LEAD JOURNAL

Institutional and Regulatory Constraints of Governing Water in India: An Illustration through Groundwater Regulation and Pollution Abatement

by Prerna Yadav, Sruthi Pillai & NC Narayanan

Vol 21/1
2025

SOAS & IELRC

ISSN 1746-5893

LEAD Journal, 2025, Vol. 21/1, page 086 - 109
DOI: https://doi.org/10.25501/soas.00506550
Publication date: June 2025
Original Article

Institutional and Regulatory Constraints of Governing Water in India: An Illustration through Groundwater Regulation and Pollution Abatement

By Prerna Yadav*, Sruthi Pillai** & NC Narayanan***

ABSTRACT

Water governance involves multiple challenges that are difficult to address with a single solution. This complexity in governing water resources in India, which makes it a wicked problem illustrated through two cases – first, groundwater exploitation situated within the existing legal framework that enables unregulated resource appropriation. The inconsistencies in the role of the state with assistance for groundwater irrigation through different subsidies such as farm electricity supply, and the incentive structure for cultivation of water-intensive crops such as the paddy-wheat cropping systems reflects the paradox of groundwater exploitation problem. Second cases elaborates on water pollution, especially by municipal sewage and the limited enforcement of environmental regulations, inadequate monitoring, and weak penalties for noncompliance. These cases call for a nuanced understanding of complexity in water resource problems for formulation and implementation of more sustainable pathways. This understanding is drawn from the analytical framework constitutive of path-dependency and wicked problem concepts. The paper traces the path-dependence in emergence of these wicked problems – groundwater exploitation and water pollution. It elaborates on how the efforts to modernise water governance and for irrigation expansion within the contextual factors and institutional legacies have led to unintended consequences. This understanding is crucial for undertaking legal and institutional reforms that could introduce flexibility, continuous evaluation, and robust accountability mechanisms.

* Prerna Yadav - Corresponding author, PhD student, Ashank Desai Center for Policy Studies (ADCPS), Indian Institute of Technology Bombay. Email: yprerna03@gmail.com

** Sruthi Pillai - Project Manager, Ashank Desai Center for Policy Studies (ADCPS), Indian Institute of Technology Bombay. Email: msruthipillai@gmail.com

*** NC Narayanan - Professor, Ashank Desai Center for Policy Studies (ADCPS), Indian Institute of Technology Bombay. Email: ncniit@gmail.com

Published by LEAD Journal (www.lead-journal.org)

I. INTRODUCTION

Despite efforts to mitigate India's worsening water crisis, problems such as groundwater exploitation and water pollution continue to strain the country's water resources.[1] At the national level, the groundwater extraction level is about 60 percent, an aggregate which hides the regional variations in the levels of extraction of more than 100 percent in areas such as Punjab, Haryana, and less than 50 percent in areas such as Assam, Bihar.[2] Though irrigation is the major consumptive use (about 87 percent) of groundwater extracted;[3] it remains unregulated and individualistic growing at an unprecedented pace hurtling India towards a water crisis. Similarly, water contamination, especially through industrial effluent, domestic sewage discharge, and poor water treatment facilities has led to unsafe drinking water.[4] With water quality parameters of most of the Indian rivers crossing the desired standards of organic pollution parameters such as Biochemical Oxygen Demand (BOD) and coliform bacterial count, untreated municipal wastewater continues to be the predominant source of water pollution across the country.[5]

To address the groundwater exploitation problem, initially noted in the late 1960s, the Government of India formulated the model bills to serve as template for different states to adapt and adopt into acts for groundwater use and conservation. The first model bill prepared in 1970 - Model Bill to Regulate and Control the Development and Management of Groundwater was revised four times (1974, 992, 1996, and 2005) without any change in its basic structure.[6] The Groundwater Model Bill 2011 and 2017 brought in changes which focused on the legal framework, institutional structure, environmental aspects, and aquifer-based resource management for groundwater sustainability among other aspects.[7] These model bills are yet to be transformed into acts that provide a groundwater legal framework for most of the states. The few states such as West Bengal, Andhra Pradesh which adopted it since the 1990s; however, have let it be a 'paper-based legislation that are not effectively implemented'.[8]

1 Niti Aayog, *Composite Water Management Index* (Ministry of Jal Shakti, Ministry of Rural Development, Government of India 2019) 6, 72; OECD, *OECD Studies on Water - Water Risk Hotspots for Agriculture* (OECD Publishing, Paris 2017).

2 Central Ground Water Board, *National Compilation on DYNAMIC GROUND WATER RESOURCES OF INDIA, 2022* (Ministry of Jal Shakti, Government of India 2022) Annexure 1.

3 CGWB ibid 49.

4 Comptroller and Auditor General, *Performance Audit of Water Pollution in India* (Ministry of Environment and Forest, Government of India 2011) 21.

5 Central Pollution Control Board, *Inventorization of Large-scale Sewage Treatment Plants in India* (Ministry of Environment and Forest, Government of India 2015) 85.

6 Philippe Cullet, 'Groundwater Law in India – Towards a Framework Ensuring Equitable Access and Aquifer Protection' (2014) 26(1) Journal of Environmental Law 55.

7 Cullet (n 6); Himanshu Kulkarni and Kumar Satyam, 'Groundwater Law – Protection and Use' in Philippe Cullet, Lovleen Bhullar and Sujith Koonan (eds), *The Oxford Handbook of Environmental and Natural Resources Law in India* (Oxford University Press 2024) 591.

8 Philippe Cullet and Sujith Koonan, 'Protection and Regulation of Groundwater', in Philippe Cullet and Sujith Koonan (eds.), *Water Law in India: An Introduction to Legal Instruments.* (Second 2nd edn,Edition (Oxford University Press 2017) 343.

To address the water pollution problem, India has adopted a state-centric command-and-control (CAC) approach, wherein laws and regulations constitute the 'command,' and institutional enforcement represents the 'control'. However, enforcement remains weak due to institutional challenges making the CAC approach largely ineffective in reducing pollution.[9] While several guiding policies, laws, and regulations aim to address pollution, studies indicate their inadequacy in achieving meaningful outcomes.[10] Consequently, developing countries, including India, face higher water pollution levels due to weak institutional structures and lax policies.[11]

Primarily, water laws have focused on resource use, access, distribution, and allocation; with conservation and water quality aspects being much-overlooked as these primarily fall within the environmental law purview. This essentially creates different legal arenas and multiple institutions for governance operating in silos impeding holistic management of water resources.[12] This disregarded related sanitation and domestic waste water governance within the concerned water laws or environmental laws,[13] until the introduction of a legal instrument for addressing pollution from domestic sources in 2024.[14] However, such change has been absent for governance of groundwater use for irrigation. This absent or sub-optimal solutions and consequent persistence of problems plaguing country's water resources is attributable to the gaps in our water governance.[15]

Water governance in India is a process shaped by the institutional structure, which is a combination of formal rules (law, property rights and the political system), informal constraints (beliefs, norms, and customs), and their enforcement characteristics (regulatory mechanisms such as policy and

9 Keren Priyadarshini and Omprakash K Gupta, 'Compliance to Environmental Regulations: The Indian Context' (2003) 2 (1) International Journal of Business and Economics 9.

10 Robert Bain and others, 'Fecal Contamination of Drinking-water in Low-and Middle-income Countries: A Systematic Review and Meta-analysis' (2014) 11(5) PLOS Medicine e1001644; CM Abraham and Armin Rosencranz, 'An Evaluation of Pollution Control Legislation in India' (1986) 11(1) Columbia Journal of Environmental Law 101.

11 Azmat Gani and Frank Scrimgeour, 'Modeling Governance and Water Pollution Using the Institutional Ecological Economic Framework' (2014) 42 Economic Modelling 363.

12 Philippe Cullet and Sujith Koonan, 'Environmental Dimensions – Protection, Conservation, and Sustainable Use of Water' in Philippe Cullet and Sujith Koonan (eds), *Water Law in India: An Introduction to Legal Instruments* (2nd edn, Oxford University Press 2017) 216.

13 Philippe Cullet and Lovleen Bhullar (eds), *Sanitation Law and Policy in India: An introduction to Basic Instruments* (Oxford University Press 2015) 9.

