From Threshold-Based Regulation to Risk-Based Water Governance: New Paradigm on Water Governance in Indonesia

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Abstract

Water pollution in Indonesia continues to threaten environmental sustainability and the realization of the right to health. Despite an extensive regulatory framework, water quality degradation remains persistent, indicating limitations in the existing legal approach. This study argues that the core weakness of Indonesia's water pollution control regime lies not merely in regulatory insufficiency but in the persistence of a threshold-based legal paradigm that legitimizes intervention only after pollution exceeds prescribed standards. While existing studies mainly focus on normative inconsistencies among regulations, limited attention has been paid to the underlying regulatory paradigm shaping environmental governance. This research employs a normative legal method using statutory, conceptual, and comparative approaches. Indonesian environmental regulations are examined in comparison with preventive principles reflected in the World Health Organization (WHO) and United Nations Environment Programme (UNEP) guidelines. The findings reveal a fundamental divergence between Indonesia's threshold-based and post-damage liability approach and the preventive risk governance model adopted in international standards. The current framework prioritizes compliance with pollution thresholds and corrective measures after environmental harm occurs, whereas risk-based water governance emphasizes continuous risk assessment, preventive intervention, and public health protection before measurable damage arises. The novelty of this study lies in shifting the analytical focus from normative-regulatory gaps to a paradigmatic critique of environmental regulation. It proposes a conceptual framework for transforming Indonesia's water pollution control regime toward risk-based water governance to strengthen environmental protection and ensure the effective realization of the right to health.

Keywords: water pollution; risk-based water governance; threshold-based regulation; right to health; environmental governance.

Introduction

Water pollution is one of the global environmental problems that directly impact public health and ecosystem sustainability. At the global level, more than 1.7 billion people worldwide use drinking water sources contaminated with feces, resulting in approximately 505,000 deaths from diarrhea each year (World Health Organization, 2023). Exposure to drinking water contaminated with pathogenic microorganisms poses an extremely high risk to human health. This fact indicates that approximately 88% of child deaths caused by diarrhea are closely associated with unsafe water, poor sanitation, and inadequate hygiene practices (Ali & others, 2022). This phenomenon confirms the close relationship between water pollution and waterborne diseases, which significantly reduce the quality of life of communities (Pramaningsih et al., 2023). Therefore, the issue of water pollution can no longer be viewed merely as a sectoral environmental problem but must instead be positioned as a public health issue and a fundamental human rights violation, particularly the right to health and the right to safe water (Munggaran et al., 2023).

In the national context, Indonesia continues to face significant challenges in effectively controlling the water pollution crisis (Widjaja, 2026). This empirical reality is evidenced by the sharp increase in diarrhea cases in Indonesia in 2022, reaching 7,350,708 cases across all age groups, including 3,690,984 cases among children under five years old (Indonesian Journal of Health & Medical, 2024). This degradation is predominantly caused by river and lake pollution resulting from industrial and domestic waste disposal, which has reduced the quality of raw water. It has been found that 60% of water sources in Indonesia's urban areas have been contaminated with E. coli bacteria and hazardous chemicals (Kusuma & Wahyudi, 2021). This weakness in governance was clearly demonstrated by the operational disruption of the Duriangkang 5 Water Treatment Plant (WTP) in Batam in 2024. The commissioning process of the WTP had to be temporarily suspended due to a technical malfunction in the dosing pump, which resulted in the interruption of clean water distribution to the public (BP Batam, 2024). Although the disruption was technical in nature, the incident demonstrates that Indonesia's water management system remains vulnerable to disruptions and has yet to provide optimal assurance of raw water quality for the public.

