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Reconstructing the legal politics of groundwater governance in Indonesia's East Bandung Industrial Zone: An ecological justice and water sovereignty approach

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Abstract
Groundwater depletion in Indonesia's East Bandung Industrial Zone has reached a critical systemic threshold due to decades of unregulated, intensive industrial extraction. This is evidenced by groundwater tables declining by more than 40 meters and land subsidence progressing at rates of 1–10 centimeters annually.
Despite an expansive statutory and regulatory framework, environmental degradation persists unabated, revealing profound structural deficiencies in groundwater governance. This study cross-examines the legal-political root causes of this governance failure and articulates a normative reconstruction model grounded in the paradigms of ecological justice and water sovereignty. Employing a normative juridical research methodology utilizing statutory, conceptual, and case study approaches, this analysis anchors its findings upon Lawrence Friedman's legal system theory, Edith Brown Weiss's intergenerational equity, Vandana Shiva's water sovereignty, and Satjipto Rahardjo's progressive law theory.
The findings demonstrate that ineffective regulatory enforcement stems directly from fragmented institutional coordination, overlapping jurisdictional boundaries, a severe deficit in technology-driven oversight, and an entrenched legal culture that consistently prioritizes short-term macroeconomic expansion over long-term ecological preservation. These conditions sustain an anthropocentric, development-oriented legal-political framework that systematically undermines environmental sustainability and public constitutional rights to water. As its primary theoretical and practical contribution, this study proposes a legal-political reconstruction framework that transforms groundwater from an economic commodity into a public trust resource and ecological asset. This framework outlines enforceable regulatory adjustments, including mandatory zero-net-depletion infrastructure, integrated digital monitoring across provincial authorities, and proactive environmental jurisprudence.

Keywords: Legal politics, groundwater governance, ecological justice, water sovereignty, intergenerational equity, environmental constitutionalism, East Bandung

Introduction

Groundwater governance has emerged as one of the most pressing socio-ecological and legal crises of the twenty-first century. As rapid industrialization, demographic expansion, and uncontrolled urban transformation converge globally, human reliance on subsurface aquifers has reached unprecedented levels [1]. In numerous developing jurisdictions across the Global South, macroeconomic growth strategies have vastly outpaced environmental regulatory and enforcement capacities [2]. Consequently, critical aquifer systems are subjected to accelerated overexploitation, permanent compaction, and systemic ecological degradation [3].

Indonesia presents a highly acute manifestation of this ecological and regulatory tension. The East Bandung Industrial Zone—encompassing manufacturing clusters across the Bandung Regency and Sumedang Regency borders—has relied exhaustively on deep groundwater extraction for over four decades to sustain its textile, chemical, and manufacturing sectors. While this industrial corridor has historically served as a macroeconomic engine for West Java, generating substantial employment and regional revenue, it has simultaneously externalized severe environmental costs onto the surrounding ecosystem and vulnerable local communities.

Empirical hydrological monitoring conducted by the Ministry of Energy and Mineral Resources (ESDM), alongside spatial data compiled in "Dokumen.pdf", reveals a catastrophic decline in the Bandung Basin's primary aquifers. Deep groundwater levels have dropped precipitously from safe historical depths of approximately 5–10 meters below the surface in the 1980s to critical deficits exceeding 40 meters at multiple industrial monitoring checkpoints today [4].

This massive void in subsurface hydrostatic pressure has triggered widespread land subsidence, averaging between 1 and 10 centimeters annually across industrial hotspots like Rancaekek and Panyileukan [5]. This structural sinking exacerbates seasonal flooding, permanently damages public infrastructure, and causes irreversible saltwater/pollutant intrusion into shallow domestic wells [6].

Paradoxically, Indonesia is not suffering from a vacuum of environmental laws. On the contrary, the nation possesses an expansive hierarchy of constitutional and statutory controls designed to safeguard its water reserves. Article 33, Paragraph (3) of the 1945 Constitution of the Republic of Indonesia explicitly establishes the Hak Menguasai Negara (State's Right of Control), mandating that all land, water, and natural resources contained therein belong to the public collective trust and must be utilized exclusively for the greatest prosperity of the people (sebesar-besar kemakmuran rakyat) [7]. This constitutional baseline is operationalized through Law Number 17 of 2019 concerning Water Resources, Government Regulation

Number 22 of 2021 concerning Environmental Protection and Management, and West Java Provincial Regulation Number 1 of 2017 concerning Groundwater Management.

Nevertheless, the relentless degradation of East Bandung's aquifers exposes a profound and systemic disconnect between normative legal theory and empirical reality. The continued depletion confirms that the current legal-political framework governing groundwater is structurally compromised. This research aims to dissect this breakdown by addressing the following core questions:

1. What legal-political factors contribute to groundwater governance failure in East Bandung?
2. How does Lawrence Friedman's legal system theory explain the persistence of groundwater depletion?
3. How can ecological justice and water sovereignty inform the reconstruction of groundwater governance?
4. What concrete legal reforms and statutory instruments are necessary to achieve sustainable groundwater governance?