14 Draft Liquid Waste Management Rules, 2024.

15 Asit K Biswas and Cecilia Tortajada, 'Future Water Governance: Problems and Perspectives' in Cecilia Tortajada and Asit K Biswas (eds), *Improving Water Policy and Governance* (Routledge 2013) 136; Héctor Garduño and others, 'India Groundwater Governance Case Study' (2011) The World Bank; Himanshu Kulkarni, Mihir Shah and PS Vijay Shankar, 'Shaping the Contours of Groundwater Governance in India' (2015) 4 (A) Journal of Hydrology: Regional Studies 172.

judiciary).[16] For instance, groundwater governance would include the 'processes that enable institutional support to help sustain aquifer-based, decentralised participatory groundwater management bearing in mind the objectives of efficiency, equity, and sustainability around groundwater resources".[17] Given such importance of institutions for water governance, it is crucial to understand how they shape water use, influence challenges, and inform policy solutions to address India's water crisis. This paper examines how policy choices and institutions have historically influenced two core issues of water crisis[18] - groundwater exploitation and water pollution. By using the concept of path dependence, and focusing on the regional geographies of Punjab and Kerala, we elaborate on how early policy choices and feedback mechanisms entrenched these issues as wicked problems, while subsequently influencing policy trajectories amid evolving contexts and scales of resource exploitation.

There are six sections in the paper. Following the introduction, the second section elaborates on path dependence and wicked problem concepts which form the analytical framework to trace the historical policy choices and their importance in shaping the problems. The next section details the methods used to provide evidence for the two cases. The subsequent two sections elaborate on the analysis of each problem. Case 1 illustrates the groundwater exploitation problem as it traces the roots of the existent pattern of groundwater use for irrigation and the role of the state in it. Case 2 illustrates the persistence of water pollution as it traces the role of institutional lock-ins in it. We compare the two cases in the last section to emphasise the fragmentation in addressing the problems that plague India's water resources.

II. PATH DEPENDENCE AND WICKED PROBLEMS

Often described as unintended consequences of development and technological advancement, groundwater exploitation and water pollution built-up slowly into wicked problems forming India's water crisis. The continued failure of the technological and market solutions necessitate recourse to understanding the role of institutions in these problems and their optimal solutions. For this understanding, we use the analytical framework constitutive of the path-dependency and the wicked problem concept.

The path dependency concept envisions the policy trajectory as a process constitutive of sequential events and critical junctures within a political and

[16] Jonathan Lautze and others, 'Putting the Cart Before the Horse: Water Governance and IWRM' (2011) 35(1) Natural Resources Forum 1; Peter Mollinga and Satya Prasad Tucker, 'Changing Water Governance in India: Taking the Longer View' (2010) 2(1) South Asian Water Studies i.

[17] Navroz K Dubash and Sudhir Chella Rajan, 'Power Politics: Process of Power Sector Reform in India' (2001) 36(35) Economic and Political Weekly 3367;
R. S. Deshpande and G. Mini, 'Management of Irrigation: A View of Institutional Arrangements', in Suresh Pal and others (eds), *Institutional Change in Indian Agriculture* (National Centre for Agricultural Economics and Policy Research 2003) 99.

[18] Vishwa Ballabh, 'India's Water Crisis and Institutional Challenges: An Overview' in Pal and others (eds), ibid 123.

environmental context,[19] strung together to form the continuously evolving developmental pathways and the policy trajectories.[20] This process occurs within the constraints of past policy choices, and its analysis helps to understand how stable patterns of politics or practices persist and reproduce themselves over time. Critical junctures are crucial moments for institutions that shape the trajectory of the developmental path.[21] Also called policy windows, these rarely open and close randomly, typically linked to events such as elections or emergence of new policy ideas (or issues) ('generational cleavages').[22]

Post-critical junctures, the existing institutions and policy legacies shape the trajectories through the feedback mechanisms.[23] When these feedback mechanisms reinforce the policy trajectory, they are responsible for policy stability and endurance. Contrarily, when they undermine the policy trajectory, they are responsible for policy change. Typically, the positive policy feedback refers to the reinforcing effect, and the negative feedback refers to the undermining effect on policy trajectory.[24] Counter to this understanding in conventional policy feedback literature, even negative feedback can have a reinforcing effect and positive feedback can have an undermining effect on the policy trajectory.[25] Despite the feedback mechanisms favouring a particular alternative, in policy, there is presence of different alternatives as opposed to technology (such as the absence of alternatives to QWERTY keypad), wherein the proponents of the alternative policy choices bid their

19 Michael Howlett, 'Process Sequencing Policy Dynamics: Beyond Homeostasis and Path Dependency' (2009) 29(3) Journal of Public Policy 241; Sven Steinmo, 'Historical Institutionalism' in Donatella Della Porta and Michael Keating, *Approaches and Methodologies in the Social Sciences: A Pluralist Perspective* (Cambridge University Press 2008) 118; Robert Cox, 'The Path-Dependency of an Idea: Why Scandinavian Welfare States Remain Distinct' (2004) 38(2) Social Policy and Administration 204; Kathleen Thelen, 'Historical Institutionalism in Comparative Politics' (1999) 2(1) Annual Review of Political Science 369.

20 Howlett, ibid.

21 Giovanni Capoccia, 'Critical Junctures and Institutional Change' in James Mahoney and Kathleen Thelen (eds), *Advances in Comparative-Historical Analysis* (Cambridge University Press 2015) 147; Giovanni Capoccia and R Daniel Kelemen, 'The Study of Critical Junctures: Theory, Narrative, and Counterfactuals in Historical Institutionalism' (2007) 59(3) World Politics 341.

22 John Hogan, 'Remolding the Critical Junctures Approach.' (2006) 39(: 3) Canadian Journal of Political Science 657; John Hogan, and David Doyle, 'The Importance of Ideas: An A Priori Critical Juncture Framework' (2007) 40(4) Canadian Journal of Political Science 883.

23 Howlett (n 19); Thelen (n 19); John G Ikenberry, 'History's Heavy Hand: Institutions and the Politics of the State' (Conference on New Perspectives on Institutions, Maryland, October 1994) < https://gji3.scholar.princeton.edu/working-papers>; Paul Pierson, 'Path Dependence, Increasing Returns, and the Study of Politics' (1997) Program for the Study of Germany and Europe Working Paper Series 7.9 < https://ces.fas.harvard.edu/publications/000113-path-dependence-increasing-returns-and-the-study-of-politics>.

24 Daniel Béland and Edella Schlager, 'Varieties of Policy Feedback Research: Looking Backward, Moving Forward' (2019) 47(2) Policy Studies 184-205; Ruth Berins Collier and David Collier, *Shaping the Political Arena: Critical Junctures, the Labor Movement, and Regime Dynamics in Latin America* (University of Notre Dame Press 2002) 122.

25 Carsten Daugbjerg and Adrian Kay, 'Policy Feedback and Pathways: When Change Leads to Endurance and Continuity to Change' (2020) 53 (2) Policy Sciences 253.

time until conditions change, or pursue different goals subversive to the existing policy goals within the institutional structure.[26] They adapt in a manner 'very different from embracing and reproducing the institution' to allow the existence of different plausible policy choices at any time.[27] The feedback mechanisms reflect the variation in benefits accrued by different actors and actor groups, wherein there is active facilitation of the organisation and empowerment of one group and active disarticulation and marginalisation of the other group, with the institutional structure influencing and reinforcing such power disparities.[28]

The concept of path dependence is not without its limitations. It focuses more on understanding stability, rather than change.[29] The emphasis is also skewed towards the role of exogenous shocks in understanding the critical junctures and policy trajectory, with minimal consideration to endogenous shocks.[30] Despite this, it allows for significant insights into the spatial and temporal processes of policy evolution,[31] with history as an analytical tool to emphasise 'how and why policy choices at one point in time affect choices at subsequent points in time'.

While path-dependence explains the adoption of suboptimal solutions and ignorance of the optimal solutions, the wicked problem concept adds to the understanding of why the solutions are sub-optimal and there is persistence of the policy problems such as groundwater exploitation and water pollution. Wicked problems are large, complex, and entangled.[32] They are intractable, open-ended, evolving, and unpredictable problems set in a changing social, environmental, economic, and political context.[33] There is uncertainty

26 James Mahoney and Kathleen Thelen, 'A Theory of Gradual Institutional Change' in James Mahoney and Kathleen Thelen (eds), *Explaining Institutional Change: Ambiguity, Agency, and Power* (Cambridge University Press 2010) 1-37. Michael Howlett and Jeremy Rayner, 'Understanding the Historical Turn in the Policy Sciences: A Critique of Stochastic, Narrative, Path Dependency and Process-sequencing Models of Policy-making Over Time' (2006) 39 Policy Sciences 1; David Kline, 'Positive Feedback, Lock-In and Environmental Policy' (2001) 34(1) Policy Sciences 95; Paul Pierson, 'The Limits of Design: Explaining Institutional Origins and Change' (2000) 13(4) Governance 475.

