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Adaptive Tropical Waterschappen Model for Sustainable Wetland Governance in Indonesia

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A B S T R A C T

Wetlands in Indonesia play a strategic role in food security, water regulation, carbon storage, and local livelihoods, yet their governance remains constrained by fragmented institutions, weak infrastructure maintenance, limited participation, and ecological degradation. This article aims to develop an adaptive governance model for sustainable wetland governance in Indonesia by translating selected principles of the Dutch Waterschappen system into tropical wetland settings. The study applies a qualitative descriptive-comparative conceptual design based on literature review, policy review, and illustrative analysis of five Indonesian wetland contexts. The findings identify four recurring governance problems: hydrological–administrative misalignment, weak institutional continuity, limited participatory integration, and low implementation capacity. In response, the article proposes the Tropical Waterschappen model, consisting of six pillars: hydrology-based institutional alignment, inclusive multi-stakeholder governance, collaborative and sustainable financing, adaptive spatial and ecological management, transparent information and participatory monitoring, and implementation capacity through human capital and institutional behavior. The model contributes to wetland governance literature by linking institutional design with an implementation mechanism grounded in human capital and behavioral readiness. Practically, it offers a management-oriented framework for strengthening coordination, participation, financing continuity, and adaptive ecological governance in Indonesian wetlands.

INTRODUCTION

Wetlands are among the most important ecosystems in Indonesia because they support food production, water regulation, biodiversity conservation, carbon storage, and local livelihoods. Their functions make wetlands strategically significant not only from an ecological perspective, but also from a socio-economic and development perspective. However, despite their importance, wetlands in Indonesia remain vulnerable to degradation caused by land conversion, hydrological disturbance, weak infrastructure maintenance, and fragmented governance arrangements. This condition indicates that sustainable wetland management cannot rely solely on technical intervention, but requires governance systems that are institutionally coherent, socially legitimate, and ecologically adaptive (Ramsar Convention Secretariat, 2021).

A major challenge in Indonesia is that wetland governance is still often organized through sectoral and administrative logics rather than hydrological realities. Responsibilities are commonly divided among public works agencies, agricultural institutions, environmental agencies, and local governments, each operating within separate organizational mandates. As a result, water governance is often fragmented, maintenance continuity is weak, and participation remains limited. Such fragmentation produces an institutional mismatch between the ecological characteristics of wetlands and the governance structures assigned to manage them. When governance boundaries do not correspond to hydrological systems, implementation tends to be inconsistent and policy outcomes remain suboptimal (Qodriyatun, 2017; Yusran, 2022).

Existing studies on wetland governance have largely emphasized structural and policy dimensions, such as institutional arrangements, environmental regulation, and coordination problems. While these studies provide valuable insights, they are often less explicit in explaining how governance models can be translated into operational institutional mechanisms in tropical wetland settings. Moreover, governance literature has not sufficiently connected institutional design with implementation capacity, particularly in terms of how actors' competence, behavioral readiness, and commitment shape governance effectiveness. This creates both a theoretical and practical gap: structurally sound governance arrangements may still fail when implementation capacity remains weak (Cantaluppi et al., 2023; Pahl-Wostl, 2009; Parker et al., 2024).

An important comparative reference for addressing this challenge is the Dutch Waterschappen system. Historically, Waterschappen developed as hydrology-based institutions that govern water beyond administrative boundaries. Their relevance lies in several core principles, including hydrological territoriality, participatory representation, financial continuity, and public accountability. These principles remain valuable in contemporary governance discussions because they support long-term institutional durability and adaptive resource management (Kabat et al., 2009). However, the Dutch model cannot be transferred directly to Indonesia, since Indonesian wetlands are shaped by tropical peat dynamics, tidal hydrology, customary institutions, and uneven local administrative capacity. What is needed, therefore, is not replication, but adaptive translation.

At this point, human capital and institutional behavior become important. Effective wetland governance depends not only on formal institutional architecture, but also on whether actors possess the competence, motivation, and behavioral readiness to implement governance functions consistently. Drawing on the Theory of Planned Behavior, this article argues that governance outcomes are influenced by the interaction between institutional design and actor-based implementation mechanisms. Human capital strengthens knowledge, skills, and readiness, while attitudes, subjective norms, and perceived behavioral control help explain how institutional intention is transformed into governance behavior (Adeyemi et al., 2025; Ajzen, 1991, 2020; Novak & Juvan, 2025).

