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Bridging Global Water Governance and Local Realities in Developing Countries

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ABSTRAK

Eskalasi krisis iklim mengubah kelangkaan air menjadi ancaman eksistensial di negara-negara berkembang, bahkan ketika agenda global seperti SDG 6 dan Perjanjian Paris menyediakan kerangka kerja normatif. Artikel ini menganalisis kesenjangan antara kebijakan internasional dari atas ke bawah dan realitas sosial-politik ekologi lokal, politik, dan siklus hidrososial. Studi ini menggunakan kasus dari India, Ethiopia, dan Indonesia untuk mengeksplorasi bagaimana bias teknokratis dan komersialisasi meminggirkan komunitas yang rentan. Hasil studi menunjukkan bahwa tata kelola global telah gagal karena mengabaikan infrastruktur, masalah sosial, tarif air yang tidak terjangkau, dan ilusi transfer teknologi; Solusi Berbasis Alam (NbS) lokal menawarkan solusi alternatif yang tangguh. Penelitian ini menyimpulkan bahwa keberlanjutan air bergantung pada produksi bersama pengetahuan hibrida daripada standardisasi global untuk keadilan distributif.

ABSTRACT

Escalation of the climate crisis is transforming water scarcity into an existential threat in developing countries, even as global agendas such as SDG 6 and the Paris Agreement provide a normative framework. This article analyzes the gap between international top-down policies and the sociopolitical realities of local ecology, politics, and the hydrosocial cycle. This study uses cases from India, Ethiopia, and Indonesia to explore how technocratic bias and commercialization marginalize vulnerable communities. Study results show that global governance has failed because it ignores infrastructure, social issues, unaffordable water tariffs, and the illusion of technology transfer; local Nature-based Solutions (NbS) offer an alternative, resilient solution. The research concludes that water sustainability depends on a hybrid co-production of knowledge rather than global standardization for distributive justice.

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1. INTRODUCTION

In the Anthropocene era, water has transformed from a purely biophysical resource into a contested socio-political entity that disrupts the global hydrological cycle through increasing frequency of droughts, extreme floods, lightning storms, and decline in groundwater reserves, creating uncertainty and acute hydrological disasters in developing countries [1]. The phenomenon manifested as changes in precipitation patterns, accelerated glacier melting, and seawater intrusion into coastal aquifers have intensified water scarcity. Global statistics project that in 2025, two-thirds of the world population will face water stress, with the Global South contributing minimally to emissions but bearing the greatest impacts; adaptation will bear the heaviest consequences and limitations, creating uncertainty and increasing the risk of acute hydrological disasters and fiscal burden [2]. For example, covering 600 million Indians who experience acute scarcity, the Nile River conflict in Ethiopia, and rapid urbanization and growth in Jakarta, which causes soil degradation at a rate of 25 cm per year due to excessive extraction.

The problem lies in the assumption of a universal solution in technical global water governance, as promoted by SDG 6 and the Paris Agreement. International push for standard models based on market efficiency, privatization, and technology (IoT sensors, AI predictions), which often fail to confront the realities of complex local issues: laws, customs, inequality, agrarian inequality, informal distribution in slums, and cultural norms [3]. Gaps between governance above (global governance) and practice field (local realities) produce inefficiency and distributive injustice, where the project dam temporarily evicts community customs, while the benefits flow to industry exports. Using a political ecology and hydrosocial perspective, this analyzes the cases of India, Ethiopia, and Indonesia to reveal the disconnection, evaluates the effectiveness of SDG 6, and formulates an adaptation model, a hybrid-based model, based on Nature-based Solutions (NbS), which integrates global norms with local wisdom to reach resilient water justice. This study aims to examine the gap between global water governance frameworks and local implementation realities in developing countries.

2. METHOD

This study adopts a qualitative comparative case study approach focusing on India, Ethiopia, and Indonesia. Three countries were chosen because they represent the diverse geography of the subcontinents of South Asia, East Africa, and Southeast Asia, and because they face similar challenges related to water scarcity, climate, urbanization, and development. The criteria for coverage include water level height (according to the WWF Aqueduct Index), international aid, and the availability of rich secondary data.