Literature Review

1. Legal Politics and Natural Resource Governance

The concept of Politik Hukum (legal politics), as articulated in Indonesian jurisprudence by Moh. Mahfud MD, represents the official state strategy regarding the direction, formulation, enactment, and enforcement of laws to achieve explicit constitutional mandates [8]. In the context of natural resource extraction, legal politics acts as the primary ideological lens that dictates whether a regulatory framework tilts toward ecological conservation, public welfare distribution, or unbridled capitalistic exploitation [9]. When the legal politics of a state is co-opted by developmentalism, environmental statutes are reduced to mere procedural checklists that legitimize resource extraction rather than enforcing ecological boundaries [10].

2. Friedman's Legal System Theory

To evaluate why environmental laws fail to halt groundwater depletion, this study utilizes Lawrence M. Friedman's tripartite legal system framework, which posits that a legal system cannot function effectively unless its three constituent elements operate in harmony [11]:

Legal Substance (Substansi Hukum): The actual text of the law, including statutes, government regulations, and regional decrees.

Legal Structure (Struktur Hukum): The institutional machinery responsible for enforcement, including ministries, environmental inspectors, police, and the judiciary.

Legal Culture (Budaya Hukum): The collective values, awareness, behaviors, and attitudes that the public and corporate entities hold toward the law.

3. Ecological Justice

Ecological justice departs sharply from traditional, human-centric anthropocentric legal models. While environmental justice focuses on the equitable distribution of environmental benefits and burdens among humans, ecological justice extends moral and legal standing to the ecosystem itself [12]. It argues that non-human entities—including rivers, forests, and sub-surface aquifers—possess intrinsic rights to exist, regenerate, and maintain their structural integrity free from destructive human interference [13].

4. Water Sovereignty

Vandana Shiva's seminal work conceptualizes water sovereignty (daulat air) as a direct counter-narrative to the neoliberal commodification and privatization of water resources [14]. Water sovereignty dictates that water is a primary commons, an irreplaceable ecological asset, and an inalienable human right.

Consequently, democratic control over water allocation must reside with local communities and the state acting as a strict public trustee, rather than being subjected to market forces or monopolistic corporate extraction [15].

5. Intergenerational Equity

Edith Brown Weiss's planetary trust doctrine establishes that each human generation holds the Earth in common with all other generations [16]. As beneficiaries of this trust, the current generation bears an absolute legal and moral obligation to preserve the quality and quantity of natural resources, including finite groundwater reserves, so that future generations inherit an undiminished ecological inheritance [17].

6. Progressive Law Theory

Developed by Satjipto Rahardjo, Progressive Law Theory (Hukum Progresif) asserts that "law is for human beings, not human beings for the law." [18] It rejects rigid, mechanical legal formalism and text-bound positivism. Instead, it urges legal actors—especially judges and regulatory enforcement officers—to perform bold, purposive interpretations and exercise judicial activism to achieve substantive social and ecological justice, even when statutory instruments are deficient [19].

Research Methods

This study employs a normative juridical legal research methodology to systematically dissect the statutory, conceptual, and institutional landscape of groundwater governance in the East Bandung Industrial Zone. The normative framework is selected to critically evaluate the internal consistency, hierarchical alignment, and operational efficacy of existing positive laws against constitutional principles and eco-legal theories [20].

To provide a comprehensive diagnosis, the research combines three distinct methodologies:

1. **Statutory Approach (Pendekatan Perundang-undangan):** Used to analyze the vertical and horizontal coherence of Indonesian legislation, mapping conflicts between national growth laws and regional environmental mandates [21].

2. **Conceptual Approach (Pendekatan Konseptual):** Used to deconstruct current legal paradigms by injecting the theories of Friedman, Shiva, Weiss, and Rahardjo directly into the governance discourse [22].

3. **Case Study Approach (Pendekatan Kasus):** Focused specifically on the empirical and structural failures observed within the East Bandung Industrial Zone, utilizing primary and secondary localized reporting as summarized in **"Dokumen.pdf"**.

Primary Legal Materials Investigated:
The 1945 Constitution of the Republic of Indonesia (UUD NRI 1945). Law Number 17 of 2019 concerning Water Resources (UU SDA).
Law Number 32 of 2009 concerning Environmental Protection and Management, as amended by Law Number 6 of 2023 concerning Job Creation.
Government Regulation Number 22 of 2021 concerning Environmental Protection and Management (PP No. 22/2021).
West Java Provincial Regulation Number 1 of 2017 concerning Groundwater Management (Perda Jabar No. 1/2017).
The collected legal texts and empirical baselines were evaluated using a prescriptive-evaluative analytical technique. This allowed the authors to pinpoint normative gaps (hukum murni vs. hukum sosiologis) and formulate a concrete, legally binding reconstruction agenda.

Methodological Limitation Note: As a qualitative, doctrinal legal study, this research relies primarily on the textual analysis of statutes, court rulings, policy whitepapers, and regional environmental reports. It does not conduct primary hydrogeological core-drilling or field surveys. Instead, it contextualizes existing scientific data through a critical socio-legal lens.