Accordingly, this study positions wetland governance not only as an institutional design problem, but also as an implementation problem. In this article, the Dutch Waterschappen system provides the comparative governance logic, while human capital and behavioral constructs explain how adapted institutional arrangements may become operational in practice. This integration helps clarify why governance reform in tropical wetlands requires both institutional architecture and actor-based implementation capacity.

Based on this background, this article aims to develop an adaptive governance model for sustainable wetland governance in Indonesia through the concept of Tropical Waterschappen. The novelty of the article lies not merely in comparing Indonesia with the Netherlands, but in proposing an integrated governance framework that combines hydrology-based institutions, inclusive participation, collaborative financing, ecological adaptation, and implementation capacity through human capital and institutional behavior. In this way, the article contributes to management and governance literature by offering a contextual and operationally oriented framework for tropical wetland governance.

RESEARCH METHODS

This study employed a qualitative descriptive-comparative conceptual design to formulate an adaptive governance model for sustainable wetland governance in Indonesia. The study did not aim to test causal relationships statistically, but to synthesize institutional principles, identify recurring governance gaps, and construct a context-sensitive governance model for tropical wetland settings.

The analysis was based on three categories of secondary sources. First, academic literature was collected from peer-reviewed journals and relevant scholarly publications addressing wetland governance, adaptive governance, hydrology-based governance, peatland restoration, human capital, and institutional behavior. Second, policy and institutional documents were used to understand the Indonesian regulatory and governance context related to wetlands and water management. Third, illustrative evidence from selected wetland regions in Indonesia was used to contextualize recurring governance problems and support comparative interpretation.

The literature search was conducted using major academic databases such as Scopus, Google Scholar, and related publisher platforms. The search used combinations of keywords including "wetland governance," "adaptive governance," "Waterschappen," "hydrology-based governance," "peatland restoration," "human capital," and "institutional behavior." Sources were included when they were relevant to the analytical themes of the study, provided conceptual or empirical insight into governance design or implementation capacity, and supported comparative interpretation between Dutch water governance and Indonesian wetland conditions. Policy documents were selected based on their relevance to the Indonesian wetland and water governance context.

The literature search focused on publications from approximately 2009–2025, with emphasis on sources relevant to five analytical themes: (1) hydrology-based institutional design, (2) stakeholder participation and accountability, (3) financing and institutional continuity, (4) adaptive and ecological wetland management, and (5) implementation capacity through human capital and institutional behavior. Sources were prioritized when they offered conceptual or empirical relevance to these themes. Publications that were only marginally related to governance design or implementation capacity were not prioritized in the synthesis.

To strengthen contextual relevance, five Indonesian wetland settings were used as illustrative cases: Barito Kuala, Ogan Komering Ilir, Indragiri Hilir, Merauke, and Kapuas Hulu. These were not treated as statistically representative cases, but as analytical illustrations selected because they reflect different ecological and governance expressions of wetland management problems. Together, they represent recurring challenges in water operation and maintenance, peatland vulnerability, institutional fragmentation, food-estate governance, and the role of local and customary institutions (Lyastini et al., 2024; Susilawati et al., 2017).

The analytical procedure was conducted in four stages. First, the core principles of the Dutch Waterschappen system were identified from the literature. Second, recurring governance problems in Indonesian wetlands were synthesized from policy and contextual sources. Third, both sets of findings were compared to identify which Waterschappen principles were transferable and which required contextual adaptation. Fourth, the results were synthesized into the proposed Tropical Waterschappen model by integrating structural governance dimensions with implementation dimensions grounded in human capital and institutional behavior.

To enhance conceptual trustworthiness, the study used source triangulation across academic literature, policy documents, and contextual wetland illustrations. Comparative validation was also applied by checking whether the proposed model remained consistent across multiple governance themes rather than relying on a single institutional perspective. The resulting framework should therefore be understood as a conceptual model intended to guide future empirical testing and pilot implementation rather than as a finalized institutional design.

RESULTS & DISCUSSION

Key Governance Problems in Indonesian Wetlands. The synthesis indicates that wetland governance in Indonesia is constrained by four recurring problems. First, governance remains misaligned with hydrological realities because institutions are commonly organized by administrative and sectoral boundaries rather than by water systems. Second, operation and maintenance of canals, sluices, and drainage structures are often weak and discontinuous, reducing the long-term effectiveness of infrastructure. Third, participation by local communities and customary actors is frequently procedural rather than embedded in the governance structure itself. Fourth, implementation capacity remains limited because formal arrangements are not always supported by actor competence, institutional learning, and behavioral commitment. These findings suggest that wetland governance problems in Indonesia are not only technical, but fundamentally institutional and managerial (Rusadi & Yuslaini, 2021; Yusran, 2022).