Primary data are collected through several stages. First, policy document analysis: review critical to UN report (UN-Water Reports 2020-2026), Law Source National Water Resources (e.g, India's National Water Policy 2012, Ethiopia's Water Resources Management Proclamation 2010, Indonesia's Law No. 17/2019), and Nationally Determined Contributions (NDC) in the framework of the Paris Agreement. Second qualitative comparative case study of the literature: Synthesis of the themes from 15-20 peer-reviewed articles in Scopus-indexed journals discussing the implementation of water project hydrological conflicts and climate adaptation in the three countries, with a focus on the 2018-2025 period. Articles were selected based on their relevance to water governance, climate adaptation, and representation of the selected country contexts. Third, political ecology analysis: identification of actors (state, private, community), interests, conflictual and asymmetric using the power cube framework (Gaventa, 2006, cited in Shah, 2024). The data were analyzed using thematic analysis, focusing on key themes such as governance gaps, technocratic bias, and local adaptation strategies. Qualitative data coding was conducted to identify recurring patterns and themes.

To ensure validity, data triangulation was conducted using policy documents, academic literature, and case-based evidence. Validity is achieved through the triangulation of sources with expert knowledge of ecological politics. Research limitations include reliance on secondary data, which may be biased towards an elite perspective. Recommendations emphasize the need for continued education in the field.

3. RESULT AND DISCUSSION

3.1 India: Crisis Amid Smart Water Ambitions

India is facing a severe water crisis, with major cities like Chennai and Bengaluru predicted to reach Day Zero in 2030 due to extreme hydrological stress. Governments respond to the ambitious Jal Jeevan Mission program (target 100% housing) and the Smart Cities Mission, in which IoT is integrated for real-time monitoring of flow and leaks.

Analysis findings show that digitalization of water governance creates enclaves of technology that reflect a global technocratic bias [4]. Sensor devices and applications data management are not only installed in commercial zones but also in elite settlements, ensuring efficient billing for consumers who pay high prices. On the other hand, millions of residents in informal settlements (slums), which account for 40% of the permanent urban population, rely on the illegal private tanker markets, which sell water at 10-20 times the official price, exemplifying real deepening of commercialization and inaccessibility [5]. The 2019 Chennai Day Zero incident demonstrated a conflict between the city's social moment and elite city order over private water, leaving poor people without access. Global policies that promote technological modernization, in turn, weaken the ecological cycle of hydro-social hybrid local systems, leading to leakage rates of up to 35% and resulting in extreme and stratified access [2].

3.2 Ethiopia: Geopolitics of the Nile and its Impact on Local

Ethiopia is undergoing a transition in hydro politics with the Grand Ethiopian Renaissance Dam (GERD) on the Blue Nile River, with significant potential to generate 6,000 MW of electricity and provide national irrigation. Although it has become a symbol of sovereignty, its impact on the local community in the Central Rift Valley is often overlooked in the narrative of macro development.

Bantider et al. [6] documented conflict between government agendas to expand large-scale irrigation for commodity exports (tea, flowers) and community water needs, Oromo customs for cattle subsistence, and the use of domestic water. In the 2022 water allocation for agribusiness, supply was reduced for 200,000 small farmers, triggering mass protests and migration, forcing a form of water grabbing driven by international green growth policies. Water charges for household local reach account for 12-15% of revenue, exceeding the WHO's inaccessibility threshold, while priority export reflects the commercialization of the power source [3]. GERD also triggers transboundary tensions with Egypt and Sudan, diverting water from the power plant to accommodate a one-lock system and customary water rotation. This failure reflects the persistence of technocratic bias in large-scale dam projects that ignores infrastructural and structural issues in the land post-irrigation reaching 25% in the Rift Valley [2].

