra: Beyond Reductionist Hydrology," *Occasional Paper No.273*, (New Delhi: Observer Research Foundation, 2020).

33 Nilanjan Ghosh, "Challenges to Environmental Security in the Context of India-Bangladesh Trans-boundary Water Relations," *Decision* (Springer) 42 (2), 2015: 211-28.

34 Nilanjan Ghosh and Anandajit Goswami, *Sustainability Science for Social, Economic, and Environmental Development* (Hershey, PA: IGI Global, 2014).

35 A.D. Mohile, "India's Water and Its Plausible Balance in Distant Future," Unpublished, 1998.

36 "National Commission on Integrated Water Resource Development Plan (NCIWRDP)," *Report of the working group on inter-basin transfer of water*, NCIWRDP, MoWR, New Delhi, 1999.

Endnotes

37 Jayanta Bandyopadhyay, *Water, Ecosystems and Society: A Confluence of Disciplines* (Sage India, 2009)

38 Yoginder K Alagh, Ganesh Pangare, and Biksham Gujja, *Interlinking of rivers in India: overview and Ken-Betwa link,* (Academic Foundation, 2006)

39 Jayanta Bandyopadhyay and Shama Perveen, "The interlinking of Indian rivers: Questions on the Scientific, Economic and Environmental dimension of the project," in *Interlinking rivers in India: issues and concerns*, ed. M.Q. Mirza et al., (Abingdon: Taylor and Francis, 2008).

40 Mujib Mashal and Hari Kumar, "Before Himalayan Flood, India Ignored Warnings of Development Risks," *New York Times*, February 8, 2021, https://www.nytimes.com/2021/02/08/world/asia/india-flood-ignored-warnings.html

41 Jayanta Bandyopadhyay, Nilanjan Ghosh, and Chandan Mahanta, *IRBM for Brahmaputra: Water Governance, Environmental Security and Human Well-being,* (New Delhi: Observer Research Foundation, 2016).

42 Nilanjan Ghosh, "Hydropower in the Himalayas: the economics that are often ignored," *The Third Pole,* March 29, 2018.

43 Nilanjan Ghosh and Jayanta Bandyopadhyay, "Governing the Ganges and Brahmaputra: Beyond Reductionist Hydrology," *Occasional Paper No.273*, September 2020, Observer Research Foundation, https://www.orfonline.org/wp-content/uploads/2020/09/ORF_OccasionalPaper_273_Ganges-Brahmaputraad1.pdf

44 Jayanta Basu, "The canal, the climate and the Teesta," *The Third Pole,* June 20, 2017, https://www.thethirdpole.net/en/climate/the-canal-the-climate-and-the-teesta/

45 Nilanjan Ghosh, "Hydropower in the Himalayas: the economics that are often ignored," *The Third Pole,* March 29, 2018.

46 Nilanjan Ghosh, Jayanta Bandyopadhyay and Jaya Thakur, *Conflict over Cauvery Waters: Imperatives for Innovative Policy Options*, ORF Monograph, September 2018, Observer Research Foundation; Nilanjan Ghosh and Jayanta Bandyopadhyay, "A scarcity value-based explanation of trans-boundary water disputes: the case of the Cauvery River Basin in India," *Water Policy,* 11(2), April, 2009: 141-167; Nilanjan Ghosh, "Sustaining the Liquid Mosaic," *Economic and Political Weekly 51(52)*, (2016): 20–24.; Nilanjan Ghosh, "From Reductionist to Holistic Paradigm: Combining Ecology, Economics, Engineering, and Social Sciences in a Transdisciplinary Framework for Water Governance," *Ecology, Economy and Society-the INSEE Journal, 1(2)*, July, 2018: 69–72.