These issues indicate the importance of conducting a fundamental evaluation of the effectiveness and philosophy of the national legal framework in ensuring water quality das sein. Normatively, Indonesia has established an environmental management legal framework through Law Number 32 of 2009 concerning Environmental Protection and Management and Law Number 17 of 2019 concerning Water Resources. However, this positive legal framework is dominated by a reactive, administrative, and threshold-based approach. Pursuant to Article 20 paragraph (1) of the Environmental Protection and Management Law (UUPPLH), the determination of environmental pollution is rigidly measured solely based on whether environmental quality standards have been exceeded. Consequently, law enforcement mechanisms and administrative sanctions under Article

76 can only be implemented after actual damage or violations have occurred post-damage liability. This problem is further aggravated by low compliance caused by weak institutional coordination, inadequate monitoring systems, and weak law enforcement in practice (Amelia, 2024; Widjaja, 2026). Furthermore, national regulations have not yet fully operationalized the precautionary approach as mandated by the Rio Declaration 1992, resulting in a legal response that remains inadequate in anticipating the latent health risks posed by contaminated water (Astuti, 2023). In fact, the guarantee of the water right cannot be achieved if the state relies solely on formal-procedural regulations without a substantive accountability mechanism for health protection (Spijkers, 2021).

The condition of Indonesia's national legal framework stands in stark contrast to the development of global standards established by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP) through the Water Quality and Health Guidelines. These international standards mark a radical shift toward the health governance paradigm, in which the protection of public health is positioned as the primary objective and the highest philosophical foundation of water quality governance. Through this health governance framework, states are required to ensure that safe, affordable, and accessible drinking water is available to everyone without discrimination as a realization of fundamental human rights. This transformation in global governance is concretely implemented through the adoption of a fully preventive and risk-based approach. The preventive and risk-based approach is systematically operationalized through the Framework for Safe Drinking-Water, which includes the establishment of health-based targets and the implementation of Water Safety Plans from source to consumer in order to identify hazards and control risks before pollution occurs. However, within the Indonesian context, numerous studies have revealed a substantial gap, as domestic regulations have not yet adopted these principles (Siregar, 2022), primarily due to the weak integration between technical water quality regulations and public health standards (Nurhayati, 2021). This paradigmatic gap, resulting from the absence of health governance, preventive approaches, and risk-based management, has created a significant discrepancy between das sein (the reality of Indonesia's regulatory framework) and das sollen (the ideal international standard).

Despite the substantial gap between national and global regulations, most previous studies have tended to focus solely on the technical aspects of pollution or sectoral-positivistic law enforcement without integrating public health and human rights perspectives (Amelia, 2024). In fact, poor water quality directly violates people's right to live in good health and to enjoy a decent environment (Munggaran et al., 2023). This condition has created a significant research gap, as no previous study has examined the paradigmatic shift from threshold-based regulation to risk-based water governance from the perspective of the right to health (Ramadanti & others, 2025). To address this academic gap, this study offers a strong novelty by not merely comparing regulatory provisions through a normative-textual approach but by demonstrating the paradigmatic discrepancy between the post-damage liability model embedded in national law and the preventive risk governance model embodied in international standards. Employing a normative legal research method analyzed through Satjipto Rahardjo's Progressive Legal

Theory, this study aims to challenge the administrative rigidity of Indonesia's positive law in order to formulate an ideal regulatory framework ius constituendum that places the protection of the public's right to health as its highest priority (Widjaja, 2026).

Research Method

This study employs a normative legal research method, as it focuses on the analysis of positive legal norms and their comparison with international legal standards. This method was selected to address the research problems concerning the weaknesses of national regulations in governing water pollution and protecting the right to health, as well as to formulate an ideal legal framework (ius constituendum) based on the principles outlined in the WHO/UNEP Guidelines. This normative legal research is conceptual and doctrinal in nature because it seeks to examine the conformity between das sein (the reality of the regulatory framework currently applicable in Indonesia) and das sollen (the legal standards that ought to be implemented according to international norms) (Disemadi, 2022; Tan, 2021). This study also adopts a conceptual approach to analyze the paradigmatic shift from environmental administrative regulation toward risk-based environmental health governance.