Table 1 summarizes the major governance gaps identified in Indonesian wetland management and links them with the proposed responses embedded in the Tropical Waterschappen model. The governance problems reflected in the table are consistent with prior discussions on fragmented wetland governance, hydrological misalignment, weak maintenance continuity, and ecological vulnerability in Indonesian wetlands and related governance studies.

Table 1. Governance Gaps and Proposed Tropical Waterschappen Responses

Governance Gaps in Indonesian Wetlands	Main Issues Identified	Proposed Tropical Waterschappen Responses
Hydrological–administrative misalignment	Wetland systems are managed according to administrative boundaries rather than hydrological units, resulting in fragmented coordination and weak system-wide control.	Reorganize governance around hydrological units such as sub-catchments, peat hydrological units, tidal blocks, or ecologically connected wetland zones.
Weak operation and maintenance continuity	Water infrastructure such as canals, sluices, and drainage systems is often poorly maintained due to unstable funding, overlapping authority, and reactive management.	Strengthen routine operation and maintenance through hydrology-based institutional responsibility, clearer functional roles, and long-term management planning.
Fragmented institutional authority	Public works, agriculture, environment, and local government institutions often operate separately, causing duplication, delay, or governance neglect.	Establish an integrated governance platform through the Tropical Waterschappen framework to improve cross-sectoral coordination and institutional alignment.
Limited and procedural participation	Local communities, customary actors, and water users are often consulted only formally and not meaningfully involved in decision-making or monitoring.	Build inclusive multi-stakeholder forums that embed farmers, customary institutions, village actors, women's groups, and relevant stakeholders into governance processes.

Governance Gaps in Indonesian Wetlands	Main Issues Identified	Proposed Tropical Waterschappen Responses
Unstable and project-based financing	Wetland governance remains dependent on annual budgets or short-term projects, reducing institutional continuity and implementation effectiveness.	Develop collaborative and sustainable financing through regional budgets, village funds, community contributions, corporate support, and environmental incentive mechanisms.
Weak transparency and monitoring	Governance decisions, maintenance priorities, and ecological conditions are not always supported by transparent and accessible information systems.	Introduce transparent information systems and participatory monitoring supported by community-based reporting, digital dashboards, and hydrological observation tools.
Low adaptive capacity	Governance systems are often rigid and slow to respond to ecological change, peat degradation, tidal variability, and climate-related risk.	Integrate adaptive spatial and ecological management, including restoration-sensitive planning, hydrological monitoring, and iterative governance adjustment.
Limited implementation capacity	Governance effectiveness is constrained by weak human capital, inconsistent coordination behavior, and low implementation discipline.	Strengthen implementation capacity through human capital development, institutional learning, technical training, and behavior-oriented governance support.

Source: Research data processed from reviewed literature, 2026.

As shown in Table 1, the Tropical Waterschappen model addresses wetland governance problems not through a single institutional intervention, but through an integrated set of responses. This confirms that sustainable wetland governance requires simultaneous improvement in institutional design, participation, financing, ecological adaptation, information systems, and actor capacity.

Transferable Principles from Dutch Waterschappen. The comparative review shows that the Dutch Waterschappen system provides several transferable governance principles. These include hydrology-based institutional alignment, participatory representation, financial continuity, and accountability. In modern governance terms, these classical principles can be extended by adaptive governance, ecological restoration, and information-based monitoring. Their relevance for Indonesia lies not in institutional replication, but in their capacity to address recurring governance weaknesses such as fragmentation, maintenance discontinuity, and low legitimacy. This confirms that Waterschappen should be treated as a source of institutional logic rather than a ready-made administrative blueprint (Kabat et al., 2009; Pahl-Wostl, 2009; Runhaar et al., 2015).

Proposed Tropical Waterschappen Model. Based on the synthesis, this study proposes the Tropical Waterschappen model as an adaptive governance framework for Indonesian wetlands. The model consists of six pillars: (1) hydrology-based institutional alignment, (2) inclusive multi-stakeholder governance, (3) collaborative and sustainable financing, (4) adaptive spatial and ecological management, (5) transparent information and participatory monitoring, and (6)

implementation capacity through human capital and institutional behavior. Together, these pillars respond directly to the governance gaps identified in Indonesian wetlands and provide an integrated architecture for wetland governance reform.