47 Pyaralal Raghavan, "There has not been a final settlement on any interstate river water dispute since 1980," *The Times of India*, September 7, 2016, https://timesofindia.indiatimes.com/blogs/minorityview/there-has-not-been-a-final-settlement-on-any-inter-state-river-water-dispute-since-1980/

Endnotes

48 Risha Kulshrestha, "Kuldip Nayar v. Union of India and Ors. – Case Summary," *Law Times Journal*, September 14, 2018, https://lawtimesjournal.in/kuldip-nayar-v-union-of-india-and-ors-case-summary/#google_vignette; Shivangi Goel, "S.R. Bommai vs. Union of India," *Law Times Journal*, October 2, 2019. https://lawtimesjournal.in/s-r-bommai-vs-union-of-india/

49 Sarkaria Commission, *Chapter XVII: Inter-State River Water Disputes*, 1988 https://interstatecouncil.nic.in/wp-content/uploads/2015/06/CHAPTERXVII.pdf

50 Srinivas Chokkakula, "Interstate river water governance: shift focus from conflict resolution to enabling cooperation," *Centre for Policy Research*, June 13, 2019, https://www.cprindia.org/news/interstate-river-water-governance-shift-focus-conflict-resolution-enabling-cooperation

51 Nilanjan Ghosh, and Jayanta Bandyopadhyay, "Sustaining the Liquid Mosaic," *Economic & Political Weekly* 51, No. 52, December 24, 2016, https://www.epw.in/journal/2016/52/water-governance/sustaining-liquid-mosaic.html.

52 "The Inter-State River Water Disputes (Amendment) Bill, 2019," *PRS Legislative Research*, https://prsindia.org/billtrack/the-inter-state-river-water-disputes-amendment-bill-2019.

53 Nilanjan Ghosh, Jayanta Bandyopadhyay and Jaya Thakur, *Conflict over Cauvery waters: Imperatives for innovative policy options* (New Delhi: Observer Research Foundation, 2018).

54 Nilanjan Ghosh and Sayanangshu Modak. "Water Disputes in the Cauvery and the Teesta Basins: Conflictual Federalism, Food Security, and Reductionist Hydrology," In *Sustainable Development Insights from India: Selected Essays in Honour of Ramprasad Sengupta*, ed. Purnamita Dasgupta, Anindita Roy Saha and Robin Singhal (Singapore: Springer, 2021).

55 Nilanjan Ghosh, Jayanta Bandyopadhyay and Jaya Thakur, *Conflict over Cauvery waters: Imperatives for innovative policy options*, (New Delhi: Observer Research Foundation, 2018).

56 Nilanjan Ghosh, Jayanta Bandyopadhyay and Jaya Thakur, *Conflict over Cauvery waters: Imperatives for innovative policy options*,

57 Angela H. Arthington, "Environmental Flow Concepts and Holistic Applications in River Basin Governance," *Ecology, Economy, and Society*, 1(2) (2018): 73-76.

58 Jayanta Bandyopadhyay, *Water, Ecosystems and Society: A Confluence of Disciplines* (Sage Publications: 2009)

Endnotes

59 Yoginder Kumar Alagh, *Economic policy in a liberalising economy*, (Singapore: Springer, 2018), https://doi.org/10.1007/978-981-13-2817-6

60 Nilanjan Ghosh, "Food fears fuel Water Conflicts," *Mail Today,* February 3, 2019

61 Nitin Kaushal et al. "Towards a healthy Ganga - improving river flows through understanding trade offs," *Frontiers in Environmental Science,* 7(83) (2019), DOI: 10.3389/fenvs.2019.00083

62 Jonas Förare ed., *Water and Food,* (Stockholm: The Swedish Research Council Formas: 2008), https://www.formas.se/download/18.462d60ec167c69393b91e03c/1549956098121/WaterforFood.pdf

63 Nilanjan Ghosh, "Water, Ecosystem Services, and Food Security,"

64 Ranjan Bhattacharyya et al. "Soil Degradation in India: Challenges and Potential Solutions," *Sustainability*, 7(2015): 3528-3570, doi:10.3390/su7043528

65 Nilanjan Ghosh, "Water Wars over Paradigms," *ORF Expert Speak*, May 14, 2020, https://www.orfonline.org/expert-speak/water-wars-over-paradigms-66120#:~:text=The%20ongoing%20%E2%80%9Cwater%20wars%E2%80%9D%20is,talks%20of%20a%20holistic%20approach.