Other approaches employed in this study include the statutory approach and the comparative approach. The statutory approach is used to examine relevant national legislation, including Law Number 32 of 2009 concerning Environmental Protection and Management, Law Number 36 of 2009 concerning Health, and implementing regulations related to water quality and pollution control. Meanwhile, the comparative approach is employed to assess the conformity of Indonesia's national regulations with the WHO Guidelines for Drinking-Water Quality (2017) and the UNEP Guidelines for Water Quality Policy and Monitoring (2022). The research data consist of primary legal materials, namely legislation and international legal instruments; secondary legal materials, including books, scientific journals, official government reports, and WHO/UNEP publications; as well as tertiary legal materials, such as legal dictionaries and environmental law encyclopedias. Data were collected through library research by examining legal documents and academic literature. All data were analyzed using a qualitative-descriptive method by interpreting and comparing legal norms to identify the weaknesses of national regulations and formulate alternative solutions based on international legal standards (Disemadi, 2022). This approach is further analyzed through the perspective of Satjipto Rahardjo's Progressive Legal Theory, which positions law as an instrument for the protection of human rights and public welfare.

Results and Discussions

The Paradigm of Water Pollution Control Regulation in Indonesia and Its Weaknesses in Protecting the Right to Health

Human rights are rights inherent in every individual solely by virtue of being human and, therefore, cannot be arbitrarily revoked by the state or any other party (Jack Donnelly, 2003). Water is one of the basic human necessities and constitutes a fundamental human right (Lubis & others, 2024). This is supported by Article 33 paragraph (3) of the 1945 Constitution of the Republic of Indonesia (UUD NRI 1945). The provision affirms that all natural resources and wealth contained within the state shall be utilized for the greatest prosperity of the people. Therefore, access to safe and high-quality water is a fundamental aspect of human rights. The essential human need for water is undeniable, as water is the source of life and a means of sustaining human existence (Sationo, 2022).

From an international perspective, Article 12 of the International Covenant on Economic, Social and Cultural Rights (ICESCR) provides that everyone has the right to the enjoyment of the highest attainable standard of physical and mental health (United Nations, 1966). The fulfillment of this right is not limited to healthcare services but also encompasses other determinants of health, such as access to clean water, sanitation, and a healthy environment (Committee on Economic, Social and Cultural Rights, 2000). Under international law, the right to clean water is therefore understood as an integral component of the fulfillment of the right to health and the right to an adequate standard of living. The United Nations Committee on Economic, Social and Cultural Rights, through General Comment No. 15, emphasizes that states have the obligation to ensure the availability, quality, and accessibility of water for the public ((Committee on Economic, Social and Cultural Rights, 2002).

This means that the water provided must be accessible to every citizen through adequate accessibility and sufficient quality. In line with these developments, international organizations such as the World Health Organization (WHO) and the United Nations Environment Programme (UNEP) have developed water quality standards aimed at protecting human health. Through its Guidelines for Drinking-Water Quality, WHO provides scientific parameters regarding water quality that is safe for human consumption (World Health Organization, 2017), while UNEP promotes the implementation of an ecosystem-based and environmentally sustainable approach to water quality management (United Nations Environment Programme, 2016). Accordingly, safe water quality constitutes an essential element in the protection of public health. The obligations of the state include establishing adequate regulations, monitoring sources of water pollution, and implementing water quality standards capable of protecting the public from health risks arising from environmental pollution.

Indonesia's responsibility to fulfill the people's right to water is embodied in several legal regulations. Article 28H paragraph (1) of the 1945 Constitution emphasizes that water constitutes an implicit constitutional right that serves as a determinant of environmental quality and public health. In this context, the availability and quality of

water directly affect the fulfillment of the right to a good and healthy environment as well as the right to healthcare services. Water, as an element of the people's prosperity, is further reinforced by Article 33 paragraph (3) of the 1945 Constitution. This provision affirms that water is regarded as a strategic natural resource under state control for the public interest. The state has a constitutional obligation to ensure that water management is carried out fairly and oriented toward the welfare of society.