3.3 Indonesia: Contradiction Regulation and Resilience Community

Indonesia faces a unique challenge: a dual flood-drought on the island of Java, particularly in coastal cities such as Jakarta (15 cm/year), due to over-extraction of groundwater-Law No. 17 of 2019 concerning water resources, involving private limited companies, through PDAM. Rumihin [7] reveals that implementation regulations at the local level hampered the improvement of the system, resulting in systemic inefficiencies, including up to 30% water leakage and governance-related corruption at the local level, resulting in a lack of proportionate fueling the black market in bottled water. However, it appears bright from the initiative's roots, challenging global technocratic bias. In Makassar, the Nature-

based Solutions (NbS) co-production program, such as park infiltration, natural mangrove filtration, and watershed restoration, reduces flooding by 40% and increases groundwater recharge, designed together with informal residents [8]. In Bali, the system of irrigation customs, subak (UNESCO heritage), proved resilient to drought in 2023, thanks to the integration of cultural rituals with collective management, in contrast to the failure of concrete dams and stalled imports, resulting in the illusion of technology transfer [10]. This case shows a potential hybrid hydrosocial systems as an alternative, inclusive approach, where local knowledge is more adaptive than the international design standard [9]. This study highlights the importance of integrating global frameworks with locally grounded governance approaches to achieve equitable and sustainable water management.

3.4 Synthesis: Why does the gap in implementation happen?

3.4.1 Technocratic Bias vs Reality Social

One of the main reasons for the implementation gap is the technocratic bias inherent in the global governance framework. Institutions such as the World Bank and UN-Water tend to prioritize solution infrastructure, physical, visible and measurable, such as large development dams, smart pipelines, and IoT sensor systems for real-time monitoring (Birkinshaw, 2025). This assumes that water scarcity can be completely addressed through engineering hydrology, ignoring the crucial social dimensions. In the framework of the hydrosocial cycle (Laituri, 2020) infrastructure physique is just one element of a complex network that includes norm culture, communal rules, and local dynamic power.

In the third study's case, the pattern repeats: In India, the smart water system in Bengaluru failed to reach the slum because of incompatibility with the pattern of informal distribution; in Ethiopia, GERD irrigation ignores the Oromo customary water rotation; while in Indonesia, modern PDAMs are often damaged due to a lack of maintenance in the community. Without strengthening infrastructure, social, namely trust, norms of cooperation, and mechanisms for resolving conflicts, investment in physical infrastructure becomes in vain. As Shah (2024) stated, water not only flows through the pipe, but through social connections. This failure results in infrastructure leakage levels of up to 40% in developing countries, far above the global average of 20% (Khalid, 2020).

3.4.2 Commercialization and Inaccessibility

Pressure to achieve efficiency from international donor agencies often drives the commercialization of water resources through a public-private partnership (PPP) and the determination of rates based on meters. Although aiming to reduce unsustainable subsidies, this model creates artificial scarcity for vulnerable groups. In India, smart metering tariffs in Chennai increased by 300% for the low-income households, leading to increased reliance on illegal tankers (Birkinshaw, 2025). In Ethiopia, water priorities for agribusiness exports, such as flower cut, reduce allocation to farmer subsistence, where water costs account for 12-15% of income. Households exceeds the WHO threshold of 3% for access to affordable water (Bantider et al, 2023).

In Indonesia, the privatization of PDAM resulted in rates that are not proportional, with 25% of the urban poor losing access (Rumihin, 2024). This phenomenon reflects hydro-capitalism where water is transformed into a commodity, a profitable corporation, a multinational corporation, making things worse, inequality. Yalew et al. (2021) highlighted that, without subsidies, progressive or intersectoral water transfer mechanisms, and commercialization, achieving SDG 6, especially Target 6.b on public participation at the local level, is weakened.