Discussion

1. Legal Problems of Groundwater Governance in East Bandung

The critical degradation of groundwater reserves within the East Bandung Industrial Zone cannot be categorized as an accidental ecological byproduct; it is a structural failure engineered by the legal system itself. Applying Friedman's framework clarifies these underlying dynamics:

1.1 Weaknesses of Legal Substance

The primary flaw within the substance of Indonesia's water regulations is the high degree of normative ambiguity regarding prioritization. While Law Number 17 of 2019 explicitly states that public daily water needs take precedence over commercial exploitation, its implementing instruments contain massive regulatory loopholes.
For instance, the regulatory mechanisms for calculating the commercial Groundwater Extraction Tax (Pajak Air Tanah / PAT) remain deeply flawed. The economic cost of extracting deep groundwater is kept lower than the tariff for purchasing treated water from state-owned municipal utilities (PDAM) [23].
Thus, the law inadvertently incenti*vi*zes corporations to deplete the aquifer because the financial penalties or extraction taxes represent only a negligible fraction of operational overhead. Furthermore, the Job Creation Act (UU Cipta Kerja) has streamlined environmental impact assessments (AMDAL), weakening pre-extraction screening for manufacturing plants in industrial zones.

1.2 Weaknesses of Legal Structure

The institutional architecture governing West Java's water resources is highly fragmented and paralyzed by overlapping jurisdictions. The authority to issue groundwater extraction permits (SIPA) is held by the provincial government under the technical recommendation of the Center for Groundwater and Environmental Geology (BGP) under the Ministry of Energy and Mineral Resources (ESDM). However, field monitoring, pollution control, and local spatial planning enforcement are split between regional environmental agencies (DLH) and local municipal governments (Bandung and Sumedang Regencies).
This separation creates an enforcement vacuum. The ESDM lacks the field personnel necessary to monitor hundreds of deep industrial wells in real time, while the local DLH lacks the direct authority to suspend or revoke extraction permits issued at the provincial level. This bureaucratic isolation allows illegal, unmetered deep-well drilling to proliferate across the East Bandung industrial corridor without meaningful oversight.

1.3 Weaknesses of Legal Culture

Among industrial operators, compliance with water conservation laws is treated as an optional business cost rather than a binding legal and ethical duty [24].
This corporate indifference is reinforced by a weak enforcement culture within the state apparatus. Administrative sanctions are rarely scaled to reflect actual ecological destruction, and criminal prosecutions under Law No. 32 of 2009 are almost never brought against corporate executives for aquifer depletion.
Consequently, the prevailing legal culture views groundwater as an infinite, free raw material rather than a finite public trust resource.

Conclusion

The critical groundwater depletion and resulting land subsidence in Indonesia's East Bandung Industrial Zone represent a failure of the state's legal politics. The current framework remains captive to a development-oriented, anthropocentric ideology that treats groundwater as an infinite economic input rather than a fragile, finite public trust resource. This orientation has fractured the legal substance, crippled enforcement institutions, and fostered a corporate culture of non-compliance.
Arresting this environmental decline requires a comprehensive reconstruction of Indonesia's legal politics. By centering governance on the pillars of ecological justice, water sovereignty, intergenerational equity, and progressive law, the state can realign industrial development with its constitutional mandates.
Groundwater must be repositioned as an invaluable public asset, ensuring that the ecological integrity of the Bandung Basin is preserved for both the current generation and those to come.

Recommendations

To implement this legal-political reconstruction, the following actions are recommended:
Enact an Immediate Extraction Moratorium: The Ministry of Energy and Mineral Resources (ESDM), in coordination with the West Java Provincial Government, must issue a joint decree declaring a moratorium on all new groundwater extraction permits (SIPA) within designated critical aquifer zones in East Bandung, alongside a mandatory audit of all existing industrial permits.

Mandate Infiltration and Recharge Infrastructure: Amend regional building and industrial zoning regulations to require all manufacturing firms to construct certified deep-well injection and rainwater harvesting systems. Non-

compliance must result in the automatic revocation of their operational licenses.

Deploy an Integrated Digital Monitoring Network: Establish a mandatory, cloud-based telemetry metering system on all industrial deep wells, linked directly to an open-access public dashboard managed by a joint ESDM-DLH council to ensure absolute transparency in extraction volumes.

Form a Specialized Groundwater Enforcement Task Force: Create a dedicated inter-agency environmental law enforcement unit—comprising civil service investigators (PPNS), environmental inspectors from the DLH, and prosecutors—authorized to conduct unannounced inspections and initiate criminal proceedings against illegal extractors.

Establish a Progressive Groundwater Taxation Scheme: Radically restructure the calculation of the Groundwater Extraction Tax (Pajak Air Tanah) to ensure the cost per cubic meter significantly exceeds the tariff for treated municipal industrial water, using the surplus revenue exclusively for regional aquifer remediation.

Issue Supreme Court Environmental Guidelines: The Supreme Court (Mahkamah Agung) should issue a specific circular letter (SEMA) instructing administrative and civil judges to apply the principles of strict liability, the public trust doctrine, and extensive ecocentric restorations when adjudicating groundwater depletion and environmental cases.

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