The failure to ensure the accessibility, quality, and availability of water may adversely affect the prosperity of the people and therefore has the potential to contradict the constitutional objective of state control as mandated by the Constitution. This also demonstrates the existence of a dualistic constitutional approach, whereby water is positioned both as an object of state control and as an integral component of the fulfillment of human rights. The coexistence of these constitutional provisions emphasizes that water pollution control functions not only as an instrument of environmental protection but also as a state obligation to guarantee the fulfillment of the right to health. Therefore, the effectiveness of water pollution regulations should be measured by their ability to prevent public health risks rather than merely by administrative compliance with applicable environmental standards. The fulfillment of the right to health also encompasses the availability of clean and high-quality water as well as the prevention of diseases caused by poor water quality (Jiwantara et al., 2026). Accordingly, the success of regulatory frameworks should not be assessed solely based on the formal existence of legal norms but also on their ability to provide genuine protection for public health through risk prevention from the earliest possible stage.

The Basic Agrarian Law of 1960 (Undang-Undang Pokok Agraria or UUPA 1960) also serves as one of the legal instruments governing water as part of agrarian resources. This law reflects the orientation of state control intended to achieve the greatest possible prosperity of the people. From a normative perspective, this provision demonstrates the objective of realizing public welfare through the management of natural resources. Nevertheless, in practice, the regulation has also generated debates concerning the balance between public welfare and the protection of investment interests. On the one hand, the state acts as the manager of natural resources for the benefit of society; on the other hand, policies concerning state control and the granting of land and water rights frequently accommodate economic and investment interests. This indicates that the normative orientation of the UUPA is not always consistent with its implementation in practice. Such tension further demonstrates that the orientation of state control has not yet fully reflected the principles of social justice and constitutionalism, which place the welfare of the people as the primary objective of natural resource management.

The regulation of water pollution control under Law Number 32 of 2009 concerning Environmental Protection and Management (UUPPLH) demonstrates a normative effort to protect the environment through various legal instruments as stipulated in Article 2 of the UUPPLH. Nevertheless, these provisions remain declaratory in nature and have not been accompanied by operational mechanisms requiring the systematic implementation of risk assessment. Article 20 paragraph (1) of the UUPPLH further emphasizes that the establishment of environmental quality standards reflects a

threshold-based approach, under which pollution is deemed to occur only when specific standards have been exceeded. From the perspective of Satjipto Rahardjo's Progressive Legal Theory, such an orientation has the potential to shift the purpose of law from protecting human beings to merely verifying compliance with legal procedures. This approach demonstrates that the water pollution control system remains oriented toward conditions after adverse impacts have occurred. The imposition of administrative sanctions upon responsible parties by the Minister, Governor, or Regent/Mayor when violations occur further confirms that the law enforcement mechanism is reactive in nature. Accordingly, the regulatory framework established under this Law has yet to adopt a risk-preventive approach as developed under international standards.

The regulation of water resources under Law Number 17 of 2019 concerning Water Resources demonstrates that water is positioned primarily as a resource managed to fulfill utilization needs. Article 3 letter (d) emphasizes the importance of public participation in supervising the utilization of water resources. Although this provision reflects an effort to strengthen water resource governance, the regulation remains focused on the utilization of water resources rather than on monitoring water quality and addressing health risks. It does not explicitly integrate mechanisms for identifying and controlling health risks arising from water pollution. Consequently, water quality continues to be regarded as part of the administrative management of natural resources rather than as a primary instrument for protecting public health. This condition demonstrates that national regulations continue to perceive water pollution as an issue of administrative non-compliance measured against environmental quality standards. In reality, however, health risks may arise long before a parameter is formally declared to have exceeded the prescribed quality standards. Therefore, the threshold-based regulatory paradigm has the potential to result in delayed protection of public health.

Aspects	Indonesia's regulation	WHO / UNEP Guidelines
Approach	Reactive	Preventive (Risk-based)
System	Threshold-Based	Water Safety Plan
Focus	Environment Administration	Health Administration
Advocacies	Administrative Sanction	Continuous Monitoring
Precautionary Approach	Normative	Operational & Systemized

Table 1. *Comparison between Indonesia's regulation and WHO / UNEP Guidelines*
Source: Authors' Analysis