27 ibid Mahoney and Thelen (n 26) 1.

28 Richard Deeg, 'Institutional Change and the Uses and Limits of Path Dependence: The Case of German Finance' (2001) 01(6) MPIfG Discussion Paper 1; Carsten Daugbjerg, 'Sequencing in Public Policy: The Evolution of the CAP over A Decade,' (2009) 16(2) Journal of European Public Policy 395; Pierson (n 23); Thelen (n 19).

29 Howlett (n 19); Adrian Kay, 'Policy Trajectories and Legacies' in Eduardo Araral and others (eds), *Routledge Handbook of Public Policy* (Routledge 2012) 462.

30 Ian Greener, 'Theorizing Path-Dependency: How Does History Come to Matter in Organizations?' (2002) 40 (5-6) Management Decision 614; Ian Greener, 'Understanding NHS Reform: The Policy-Transfer, Social Learning and Path Dependency Perspectives' (2002) 15(2) Governance 161; Kathleen Thelen, 'How Institutions Evolve: Insights from Comparative Historical Analysis' in James Mahoney and Dietrich Rueschemeyer (eds), *Comparative Historical Analysis in the Social Sciences* (Cambridge University Press 2003) 468.

31 Andre Sorensen, 'Taking Path Dependence Seriously: An Historical Institutionalist Research Agenda in Planning History' (2015) 30(1) Planning Perspectives 17.

32 Brian W Head and John Alford, 'Wicked Problems: Implications for Public Policy and Management' (2015) 47(6) Administration & Society 711.

33 Tom Ritchey, 'Wicked Problems: Modelling Social Messes with Morphological Analysis' (2013) 2(1) Acta Morphologica Generalis 1; John Alford and Brian W Head, 'Wicked and Less Wicked Problems: A Typology and A Contingency Framework' (2017) 36(3) Policy and Society 397.

to how the problem would evolve with or without the adoption of a certain solution; with value-divergence among stakeholders regarding both the problem and solution.[34]

The concept was formulated by Rittel and Webber in the 1960s-70s to understand the gaps in planning and policy implementation that led to the persistence of social and environmental problems in US.[35] They argued that, 'One cannot understand the problem without knowing about its context....', emphasising the focus on the problem context and its roots being pertinent for viable solutions.[36] Since then, the concept has been extensively used to contextualise environmental problems for understanding their various analytically important aspects.[37] Though not all wicked problems are policy problems, almost all contemporary public policy problems are wicked problems or exhibit 'at least some wicked tendencies'.[38]

The wicked policy problems are often the culmination of both endogenous and exogenous shocks, continuously shaped by the 'natural systems, technical systems, or the socio-ecological-technical interface'.[39] This is particularly the case with creeping crisis wherein the "narratives shift" from problem-recognition to high priority action' in policy about a routine or familial occurrence to it being a crisis.[40] Creeping crisis are problem that originate and balloon into wicked problems over a period due to their increasing anthropogenic relevance.[41] The issues of irrigation systems, water and salinity, land degradation and erosion, environmental contamination are the most apparent instances of such creeping crises wherein short-term financial benefits have been prioritised over long-term costs.[42] In this context, it is pertinent to understand the roots of the wicked problems that plague India's water resources and their persistence given the country's water crisis.

34 B Guy Peters, 'Wicked, Complex, or Just Difficult Problems' in B Guy Peters, *Policy Problems and Policy Design* (Edward Elgar 2018) 60.

35 B Guy Peters and Matthew Tarpey, 'Are Wicked Problems Really so Wicked? Perceptions of Policy Problems' (2019) 38(2) Policy and Society 218; Horst WJ Rittel and Melvin M Webber, 'Dilemmas in A General Theory of Planning' (1973) 4(2) Policy Sciences 155.

36 Rittel and Webber (n 35); Brian W Head, 'Forty Years of Wicked Problems Literature: Forging Closer Links to Policy Studies' (2019) 38(2) Policy and Society 180.

37 Kate Crowley and Brian W Head, 'The Enduring Challenge of "Wicked Problems": Revisiting Rittel and Webber' (2017) 50(4) Policy Sciences 539.

38 Joshua Newman and Brian W Head, 'Wicked Tendencies in Policy Problems: Rethinking the Distinction between Social and Technical Problems' (2017) 36(3) Policy and Society 414.

39 Arjen Boin, Magnus Ekengren and Mark Rhinard, 'Understanding and Acting Upon a Creeping Crisis', in Arjen Boin, Magnus Ekengren and Mark Rhinard, (eds), *Understanding the Creeping Crisis* (Springer Nature 2021) 4.

40 Brian W Head, *Wicked Problems in Public Policy: Understanding and Responding to Complex Challenges* (Springer Nature 2022) 62.

41 Arjen Boin, Magnus Ekengren and Mark Rhinard, 'Understanding and Acting Upon a Creeping Crisis' in Boin, Ekengren and Rhinard (eds) (n 39) 1.

42 Alan MG Jarman and Alexander Kouzmin, 'Creeping Crises, Environmental Agendas and Expert Systems: A Research Note' (1994) 60(3) International Review of Administrative Sciences 399; Boin and others (n 41) 4.

III. METHOD

We use a mix of qualitative methods to understand how the path dependence concept can be employed to understand the wicked problems of groundwater exploitation and water pollution. We reviewed academic literature, regulations related to water governance and their amendments, and document analysis of five-year plan documents, national water policy, national and state level commission reports, and other policy documents. This was followed by the identification of key stakeholders and experts in the domains. Data collection methods mainly included semi-structured qualitative key informant interviews. Interviews were conducted with officials representing the state such as those from the Kerala State Pollution Control Board (KSPCB), Alappuzha Municipality, and Suchitwa Mission, environmental lawyers and law experts.[43] The interviews also helped identify other relevant stakeholders (snowball sampling) and provided reference to relevant documents. Further sector experts and concerned citizens were also consulted through informal discussions for their viewpoints and concerns. As part of the analysis, we corroborated the findings from the first step of document analysis with data from interviews through the analytical framework of path-dependence and wicked problem concepts. Initially, the collected data and its analysis were largely descriptive in nature, but with frequent discussions and brainstorming with each other, the data analysis evolved to contain interpretations and insights that sought to answer how path dependence can explain the problem of groundwater exploitation and water pollution.

[43] Further details of the interviews could be shared upon request.

IV. GROUNDWATER EXPLOITATION AND ABSENCE OF REGULATION

The making of groundwater exploitation as a wicked problem is rooted in the pattern of groundwater use for irrigation. This pattern is individualistic, private, and unregulated;[44] possible within the legal framework that 'specifically permitted landowners to take as much groundwater as they see fit with hardly any restrictions or safeguards in place', which 'essentially' restricted 'effective regulatory action' and contributed in-part to the exploitation problem.[45] Tracing the institutionalisation of this pattern with reference to the role of the state in it is crucial to understand the challenges to the policy problem of groundwater exploitation.

In the years following the late 1870s famine, the policy window opened wherein the colonial state was to define the rules of groundwater use for irrigation, in accordance with the recommendations of the first Famine Commission of 1880 for protection and prevention against famine through irrigation expansion.[46]

[44] Tushaar Shah, *Taming the Anarchy: Groundwater Governance in South Asia* (Routledge 2009); Rema Devi P, 'Groundwater Development and Legal Regulation' (1991) 33(4) Journal of the Indian Law Institute 614; Phillippe Cullet, 'Groundwater Law in India: Towards A Framework Ensuring Equitable Access and Aquifer Protection' (2014) 26(1) Journal of Environmental Law 55.

[45] Philipe Cullet, 'Governing Groundwater: Fostering Participatory and Aquifer-based Regulation' in Amarjit Singh, Dipankar Saha and Avinash C Tyagi (eds), *Water Governance: Challenges and Prospects* (Springer 2019) 117.

[46] Famine Commission (FC) of India, 1880: 71.