3.4.3 The Illusion of Technology Transfer

Work in the same international environment often requires technology transfer from donor countries, such as desalination systems or AI flood prediction. However, technology is prone to stalling due to reliance on spare parts from tribes, expensive imports, and a lack of skilled technicians. In India,

60% of smart water projects fail operationally within 2 years (Birkinshaw, 2025); in Ethiopia, pumps are damaged by solar donors due to dust and power outages (Bantider et al, 2023). In contrast, the right solution (appropriate technology), such as rainwater harvesting in Indonesia, has been proven durable because it uses local materials and the society's knowledge (Taufik et al, 2022).

Illusion: This is rooted in the assumption of linear modernization, which ignores context and hydrosocial hybrids in the Global South. As Laituri (2020) argued, technology transfer without local adaptation creates long-term dependence, inhibiting autonomy and adaptation to the climate.

3.5 Implications, Policies, and Recommendations

3.5.1 Shift Paradigm to Local-led Adaptation

To bridge gaps, global governance must shift from a top-down model of instructions to one that facilitates local-led adaptation. Allocation of climate funds, such as the Green Climate Fund (GCF), must be prioritized directly to government regions and organizations, and to public civil society (OMS), not only through channels vulnerable to corruption. Yalew et al. (2021) recommend a block grants mechanism with an accountability-based community, as was successful in the Ethiopian NbS pilot. At the community level, national policy must require free, prior, and informed consent (FPIC) for water projects, integrating voice customs such as Balinese subak or the Oromo system. Global institutions are to re-establish regional Water Justice Forums for ongoing dialogue among international and local actors.

3.5.2 Integration of Nature-based Solutions (NbS) at a scalable scale replicated

Nature-based Solutions (NbS) must become the main pillar of adaptation because they are cheaper (50-70% of the cost), more resilient, and more inclusive. Recommendations specific includes: (1) River Basin Restoration (DAS) with incentive payment service ecosystem (PES) for farmer upstream, such as in Makassar which reduces flooding 40% (Moschonas et al, 2025); (2) Rainwater harvesting scale households with subsidy for 80% of the poor population: (3) Protection of natural water towers like forest mountains in Ethiopia and Java. The government needs to develop NbS Toolkits based on proven local, supported training capacity for the technician community. Collaboration with IUCN can accelerate scalability, ensuring NbS is not just a pilot but a national initiative.

3.5.3 Indicator Reform Success and Mechanism Accountability

SDG 6 indicators must be reformed from metric reductionist (number pipe connection) to comprehensive: (1) Quality service (consistency flow >12 hours/ day); (2) Justice distributive (percentage of households served <10% of costs income); (3) Resilience climate (capacity responsive to drought). Bantider et al. (2023) proposed citizen-led monitoring through a mobile application for field verification, similar to the Philippine Score card, which improved PDAM accountability by 30%. At the global level, UN-Water must adopt an Equity Index that includes gender and customary dimensions. In addition, sanctions for failed projects under FPIC will prevent greenwashing of development.

Implementation recommendation: This needs commitment from the political cross-scale, with a target of achieving 50% of water-based NbS projects locally by 2030. Funding hybrid (climate funds + private CSR) can bridge the fiscal gap, ensuring a fair transition towards SDG 6.

4. CONCLUSION

Climate change has transformed water scarcity into a reflection of systemic governance failures in developing countries where global mandates such as SDG 6 often collide with complex local realities. The analysis of India, Ethiopia, and Indonesia shows that technocratic bias, commercialization, and misaligned technology transfer continue to marginalize vulnerable communities. This weakens hybrid hydrosocial systems that form the backbone of local resilience, and modern solutions like smart water

and mega dams often fail operationally, while initiatives rooted in grassroots, like NbS in Makassar and Bali's subak, offer affordable and inclusive adaptive models.

Reconciliation between international norms and local wisdom requires co-production of knowledge. Top-down standardization is not a prerequisite for water sustainability. Reforming SDG indicators towards metric justice and resilience, allocating funds directly to the local level, and prioritizing NbS will bridge the implementation gap. Ultimately, maintaining water sustainability means upholding social justice: water must flow to all, not only to those who can afford it. Research is recommended to explore the scalability of NbS through longitudinal trials and analysis of the transboundary political economy.

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