Operationally, the model can be implemented through governance units organized around hydrological zones such as sub-catchments, peat hydrological units, or connected wetland blocks. These units should be supported by multi-actor forums involving local government, technical agencies, communities, customary institutions, and other relevant stakeholders. Financing should combine public budgets, local contributions, and restoration-related support mechanisms. Monitoring should combine hydrological observation, ecological indicators, and accessible information systems. This means that the proposed model is not only conceptual, but also capable of being translated into a practical governance arrangement at regional level (Qodriyatun, 2017; Susilawati et al., 2017).

Table 2 presents the six pillars of the Tropical Waterschappen model and their managerial functions. These pillars were synthesized from the institutional principles of Waterschappen, adaptive governance literature, wetland restoration studies, and the role of human capital and institutional behavior in governance implementation (Ajzen, 1991, 2020; Kabat et al., 2009; Pahl-Wostl, 2009).

Table 2. Six Pillars of the Tropical Waterschappen Model and Their Managerial Functions

Pillar of the Tropical Waterschappen Model	Core Meaning	Managerial Function in Wetland Governance
Hydrology-Based Institutional Alignment	Governance is organized according to hydrological units rather than administrative boundaries.	Improves institutional alignment, reduces fragmentation, and strengthens coordination across ecologically connected wetland areas.
Inclusive Multi-Stakeholder Governance	Governance includes farmers, local communities, customary institutions, village actors, women's groups, government, and other stakeholders.	Enhances legitimacy, improves decision quality, and strengthens shared responsibility in wetland management.
Collaborative and Sustainable Financing	Wetland governance is supported through diversified and predictable funding sources.	Ensures continuity of operation and maintenance, monitoring, restoration, and institutional facilitation.
Adaptive Spatial and Ecological Management	Governance integrates ecological restoration, hydrological sensitivity, and adaptive planning.	Strengthens resilience, supports restoration-based decision-making, and improves the institutional ability to respond to environmental change.
Transparent Information and Participatory Monitoring	Governance is supported by accessible data, open reporting, and stakeholder-based monitoring mechanisms.	Improves accountability, reduces information asymmetry, and supports evidence-based management.
Implementation Capacity through Human Capital and Institutional Behavior	Governance effectiveness depends on actor competence, organizational learning, and behavior-oriented implementation.	Strengthens execution, maintenance discipline, institutional commitment, and the translation of governance design into actual practice.

Source: Research data processed from reviewed literature, 2026.

As presented in Table 2, the Tropical Waterschappen model combines structural and managerial dimensions within a single governance framework. Each pillar performs a distinct but interconnected role, showing that wetland governance effectiveness depends on the integration of ecological alignment, institutional participation, financial sustainability, information transparency, and implementation capacity. This confirms that sustainable wetland governance cannot be supported by a single intervention, but requires a coordinated system of institutional and managerial functions.

The conceptual novelty of the Tropical Waterschappen model lies in its effort to move beyond descriptive comparison and toward adaptive institutional design. Rather than treating the Dutch Waterschappen system as a model to be copied, this article reconstructs its transferable principles into a tropical governance framework that is sensitive to hydrological diversity, ecological vulnerability, local participation, financing constraints, and implementation capacity. This makes the model particularly relevant for Indonesian wetlands, where sustainability problems emerge from both institutional fragmentation and weak operational execution.

Figure 1 presents the conceptual framework of the Tropical Waterschappen model for sustainable wetland governance. The figure shows that the model is developed as a response to major governance challenges in Indonesian wetlands and is structured around six institutional pillars. It also clarifies that the effectiveness of the governance framework depends on implementation capacity, in which human capital influences attitudes, subjective norms, and perceived behavioral control, which subsequently shape institutional intention, institutional governance behavior, and sustainable wetland governance outcomes.