As per the recommendations, the colonial state adopted the Easements Act, 1882 to delineate the role of the state and the user (farmers) for well-irrigation. It defined the usufructuary rights for groundwater use by the farmers, unregulated by the state.[47] Thus, groundwater irrigation was to be a farmers' program assisted by the state in its construction, operation, and maintenance of the wells.[48]

The FC in 1880 and then the first Irrigation Commission (IC) 1901-03 strongly argued against the alternative policy choice of the state (similar to that for canal irrigation systems) in undertaking well construction, operation, and maintenance.[49] This was not only due to the individual and scattered presence of wells which were decisive in the transaction costs for the state, but also due to the interlinked ownership rights in the colonial land settlement rules and financial interests.[50] The alternative policy choice did later materialise in subsequent decades in the form of few Public Tubewell Programs in both colonial and post-colonial period, however, these suffered like canal irrigation systems from problems of Operation & Management.[51] Thus, the initial policy choice of the Easements Act, 1882, which continues to form the main tenet of groundwater legal framework along with various judicial rulings over the years shaped groundwater irrigation to be individualistic and private.[52] Governance for groundwater resources has been in-accordance to this legal framework with limited evolution of the case law.[53]

The role of state was prescribed as per the two primary limiting factors for well irrigation expansion; first, the absence of capital in areas with favourable scope of its expansion, and second, the proprietorship conflicts.[54] In accordance, the recommendations were improvements in the takkavi system, defining rights for groundwater resources' appropriation and security for investment in wells.[55]

There is continuity in the role of state for financial assistance to the farmers for groundwater irrigation across the colonial and post-colonial period. The improvements in the takkavi system came

47 ibid 168-169; Famine Commission, 'Report of the Indian Famine Commission' (The Government Central Printing Office, Simla 1898); Irrigation Commission (IC), 'Report of the Indian Irrigation Commission' (Office of the Superintendent Government Printing, India, Calcutta 1901) 53.

48 Famine Commission, 'Report of the Indian Famine Commission' (Office of the Superintendent Government Printing, India, Calcutta 1901) 108.

49 FC (n 46) 150; FC (n 47) 108; Irrigation Commission, 'Punjab. Indian Irrigation Commission – Minutes of Evidence' (Office of the Superintendent Government Printing, India, Calcutta 1901) 54.

50 Patrick McGinn, 'Capital, "Development" and Canal Irrigation in Colonial India' (2009) Institute for Social and Economic Change Working Paper 209; Elizabeth Whitcombe, 'Irrigation' in Dharma Kumar and Meghnad Desai (eds), *The Cambridge Economic History of India Volume 2: c. 1757 – c. 1970* (Cambridge University Press 1983).

51 Government of India, Seventh Five-Year Plan 1985-90 (Planning Commission of India 1985) 77; Whitcombe (n 50) 723; Tushaar Shah, *Ground Water Markets and Irrigation Development* (Oxford University Press 1993).

52 Cullet (n 45) 117; Sujith Koonan, 'Groundwater Legal Regime in India: Towards Ensuring Equity and Human Rights' (2013) SOAS Law Working Papers 1/2013, 28.

53 Phillipe Cullet, 'Water Sector Reforms and Courts in India: Lessons from the Evolving Case Law' (2010) 19(3) Review of European Community & International Environmental Law 328.

54 FC (n 47) 168.

55 FC (n 47) 168.

from closely associated ('sister acts'), the Land Improvement Loans Act, 1883 (LILA 1883) and the Agriculturists' Loans Act, 1884 (ALA 1884). These addressed the FC 1880 recommendations to exempt changes in land settlement rates till the period required for the farmers to accrue a 'reasonable return on their investment', along with separate financial assistance provisions for landowners' debt, purchase of bullocks or seed grain, and construction of embankments and water courses.[56] Called as the 'most convenient and obvious' system of all the other measures to incentivise and assist private irrigation improvements;[57] these were improvisations of the North India Takkavi Act, 1879 along with the Land Improvement Act, 1871 and its 1876 amendment that formed the sub-optimally utilised takkavi system before these recommendations.[58]

The improvements in financial assistance provisions under the LILA 1883 and ALA 1884 further reinforced the de-facto interlinkages between the land ownership and the appropriation of groundwater resources.[59] With land as the mortgage - the 'needful precautions',[60] the Easements Act, 1882 and the Transfer of Property Act, 1882 were to ensure that farmers' investments for land improvement (primarily wells) were included in the cost of land while the LILA 1883 and ALA 1884 provided for exclusion from any increase in their taxation amount.[61] Thus, land as mortgage could have been simply the colonial state's effort to minimise its risks, however, it led to further individualistic and privatised well irrigation, contingent on the land ownership. This also meant that the absence of land-title or enough security excluded the poor farmers or landless from access to groundwater irrigation.

There is a continuity in such state assistance for the capital cost of well construction across the 20th century, aiding in the institutionalisation of the private and individualistic pattern of groundwater irrigation. This is evident in the recommendation of the first IC to further scale up the 'liberal takkavi advances' in general and 'free grants' in 'special localities' at the start of the 20th century.[62] To expand and improve the takkavi system, the Credit Associations and Agricultural Banks (which originally were to be part of the LILA 1883) had also been set up.[63] This was the start of the institutional credit facilities for the farmers. With technological advancement, these provisions of state assistance were oriented towards tubewell construction as per the Royal Commission of Agriculture recommendations in the early 20th century during the colonial regime itself.[64] In 1950-51, there were several million dug wells (3.85 million) and only a few thousand tubewells (0.5 million).[65] Data limitations do not allow a quantitative analysis of the extent of loans granted for

56 FC (n 48) 143-145.

57 IC (n 47) 59-60; FC (n 48) 99-100.

58 FC (n 47) 144.

59 ibid 48.

60 FC (n 47) 144; FC (n 48) 101-102.

61 The Easements Act 1882 and The Transfer of Property Act 1882.

62 IC (n 48) 52.

63 FC (n 49) 101.

64 Royal Commission of Agriculture, 'Royal Commission on Agriculture in India - Abridged Report' (The Government Central Press 1927) 341-350.

65 Government of India (GoI), *Statistical Abstract of India 1953-54* (Economic Advisor to Government of India 1953-54).

wells and tubewells during the colonial period.

After Independence in 1947, the financial assistance mechanisms shifted from takkavi loans to institutional credit as the latter took root and developed adequate capacity.[66] Amongst the three sources of financing (the public sector, institutional credit, and private resources),[67] the institutional credit facilities and private resources ensured and enabled groundwater irrigation to be private and individualistic. The state expanded, reorganised, and strengthened these institutional credit sources along with progressively easing the process for availing it as part of the New Agricultural Strategy (NAS) post-1965.[68] The institutional credit facilities such as the land development and commercial banks ensured a continuous supply of short-term and long-term credit to all types of farmers under different schemes for undertaking groundwater irrigation.[69] Schemes to incentivise the credit uptake for groundwater irrigation focused on the improvements in the institutional credit flow by completing and updating the land records and the adoption of the quick procedures for land title certification in absence of the updated records.[70] However, despite about 40-50 percent of the total investment in groundwater irrigation being from institutional credit sources in the 1990s, information about it even at the district level has been absent due to unreliable estimates of farmers' investments.[71]

Thus, the policy choices in the late 19th century about the groundwater appropriation rights to be farmers' prerogative, with the role of state to be of assistance for it enabled the institutionalisation of groundwater irrigation to be private and individualistic. Furthermore, the shift from the takkavi system to institutional credit

66 Government of India (GoI), First Five-Year Plan 1951-56 (Planning Commission of India 1951) 251;
Government of India (n 52) 78.

67 Government of India (GoI), Fourth Five-Year Plan 1969-74 (Planning Commission of India 1970) 248-254;
Government of India (GoI), Fifth Five Year Plan 1974-1978 (Planning Commission of India 1974) 110;
Government of India (GoI), Third Five-Year Plan 1961-66 (Planning Commission of India 1961) 380.

68 ibid; Government of India (GoI), Fifth Five Year Plan 1974-1978 (Planning Commission of India 1974); Chidambaram Subramaniam, *Hands of Destiny Vol. 2: The Green Revolution Bombay* (Bharatiya Vidya Bhavan 1995).

69 Government of India 1970 (n 67) 116-248; Kapil Subramanian, '*Revisiting the Green Revolution: Irrigation and Food Production in Twentieth-century India*' (PhD Theses, King's College London 2015).