66 Mihir Shah et al, *A 21st Century Institutional Architecture for India's Water Reforms,*

67 Nilanjan Ghosh, "India's Enduring War of Water Governance Paradigms," *Issue Brief No. 446*, February 2021, Observer Research Foundation, http://20.244.136.131/research/indias-enduring-war-of-water-governance-paradigms ; M. Dinesh Kumar et al., "Mihir Shah Committee Report (2016) on Water Reforms in India: A Critique," *Institute for Resource Analysis and Policy Occasional Paper*, December, 2016 http://www.irapindia.org/images/irap-Occasional-Paper/IRAP-Occasional-Paper-No9.pdf

68 Amitabh Sinha, "CWC staff slam Mihir Shah panel report on water reforms," *The Indian Express*, August 26, 2016, https://indianexpress.com/article/india/india-news-india/cwc-staff-slam-mihir-shah-panel-report-on-water-reforms-2996427/

69 Renita D'Souza, "Water in British India: The Making of a 'Colonial Hydrology," *History Compass* (2006), https://doi.org/10.1111/j.1478-0542.2006.00336.x

70 Anamitra Anurag Danda et al. "Managed Retreat: Adaptation to Climate Change in the Sundarbans ecoregion in the Bengal Delta," *Journal of Indian Ocean Region* (2019), DOI: 10.1080/19480881.2019.1652974

71 Nilanjan Ghosh, "Challenges to Environmental Security in the Context of India-Bangladesh Transboundary Water Relations," *Springer*, 2015, https://www.researchgate.net/publication/275659552_Challenges_to_environmental_security_in_the_context_of_India-Bangladesh_transboundary_water_relations

Endnotes

72 Mihir Shah, "*1st Jayanta Bandyopadhyay Endowment Lecture on Water Governance*," *XII Biennial Conference of the Indian Society for Ecological Economics*, January 31 – February 2, 2024.

73 PIB Report, *Ministry of Jal Sakti*, Government of India, December 16, 2021, https://pib.gov.in/Pressreleaseshare.aspx?PRID=1782283

74 PIB Report, *Ministry of Jal Sakti*, Government of India, December 16, 2021, https://pib.gov.in/Pressreleaseshare.aspx?PRID=1782283

75 Sayanangshu Modak, "Rivers and their legal rights," *ORF Expert Speak*, October 29, 2021, https://www.orfonline.org/expert-speak/rivers-and-their-legal-rights#:~:text=The%20right%20to%20flow.,to%20be%20free%20from%20pollution; Sayanangshu Modak, "Should rivers have legal rights?," *ORF Expert Speak*, June 16, 2020, https://www.orfonline.org/expert-speak/should-rivers-have-legal-rights-like-you-me-67967

76 Interview with Mihir Shah, "Must learn from success stories, break silos, take people along," *The Indian Express*, August 29, 2016, https://indianexpress.com/article/explained/mihir-shah-panel-water-management-cwc-3001152/

77 Mihir Shah, "What India's new water policy seeks to deliver," *The Indian Express*, October 30, 2021, https://indianexpress.com/article/opinion/columns/what-indias-new-water-policy-seeks-to-deliver-7595819/

78 Srinivas Chokkakula, "Indian states have fought over shared rivers for long. Modi must make them cooperate now," *The Print*, June 13, 2019, https://theprint.in/opinion/indian-states-have-fought-over-shared-rivers-for-long-modi-must-make-them-cooperate-now/249361/

79 Sayanangshu Modak and Ambar Kumar Ghosh, "Federalism and Interstate River Water Governance in India," *Occasional Paper*, Observer Research Foundation, January 2021, https://www.orfonline.org/research/federalism-and-interstate-river-water-governance-in-india

80 Jayanta Bandyopadhyay, "Towards a synergy-based approach to river basin governance," *Issue Brief*, Observer Research Foundation, August 27, 2019, https://www.orfonline.org/research/towards-a-synergy-based-approach-to-river-basin-governance

81 Malin Falkenmark, "Water Management and Ecosystems: Living with Change," *TEC Background Paper 9*, Stockholm: Global Water Partnership, 2003, https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/09-water-management-and-eco-systems.-living-with-change-2003-english.pdf

82 Mark Giordano and Tushaar Shah, "From IWRM back to integrated water resources management," *International Journal of Water Resources Development*, 30:3, 364-376: 2014, DOI: 10.1080/07900627.2013.851521

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20, Rouse Avenue Institutional Area,
New Delhi - 110 002, INDIA
Ph. : +91-11-35332000. **Fax :** +91-11-35332005
E-mail: contactus@orfonline.org
Website: www.orfonline.org