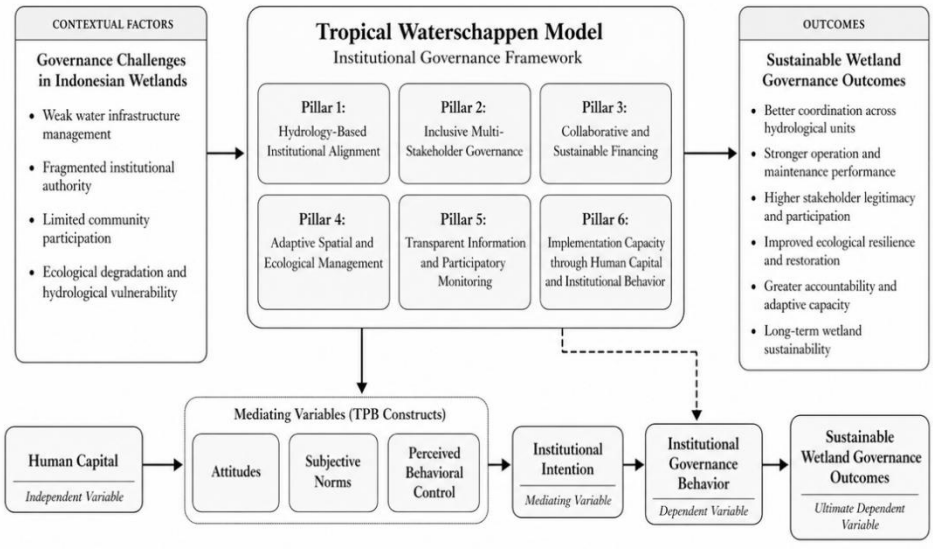

Figure 1. Conceptual Framework of the Tropical Waterschappen Model for Sustainable Wetland Governance

Source: Research Data (Processed), 2026

In the proposed conceptual model, human capital is positioned as the main independent variable because it represents the foundational capacity that shapes institutional readiness for wetland

governance. Its influence is mediated by the core constructs of the Theory of Planned Behavior, namely attitudes, subjective norms, and perceived behavioral control, which subsequently shape institutional intention. Institutional intention then influences institutional governance behavior as the main behavioral dependent variable. At the final level, sustainable wetland governance outcomes are positioned as the ultimate dependent outcome of the model. Meanwhile, the Tropical Waterschappen model functions as an institutional governance framework that organizes hydrological alignment, participation, financing, ecological adaptation, transparency, and implementation capacity into an integrated system.

To clarify the comparative logic of this study, Figure 2 presents an illustrative comparison between the main principles of the Dutch Waterschappen system and their adaptive translation into the proposed Tropical Waterschappen model for Indonesia. The figure shows that the relevance of Waterschappen for Indonesia does not lie in direct institutional replication, but in the transfer of governance logic into a tropical wetland context characterized by hydrological complexity, ecological vulnerability, and multi-actor governance needs. Through this comparison, the figure helps explain how selected Dutch principles are reformulated into context-sensitive institutional and managerial components for sustainable wetland governance in Indonesia.

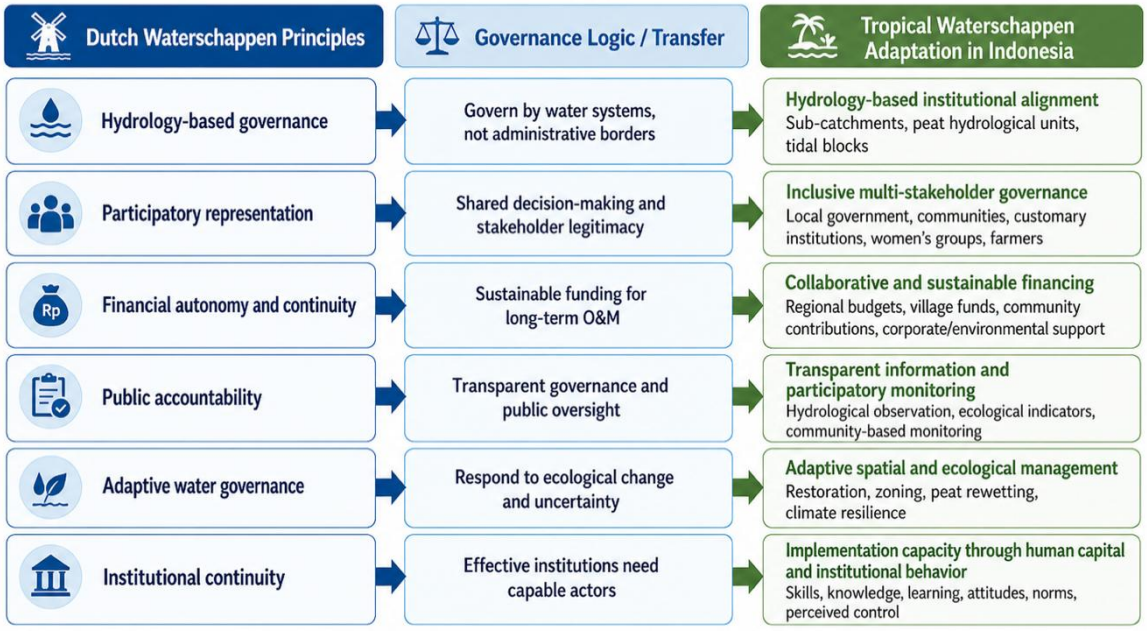

Figure 2. Illustrative Comparison Between Dutch Waterschappen Principles and Tropical Waterschappen Adaptation in Indonesia