70 Government of India 1970 (n 67) 248; Government of India (GoI), Ninth Five Year Plan 1997-2002 (Planning Commission of India 1997) 503; Government of India (GoI), Sixth Five-Year Plan 1980-85 (Planning Commission of India 1980) 153-154; Government of India (GoI), Eight Five-Year Plan 1992-74 (Planning Commission of India 1992) 61.

71 Government of India (GoI), Eight Five Year Plan 1992-97 (Planning Commission of India 1992) 63; B D Dhawan, 'Developing Groundwater Resources: Merits and Demerits' (1991) 26(8) Economic and Political Weekly 425.

investments reinforced the de-facto link between groundwater resources and land ownership, reflective of the continuity between colonial and post-colonial period.

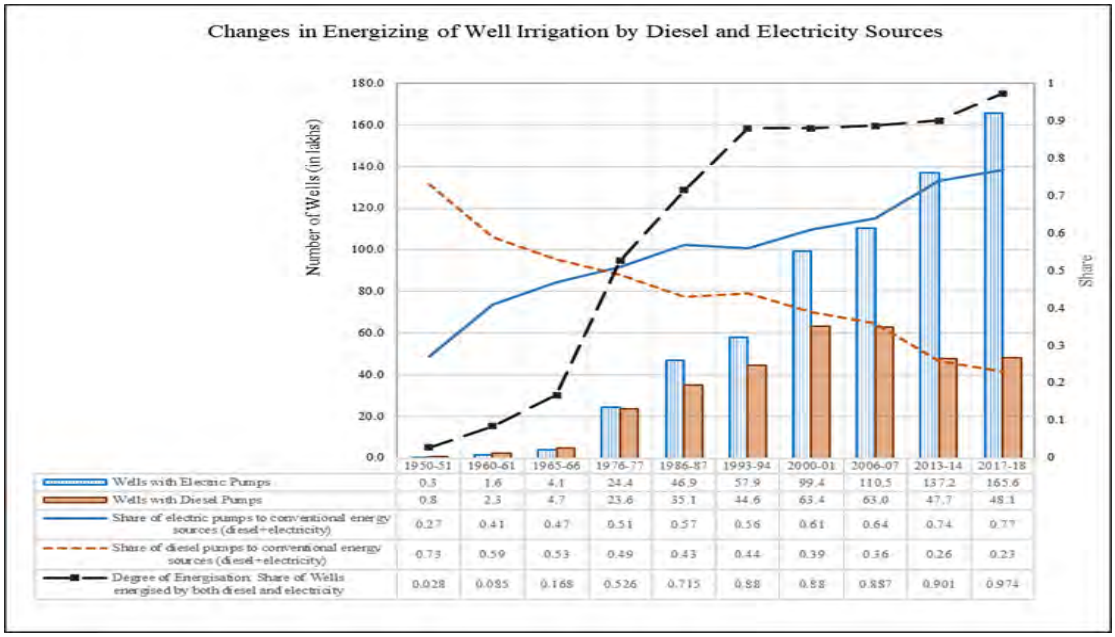
Such institutionalisation was also possible due to the post-colonial state's assistance in operational costs of groundwater irrigation. The temporal (fixed supply schedules not necessarily synchronised with crop irrigation requirements) and spatial (areas outside canal command areas) limitations of canal irrigation were more pronounced for hybrid high-yielding-varieties, whose cultivation required adequate-timely-assured irrigation, which further shifted the farmers' preference towards groundwater irrigation.[72] Given that the use of mechanised pumps either energised by electricity or diesel was the only possibility of large-scale groundwater irrigation expansion to fulfil such irrigation demands, the policy choice of subsidising the energy costs for the farmers materialised with subsidised farm electricity and diesel oil.[73] Initially diesel pumps served the purpose, however, the fall in groundwater levels increasingly pushed for a shift to electricity pumps. Since the 1990s, there have been incremental provisions for subsidising operational costs through electricity subsidy by pricing farm electricity either at flat-rate tariffs as in Andhra Pradesh and Gujarat or zero-tariffs as in Punjab.[74] After the Electricity Reforms in 2003, the improvements in access and availability of farm electricity supply and increasingly prohibitive costs of diesel, further facilitated the shift towards electricity for energising groundwater irrigation.[75] This shift is apparent in the increase in share of the number of wells (both dug wells and tubewells) energised by the electricity pumps to the total number of energised wells from 61 percent in 2000-01 to 77 percent in 2017-18 (figure a).

[72] Government of India (n 51) 78.

[73] Government of India (GoI), Second Five-Year Plan 1956-61 (Planning Commission of India 1956).

[74] Dubash and Rajan (n 17); Shripad Dharmadhikary and others, *Understanding the Electricity, Water & Agriculture Linkages, Volume 1: Overview* (Prayas 2018); Karam Singh, 'Electricity Subsidy in Punjab Agriculture: Extent and Impact' (2012) 67(4) Indian Journal of Agricultural Economics 1.

[75] Dubash and Rajan (n 17); Dharmadhikary and others (n 74); Ramesh Bhatia and Meera Mehta, 'Tubewell Irrigation Analysis of Some Technical Alternatives' (1975) 10(52) Economic and Political Weekly A111.



	1950-51	1960-61	1965-66	1976-77	1986-87	1993-94	2000-01	2006-07	2013-14	2017-18
Wells with Electric Pumps	0.3	1.6	4.1	24.4	46.9	57.9	99.4	110.5	137.2	165.6
Wells with Diesel Pumps	0.8	2.3	4.7	23.6	35.1	44.6	63.4	63.0	47.7	48.1
Share of electric pumps to conventional energy sources (diesel+electricity)	0.27	0.41	0.47	0.51	0.57	0.56	0.61	0.64	0.74	0.77
Share of diesel pumps to conventional energy sources (diesel+electricity)	0.73	0.59	0.53	0.49	0.43	0.44	0.39	0.36	0.26	0.23
Degree of Energisation: Share of Wells energised by both diesel and electricity	0.028	0.085	0.168	0.526	0.715	0.88	0.88	0.887	0.901	0.974

Figure a: Changes in comparative dependence on electricity and diesel pumps for well irrigation by tracing the share of each type in the total energised wells (tubewells/ borewells + dug wells) over the decades (1950-51 to 2017-18)[76]

Such an increasing dependence on electricity for irrigation has factored into the emergence of farmers' interest groups, closely associated with the incentives and benefits from the different agricultural policies such as the electricity subsidy, fertiliser subsidy, pricing, and procurement policy of NAS.[77] Despite farm electricity supply being one of the most crucial policy instruments for checking groundwater exploitation;[78] the political economy determinative of electricity subsidy impedes checks or regulation.[79] This

[76] Source: Author as per different Minor Irrigation (MI) Census reports and Statistical Abstract of India reports.

[77] William D Coleman, Grace D Skogstad and Michael M Atkinson, 'Paradigm Shifts and Policy Networks: Cumulative Change in Agriculture' (1996) 16(3) Journal of Public Policy 273; Ashutosh Varshney, *Democracy, Development, and the Countryside: Urban-Rural Struggles in India* (Cambridge University Press 1995);
Regina Birner, Surupa Gupta and Neeru Sharma, *The Political Economy of Agricultural Policy Reform in India: Fertilizers and Electricity for Irrigation* (International Food Policy Research Institute 2011) 261.

[78] Dubash and Rajan (n 17); Dharmadhikary and others (n 74); The World Bank, *India: Revitalizing Punjab's Agriculture* - Report 37069 (The World Bank 2003).

[79] Birner, Gupta and Sharma (n 77).

feedback mechanism constitutive of increasing dependence on subsidised farm electricity for groundwater irrigation forms the water-energy link of the water-energy-food (WEF) nexus.[80] Though there has been a policy focus on use of renewable ('non-conventional') energy sources such as solar, wind for groundwater irrigation since the 1990s,[81] which has had a limited uptake by farmers.

While the water-energy link is becoming all pervasive in different parts of the country, there is also the cultivation pattern of groundwater irrigated water-intensive crops such as paddy in Punjab, Haryana, or sugarcane in Maharashtra. In Punjab, the continuum in policy support for paddy cultivation under the objective of food security since the late 1960s forms the water-food nexus, exacerbating groundwater exploitation for water-intensive paddy-wheat cropping systems.[82] Changes such as the improvements in availability and accessibility of different inputs, the storage and marketing facilities, the extension services, the mechanisation of agricultural practices institutionalised the policies and practices,[83] which over the decades have served as mechanisms of positive feedback in the nexus. Though the dependence on groundwater irrigation for India's foodgrain self-sufficiency necessitates the continuum of water-food interlinkage; the extraction being private, individualistic, and unregulated drives the wicked problem of groundwater exploitation - a creeping crisis due to the unintended consequence of the foodgrain self-sufficiency policies.

Despite the problem being evident in parts of Punjab, Gujarat, Haryana, and Tamil Nadu by the late 1970s, only generic recommendations - the 'necessary measures to control over exploitation' were suggested.[84] As the problem aggravated, the need to shift from supply-side measures such as artificial recharge to demand-side measures such as crop diversification became more pertinent. However, given that the demand-side measures intrinsically challenge the individualistic and unregulated groundwater use for irrigation, these have failed to be implemented. For instance, the

80 Tushaar Shah, Mark Giordano and Aditi Mukherji, 'Political Economy of the Energy-Groundwater Nexus in India: Exploring Issues and Assessing Policy Options (2012) 20(5) Hydrogeology Journal 995; Dharmadhikary and others (n 74).

81 Government of India (GoI), 1992 (n 72); Government of India (GoI), Eight Five-Year Plan 1992-97 (Planning Commission of India, 1992) 36;
Government of India (GoI), Eleventh Five Year Plan 2007-2012 (Planning Commission of India 2007) 54.

82 Beas Barik and others, 'Water-Food-Energy Nexus with Changing Agricultural Scenarios in India During Recent Decades' (2017) 21(6) Hydrology and Earth System Sciences 3041; Aditi Mukherji, 'Sustainable Groundwater Management in India Needs A Water⁄Energy⁄Food Nexus Approach' (2022) 44(1) Applied Economic Perspectives and Policy 394.

83 H S Sidhu, 'Crisis in Agrarian Economy in Punjab: Some Urgent Steps' (2002) 37(30) Economic and Political Weekly (2002) 3132; Anindita Sarkar, Sucharita Sen and Animesh Kumar, 'Rice-Wheat Cropping Cycle in Punjab: A Comparative Analysis of Sustainability Status in Different Irrigation Systems' (2009) 11 Environment, Development and Sustainability 751; Vasant P Gandhi, 'Technology, Cost Reduction, and Returns in Agriculture: A Study of Wheat and Rice in Punjab' (1997) 22(2) Vikalpa 35; Lakhwinder Singh and Sukhpal Singh, 'Deceleration of Economic Growth in Punjab: Evidence, Explanation, and A Way-out' (2002) 37(6) Economic and Political Weekly 579.

84 Government of India (GoI), Sixth Five-Year Plan 1980-85 (Planning Commission of India 1980) 154.

crop diversification scheme and the MSP policy with assured procurement for the moong crop in Punjab was adopted with the objective to incentivise farmers to replace paddy with moong as the kharif crop.[85] Rather than replace the water-intensive groundwater irrigated paddy, farmers have chosen to cultivate moong as the third crop in an agricultural season.[86]

There are also measures which only partially address the problem, neither strictly regulating groundwater extraction for irrigation nor the crops cultivated. Conceptualised as per an incentive structure, the irrigation efficiency schemes[87] and the electricity efficiency schemes[88] focus on water-food and water-energy interlinkage of the nexus respectively. For instance, the Punjab Subsoil Preservation Act, 2009 provides for regulation of sowing and transplantation timings of paddy to reduce evapotranspiration losses to save groundwater;[89] or the Punjab Water Resources (Management and Regulation) Act, 2020 which directed the setting up of the Punjab Water Regulation and Development Authority (PWRDA) that adopted the Punjab Guidelines for Ground Water Extraction and Conservation, 2023; or the Jyotigram scheme in Gujarat that separates the farm electricity supply from the village's supply as a measure to regulate electricity use for groundwater extraction;[90] or the Gujarat Irrigation and Drainage Act 2013 which provides for regulation of any tubewell or borewell or artesian well within 200 meters of canal command.[91]

Moreover, the complexity of the problem is attributed to different aspects of groundwater resources such as the diverse hydrogeological settings,[92] the inconsistent or absent data of groundwater potential and extraction assessment at the micro-level,[93] the differential severity of the problem across the country,[94] the inequitable access due to skewed land ownership and competitive exclusion of the poor from groundwater irrigation,[95] the high transaction costs of regulation,[96] the emergence of multiple politically affluent interest groups that benefit from the continuation of existing incentive structure.[97]

85 Crop Diversification Program (CDP) in Punjab <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1605057>.

86 Field Work in Ludhiana District of Punjab in July 2023.

87 Efforts for Irrigation Efficiency with different schemes as part of the Efficient Management of Water Resources. <https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1847103>.

88 Demand-side measures focused on improving energy efficiency in groundwater extraction. <https://www.peda.gov.in/ec/agdsm.php>.

89 The Punjab Preservation of Sub-soil Water Act-2009.

90 Tushaar Shah and Shilp Verma, 'Co-Management of Electricity and Groundwater: An Assessment of Gujarat's Jyotirgram Scheme' (2008) 43(7) Economic and Political Weekly 59.

91 The Gujarat Irrigation and Drainage Act of 2013, section 34, 51, 52.

92 Kulkarni, Shah and Shankar (n 15).

93 Government of India 1970 (n 67).

94 Kulkarni, Shah and Shankar (n 15).

95 Jacob J Burke and Marcus H Moench, *Groundwater and Society: Resources, Tensions and Opportunities. Themes in Groundwater Management for the Twenty-first Century* (United Nations Publication 2000).

96 Shah (n 44).

97 Dubash and Rajan (n 17); Dharmadhikary and others (n 74).

Such complexity necessitates changes in the regulatory framework. For much of the colonial period, the discussion about regulating groundwater irrigation had been absent. This was under the assumption that the 'inordinate expense' (the energy costs) of groundwater withdrawal would automatically limit its extraction for irrigation.[98] Technological advancement in drilling and pumping, paired with subsidised electricity and institutional credit facilities in absence of commensurate regulatory mechanisms for checking extraction enabled groundwater exploitation. As it pushed the limits of groundwater withdrawal beyond its annual recharge rate vis-à-vis the sustainable value; the consequent unregulated, private, and individualistic extraction has led to the wicked problem of groundwater exploitation. The lock-ins of de-facto linked land-title ownership to groundwater ownership, and the positive feedback from the farmers for the state assistance (the subsidies, the procurement and pricing policies) characterise the path-dependent pattern of groundwater use for irrigation. This makes certain solutions like well regulation or crop diversification difficult to implement despite the decline in growth rates of production and productivity, increase in input costs, and the environmental degradation (land, water, and air degradation).[99] The analysis emphasises the changes in the institutionalised incentive structure and the legal framework along with the pattern of groundwater use for irrigation to be necessary for sustainable groundwater use.

V. INSTITUTIONAL PATH-DEPENDENCY IN WATER POLLUTION GOVERNANCE

Water pollution gained traction as a policy problem in 1974. Traditionally, water quality had been a peripheral aspect of water laws, in Indian given they primarily concerned with resource allocation and appropriation. In the colonial period, the Easements Act 1882 and the Indian Penal Code 1860 governed water quality and pollution. However, with very little industrial pollution, concern regarding the quality of water was negligible. Post-independence, with increasing industrialisation, urbanisation and population growth, water pollution emerged as a problem that is complex, evolving and without a single solution exemplifying a creeping crisis, as it gradually aggravated into a wicked policy problem whose regulation straddles both spatial and temporal scales.

The outcomes of any plausible policy solutions to water pollution are contingent on the institutional framework that determines its regulation and management. This institutional framework is determined by the legislative provisions that provide legitimacy to the authority of organisations and their functioning for governance.[100] The Water Act 1974 enacted after the Stockholm Declaration of 1972, as a Central Legislation under Article 252 of the Constitution, was to provide the legal framework to set up

[98] Royal Commission of Agriculture (n 64) 350.

[99] Ramesh Chand, 'Emerging Crisis in Punjab Agriculture: Severity and Options for Future' (1999) 34(13) Economic and Political Weekly A2; Anindita Sarkar, 'Groundwater Depletion in Punjab: Turning Common Property Resource into Commodities' (2010) 30 (1) Annals of the Indian Association of Geographers 80; Government of India (GoI), Sixth Five-Year Plan 1980-85 (Planning Commission of India 1980) 154.