Source: Research Data (Processed), 2026

As shown in Figure 2, the proposed Tropical Waterschappen model is built through selective adaptation rather than institutional imitation. Each principle derived from the Dutch Waterschappen system is translated into a governance function that responds to Indonesian

wetland realities, including hydrology-based institutional alignment, inclusive multi-stakeholder governance, collaborative financing, transparent monitoring, adaptive ecological management, and implementation capacity through human capital and institutional behavior. This comparison reinforces the argument that sustainable wetland governance in Indonesia requires a context-sensitive governance framework that combines institutional structure, ecological responsiveness, and actor-based implementation capacity.

Implementation Mechanism and Practical Implications. Although the Theory of Planned Behavior is commonly applied at the individual level, this study uses it as an interpretive framework to explain how actor readiness, shared norms, and perceived implementation capacity may shape governance behavior within institutional settings. In this sense, TPB is not treated as a strict individual-level predictive model, but as a behavioral lens for understanding how institutional arrangements become operational through the actors who enact them.

A key extension of this study is the integration of human capital and institutional behavior into the governance framework. The article argues that governance design alone is insufficient if actors lack competence, motivation, and implementation readiness. Human capital functions as the foundational capacity that supports technical ability, coordination, and organizational learning. At the same time, Theory of Planned Behavior provides a useful explanatory lens because attitudes, subjective norms, and perceived behavioral control help explain how institutional intention is translated into governance behavior (Adeyemi et al., 2025; Ajzen, 1991, 2020; Novak & Juvan, 2025).

This integration strengthens the model theoretically and practically. Theoretically, it extends wetland governance discussion by linking institutional architecture with actor-based implementation mechanisms. Practically, it suggests that governance reform should include training, institutional learning, stakeholder engagement, and performance systems that go beyond infrastructure outputs. Therefore, the Tropical Waterschappen model should be understood as both a governance framework and an implementation strategy for sustainable wetland governance in Indonesia.

In practical terms, the governance structure may be organized through a regional wetland coordination unit or board operating at the level of hydrological zones rather than purely administrative boundaries. Key implementation actors would include local governments, technical agencies, village institutions, community groups, customary actors, and where relevant, private-sector stakeholders. Financing may combine regional government budgets, village funds, environmental restoration support, and community-based contributions depending on local institutional capacity. This arrangement improves practical feasibility because it allows the model to be adapted to existing governance structures rather than requiring a fully new institutional system in every wetland region.

CONCLUSION & SUGGESTION

The results of this study are presented as conceptual synthesis findings rather than statistical findings. Specifically, the results consist of: (1) identification of recurring governance problems in Indonesian wetlands, (2) extraction of transferable principles from the Dutch Waterschappen system, and (3) formulation of the proposed Tropical Waterschappen model as an adaptive governance framework for Indonesia.

This article proposes the Tropical Waterschappen model as an adaptive governance framework for sustainable wetland governance in Indonesia. The study shows that current wetland governance is constrained by hydrological–administrative misalignment, weak maintenance continuity, limited participatory integration, and low implementation capacity. By selectively translating principles from the Dutch Waterschappen system, the article formulates a six-pillar model that integrates hydrology-based governance, multi-stakeholder participation, collaborative financing, adaptive ecological management, transparent monitoring, and implementation capacity through human capital and institutional behavior.

The main theoretical contribution of this article lies in connecting governance design with an implementation mechanism grounded in human capital and behavioral readiness. This perspective extends existing wetland governance discussion by showing that institutional effectiveness depends not only on structural arrangements, but also on whether actors are capable and willing to enact them consistently. Practically, the model provides a framework for regional governments and wetland stakeholders to strengthen coordination, financing continuity, participation, and ecological responsiveness.

Future research should move beyond conceptual formulation by pilot-testing the model in selected wetland regions, conducting stakeholder surveys, and comparing governance feasibility across different hydrological and institutional settings. Overall, the Tropical Waterschappen model offers a strategic direction for developing more adaptive, participatory, and operationally grounded wetland governance in Indonesia.

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