[100] Douglas C North, *Institutions, Institutional Change and Economic Performance* (1st edn, Cambridge University Press 1990) 66.

the pollution control boards - the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs).[101] These were intended to be core regulatory bodies with wide ranging powers to set standards as well as regulations to control water pollution. Similarly, under Schedule VI of the Environment (Protection) Rules of the Environment Protection Act 1986 regulatory standards for wastewater disposal were set up.[102] Both these Acts are the core of the legislative framework for the regulation of water pollution in the country, and central to the institutional complexity for water pollution regulation.

The Water Act 1974 was a critical juncture, the foundational policy window which shaped the future course of water governance for pollution in India. By centralising control under the CPCB and SPCBs, this initial policy choice created an institutional pathway that emphasised a top-down, bureaucratic approach to governance. This top-down bureaucratic hierarchy became the traditional mode of governance for regulating water pollution, operationalised through the pollution control boards (PCBs).

The minor amendments to the Water Act in 1978 and 1988 and the major amendment of decriminalising environmental violations in 2024,[103] reinforced this centralised model rather than adapting it to the evolving environmental and socio-political landscape. While these amendments themselves are sequential events that expanded the bureaucratic centralised models, an examination of successive National Water Policies (NWPs) in 1987, 2002, and 2012shows how they built upon a governance structure resistant to local, decentralised approaches.[104] The 1987 National Water Policy (NWP) established a centralised approach to water governance, prioritising state-led control of water allocation while offering limited provisions for local stakeholder involvement or water quality monitoring. This top-down model, influenced by earlier Five-Year Plans focused on economic growth through state infrastructure projects, largely excluded community-based input. The 2002 NWP continued this centralised focus, making only minor considerations toward stakeholder engagement. The policy retained a command-and-control approach that prioritised administrative efficiency but limited regional adaptability. The 2012 NWP advanced the agenda by recognising the need to integrate water quantity and quality considerations and proposed the 2016 National Water Framework Bill. However, while mandating that states ensure sufficient water quality for citizens and maintain centralised control, the bill did not specify enforceability provisions or clarify the institutional responsibilities across governance tiers, resulting in limited local decision-making power to address localised water challenges effectively.[105] Decentralised interventions, like Kochi's Septage Management

[101] The Water (Prevention and Control of Pollution) Act (India) 1974.

[102] The Environment Protection Act (India) 1986.

[103] Water (Prevention and Control of Pollution) Amendment Act (India), 1978 (No. 44 of 1978); Water (Prevention and Control of Pollution) Amendment Act (India), 1988 (No. 53 of 1988); Water (Prevention and Control of Pollution) Amendment Act, (India), 2024 (No. 5 of 2024).

[104] National Water Policy (India), 1987; National Water Policy (India), 2002; National Water Policy (India), 2012.

[105] Veena Srinivasan and others, 'Comments On the Draft National Water Framework Bill, 2016' (ATREE Archives) <https://archived.atree.org/sites/default/files/ATREE_Comments_NationalWaterFrameworkBill.pdf>.

Byelaws,[106] which account for specific local conditions, illustrate how scaling policy to the local level can improve responsiveness to community needs and environmental contexts.

Several studies have established that such regulation has been ineffective in addressing water pollution, evident from the persisting and aggravating pollution load.[107] The CPCB attributed this persistence of the water pollution to the anomalies in infrastructure development and maintenance, the lack of funds and capacities at the implementation level, the ULBs and State Water Supply and Sewage Boards.[108] However, we argue that this persistence of the water pollution problem is in-part due to the institutionalisation of the centralised approach to regulating the pollution. We understand this institutionalisation through a deeper examination of specific factors associated with pollution control boards such as authority, autonomy, and accountability. The Water Act confers the authority on the boards to make major decisions regarding staffing, financial allocations, and operations. While the Water Act lays down a broad composition of the Board with representatives from various sectors,[109] it does not specify the qualification of these members allowing arbitrary decisions by the state government for their selection.[110] The policy choice of not specifying member selection criteria has manifested as insufficient representation of the stakeholders who understand the nuances of the water pollution as a wicked problem and who are the affected communities.

Through the path dependency concept, this instance illustrates how early decisions—such as the vague guidelines on the composition of PCBs—have long-lasting impacts on the institutional processes which govern water pollution in the country. The institutional structure of boards set up during the critical juncture of notification of the Water Act has culminated in a lock-in, wherein subsequent policy decisions and institutional behaviours have become path dependent. In this case, the lack of clearly defined selection criteria has led to a feedback loop that entrenched arbitrary appointments. These appointments by state governments seem to be driven by considerations other than the technical competence of board members.[111]

For instance, the KSPCB had no mechanism or guidelines for the selection of the Board Chairman and member secretaries,[112] until 2016 when the National Green Tribunal prescribed the qualifications

[106] Septage Management Byelaw (Kochi Municipal Corporation 2016) <https://kochicorporation.lsgkerala.gov.in/system/files/2022-02/Septage_management_by-law.pdf>.

[107] Priyanka Jamwal, Sharachchandra Lele and Mahesh Menon, 'Rethinking Water Quality Standards in the Context of Urban Rivers' (Urbanization and the Environment: Eighth Biennial Conference of the Indian Society for Ecological Economics, Bangalore, 2016); Shreekant Gupta, Shalini Saksena and Omer F Baris, 'Environmental Enforcement and Compliance in Developing Countries: Evidence from India' (2019) 117 World Development 313.

[108] Central Pollution Control Board, 'Inventorization of Sewage Treatment Plants. Control of Urban Pollution Series' (Government of India 2015).

[109] The Water (Prevention and Control of Pollution) Act (India) 1974, Chapter 2, Section 3.

[110] Shibani Ghosh, Sharachchandra Lele and Nakul Heble, 'Appellate Authorities under Pollution Control Laws in India: Powers, Problems and Potential' (2018) 14(1) Law, Environment and Development Journal 49.

[111] ibid. 54

[112] Kerala Water (Prevention and Control of Pollution) Rules (India), 1976.

of the chairman.[113] Consecutively, the KSPCB in 2024 had a governing body constitutive of members representative of the government (5 members), the local authorities (6 members), the industries (1 member), the commercial sector (1 member), the agricultural sector (1 member), and a member secretary.[114] This composition shows that they are neither truly independent nor accountable to the public. Furthermore, it lacks independent technical experts who understand the complexity of the problem and its impact on public health and ecosystem, as well as representatives of the affected communities.

Similarly, the absence of appellate authorities in many states hinders the ability of affected communities or other stakeholders to challenge the decisions made by SPCBs. In Kerala, unavailability of information regarding the three-member appellate body, including details about its functioning on the official website of the KSPCB renders the institution opaque. The Chairman and the other two members of the appellate authority are ex-officio bureaucrats.[115] This limits the scientific and technical expertise in reviewing environmental grievances. Consequently, this lack of independent experts and stakeholder representation has crippled the boards' ability to fully address wicked problems characterised by uncertainty, complexity, and stakeholder divergence.

This pattern repeats across different states,[116] and is antithetical to what was envisaged initially in the Water Act. This clear mismatch between intent of the act and the actual outcome demonstrates how PCBs initially designed for preventing and controlling water pollution deviates from their intended objective of pollution regulation to entrenched practices. This mismatch exemplifies how early policy decisions shape the policy choices of the future and limit the scope for institutional reform. The path-dependent trajectory of the Water Act and its amendments along with the legal framework determinative of regulating water pollution has led to the institutionalisation of the selection of Board members. This in-turn is decisive of the policy solutions to the wicked problem of water pollution. Such institutionalisation of the selection mechanism of the board members exemplifies how feedback mechanisms can reflect as well as reinforce power asymmetries.

Power asymmetries emerge when certain actor groups enjoy disproportionate influence over the decision-making process. These actor groups form interest groups whose actions shape the feedback mechanisms for the path-dependent trajectory of institutions for water pollution regulation. This is evident in both the board composition and the lack of robust accountability mechanisms within the Water Act. In principle, the Act's provision of accountability mechanisms is delegated to the respective state governments who are responsible for formulation and implementation of these rules. However, the Kerala Water (Prevention and Control of Pollution) Rules, 1976 lacks the rigor

113 *Rajendra Singh Bhandari v State of Uttarakhand & Ors* [Original Application No. 318 of 2013].

114 Kerala State Pollution Control Board <https://kspcb.kerala.gov.in/about/board-members>.

115 Ghosh, Lele and Heble (n 110) 53.

116 Sharachchandra Lele, Priyanka Jamwal and Mahesh Menon, 'Challenges in Regulating Water Pollution in India: Standards, Monitoring, Enforcement and Accountability' (2021) 56 (52) Economic and Political Weekly 46.

for necessary oversight as they do not include provisions to adequately ensure accountability from the officials.

Furthermore, instances of discretionary tolerance violations also highlight the gaps in accountability mechanisms.[117] The discretionary powers vested in bureaucrats have led to informal practices such as rent-seeking and patronage.[118] The Supreme Court of India taking cognisance of the issue stated that, 'continued tolerance of such violations of law not only renders legal provisions nugatory but such tolerance by the enforcement authorities encourages lawlessness and adoption of means which cannot, or ought not to, be tolerated in any civil society'.[119] While the Supreme Court recommended taking action against the erring officials along with the violators, the Water Act 1974 and its amendments do not have any provisions to hold errant officials accountable for their action or inaction further encouraging violations. This absence of accountability institutionalised further non-compliance. Thus, incremental layering of institutional practices and policies around an entrenched institutional core created a form of institutional lock-in which further compounded water pollution as a wicked problem.

To address these gaps, it is critical that institutions are equipped with administrative forums which have mechanisms and processes to evaluate the conduct of officials. Currently, mechanisms to address failures or derelictions of duty by PCBs officials are usually restricted to show cause notices instead of criminal consequences. And often, it is up to the judiciary to hold them accountable by imposing fines after a judicial review. However, scholars have highlighted that courts and the NGT often fall short in holding government authorities accountable.[120] Thus, the institutional lock-ins of the lack of mechanisms for regular review and adaptation of laws perpetuates ineffective and outdated regulations for addressing water pollution.

VI. DISCUSSION AND CONCLUSION

Natural resource problems are often wicked policy problems characterised with significant institutional and organisational fragmentation. Complexity in such policy problems is marked by multiple levels of policy implementation; varying perceptions of the problem and policy goals; the use of diverse strategies and policy instruments; and a multifaceted foundation of institutions and organisations determining policy implementation.[121] This then reiterates Head's contention that a wicked problem is not solely about conflicting ideas and values; it is also embedded in institutional structures and processes which are inclusive of the power dynamics, authority, and procedural rules.[122]

[117] Esther Duflo and others, 'Truth-Telling by Third-Party Auditors and the Response of Polluting Firms: Experimental Evidence from India' (2013) 128(4) The Quarterly Journal of Economics 1499.

[118] ibid.

[119] *Indian Council for Enviro-Legal Action vs Union of India and others* [Writ petition no 664/1994].

[120] Raghuveer Nath and Armin Rosencranz, 'Determination of Environmental Compensation: The Art of Living Case' (2019) 12 NUJS Law Review 1.

[121] Johannes TA Bressers and Stefanus MM Kuks, 'What Does Governance Mean?' in Hans T A Bressers and Walter A Rosenbaum (eds), *Achieving Sustainable Development, The Challenges of Governance Across Social Scales* (Praeger 2003) 65.

[122] Head (n 36); Head (n 40).

While the characterisation of groundwater exploitation as a wicked problem stems from the institutional structure that has shaped groundwater resource use to be private, individualistic, and unregulated; for water pollution, it emanates from the continuation of institutional complexity in its governance defined by the structures, processes, authority, and procedural rules for its regulation. To be more specific, there is an absence of regulatory mechanisms for groundwater irrigation as opposed to suboptimal regulation in the domain of water pollution.

Governance of groundwater and water pollution in India are each constrained by distinct lock-in mechanisms. While groundwater exploitation is deeply entrenched within the institutional framework that facilitates intensive groundwaterextraction,drivenbyagricultural policies and practices; water pollution is rooted in the institutional framework that provides regulatory instruments operationalised through administrative processes and centralised institutions. Thus, the institutional lock-ins for groundwater governance perpetuate continuous extraction in a private, individualistic, and unregulated manner; as opposed to that for water pollution which sustain outdated, compliance-driven approaches. The feedback mechanisms, however, for each problemdifferconsiderably.Forgroundwater use, subsidies in the form of pricing for farm electricity supply and price support policies such as the minimum support price (MSP) act as economic incentives that reinforce the existing pattern of groundwater irrigation. However, for pollution control, feedback is predominantly operationalised through regulatory enforcement and compliance structures, which are often constrained by ineffective enforcement.

Furthermore, in theory the legal framework for water resources as per the Water Act 1974, and the Environmental Protection Act 1986 should be applicable for groundwater resources, in practice this has been absent. The advancement in scientific knowledge which negates the conceptualisation of groundwater and surface resources as separate, is yet to be adopted in practice with both being governed by the same legal framework.

These findings highlight the lack of reflexivity in the legal framework, leading to outdated and ill-conceived laws incapable of addressing the problems as they exist today. Scholars have highlighted the need for reflexivity in environmental laws to constantly adapt the solutions to the dynamic nature of the environmental problems.[123] Reflexive environmental laws, designed through the process of constructive regulation (a form of iterative and incremental improvement of laws with periodic reviewing to identify and address the gaps), ensures internal evaluation mechanisms and decision-making patterns to enable continuous self-reflection on the impact of the laws on the environment.[124] Reflexive laws further urge legal authorities to establish standards, goals, and processes for engagement while leaving decision makers with enough discretion to draft finer and more specific rules for the laws. This flexibility can be built into the laws by incrementally revising them over a period or through the concept of legal sunsets, which are planned windows of opportunities during which larger amendments can be brought into force.

[123] Daniel A DeCaro and others, 'Legal and Institutional Foundations of Adaptive Environmental Governance' (2017) 22(1) Ecology and Society: A Journal of Integrative Science for Resilience and Sustainability 1.

[124] Eric W Orts, 'A Reflexive Model of Environmental Regulation' (1995) 5(4) Business Ethics Quarterly 779.

This lack of reflexivity and institutional change is also evident in the absence of any amendments in the Easements Act 1882 that defined the usufructuary rights for the groundwater resources. Conversely, even though the amendments in the Water Act 1974 for water pollution have not been commensurate with the temporal and spatial scale of the problem, these amendments reflect a marginal shift in the efforts to address the water pollution problem.

While some aspects of the Water Act were far ahead of its time when it was conceived, it has not focused on institutional strengthening of the PCBs or the local government in order to enable them to effectively perform the tasks assigned to them. In such a context, it is important to have planned legal sunsets in the legislation to be reassessed and update the laws to reflect the changing complexities of the world. Such windows of opportunity can include a review by stakeholders from government agencies, experts, and the public in response to the emergence of new social contexts or knowledge. This was also reiterated by scholars who argued for giving financial, technical, and political support to local stakeholders and the public in solving environmental problems.[125]

The analysis shows how the path-dependence in the policy evolution has led to the persistence of water pollution and groundwater exploitation. The outdated provisions, absent or minimal regulation, and lack of adaptive governance mechanisms illustrate the changes posed by institutional legacies and fragmented enforcement. To address the wicked problems of water pollution and groundwater exploitation, the legal framework has to be reformed in cognisance of its institutional context with requisite provisions of flexibility, continuous self-evaluation, and robust accountability mechanisms.

[125] Ashutosh Sarker, 'The Role of State-Reinforced Self-Governance in Averting the Tragedy of the Irrigation Commons in Japan' (2013) 91(3) Public Administration 727.

LEAD Journal is a peer-reviewed journal which publishes - on lead-journal.org - articles, case notes and documents of interest to professionals, practitioners, researchers, students and policy-makers in the field of international and regional environmental law and domestic environmental laws of developing countries. It emphasises a comparative approach to the study of environmental law and is the only journal in the field to carry a North-South focus. It is unique in providing perspectives from both developed and developing countries. Bearing in mind the principles of "sustainable development", LEAD Journal also solicits writings which incorporate related concerns, such as human rights and trade, in the study of environmental management, thus adopting a contextual approach to the examination of environmental issues. LEAD Journal encourages scholarship which combine theoretical and practical approaches to the study of environmental law and practice.

SOAS IELRC
LEAD Journal: Law, Environment and Development Centre, SOAS University of London