The principal weakness of the threshold-based regulatory paradigm lies in its reactive nature. National regulations tend to regard water pollution as an issue of administrative compliance; whereby legal action is only initiated after violations of environmental quality standards or environmental permits have been identified. Such an approach demonstrates that Indonesia's legal system continues to be dominated by a post-damage liability model, under which legal protection is provided only after damage or violations have already occurred. This reactive characteristic further indicates that the implementation of the precautionary principle within national law remains far from

optimal, and Indonesia continues to face challenges in operationalizing and integrating this principle into environmental policymaking. Although Article 2 letter (f) of the UUPPLH recognizes the precautionary principle as one of the fundamental principles of environmental protection and management, its regulation remains merely declaratory and has not been translated into operational obligations such as risk assessment, continuous monitoring, or preventive measures based on scientific uncertainty. Consequently, the precautionary principle under the UUPPLH remains at the level of law in the books and has not yet been fully realized as an effective protection mechanism in law in action.

The absence of the precautionary principle can also be observed in Law Number 17 of 2019 concerning Water Resources. The precautionary principle is not explicitly recognized, and the regulatory framework focuses primarily on the management and utilization of water resources without integrating a system-based health risk control approach as recommended by WHO and UNEP standards. Based on these two legal frameworks, it can be concluded that Indonesia adopts a reactive regulatory perspective. This approach differs significantly from developments in international environmental law, which recognize the precautionary principle as the foundation for preventive action. Principle 15 of the Rio Declaration on Environment and Development affirms that the lack of full scientific certainty shall not be used as a reason for postponing preventive measures against threats of serious or irreversible environmental damage (United Nations, 1992). The absence of operational provisions implementing the precautionary principle also results in weak integration between water quality management and the protection of the right to health within Indonesia's national legal framework. Accordingly, the precautionary principle should function not only as a normative principle but also as an operational basis for decision-making oriented toward risk prevention.

The Global Paradigm Shift toward Risk-Based Water Governance under WHO/UNEP Standards

Various international organizations, such as the World Health Organization (WHO) and the United Nations Environment Programme (UNEP), have developed water quality standards aimed at protecting human health. Through its Guidelines for Drinking-Water Quality, the WHO establishes scientific parameters concerning water quality that is safe for human consumption (World Health Organization, 2017), while UNEP promotes the implementation of an ecosystem-based and environmentally sustainable approach to water quality management (United Nations Environment Programme, 2016). The WHO standards, as outlined in the Guidelines for Drinking-Water Quality: Fourth Edition, updated in 2022, explicitly place the protection of public health as their primary objective. This is achieved through the adoption of a preventive, risk-based approach implemented through the Framework for Safe Drinking-Water. This framework includes the establishment of health-based targets, the implementation of Water Safety Plans from source to consumer, and an independent, continuous surveillance system (UNEP & WHO, 2022).

This preventive, risk-based approach emphasizes that water quality management should be founded upon systematic hazard identification and risk assessment before pollution occurs (Ukpai, 2022; UNEP & WHO, 2022). Consequently, states are required to undertake preventive measures even under conditions of scientific uncertainty as an implementation of the precautionary principle. Accordingly, under international standards, the precautionary principle is not merely normative in nature but has been operationalized through concrete obligations, including risk management, continuous monitoring, and the early control of pollution sources to minimize adverse impacts on human health. Preventive risk management constitutes a fundamental component of modern water governance systems because it enables the identification, evaluation, and mitigation of risks before they result in more significant consequences for society and the environment. From this perspective, the success of water management is no longer measured solely by compliance with established quality standards but rather by the capacity of the system to anticipate and control potential risks from the earliest possible stage (OECD, 2014).

Unlike the WHO approach, which explicitly links water quality to the prevention of waterborne diseases and the reduction of public health burdens, Indonesia's regulatory framework continues to regard water quality merely as a component of environmental administration rather than as a primary instrument for protecting public health. Furthermore, the absence of mandatory implementation of mechanisms such as the Water Safety Plan, coupled with the lack of an integrated independent monitoring system, has resulted in Indonesia's water quality management remaining sectoral rather than systemic (Majahana et al., 2025; OECD, 2014). This demonstrates that the existing normative gap extends beyond the level of legal norms to the level of legal system design. Indonesia remains within a reactive and administrative pollution control paradigm, whereas international standards have evolved toward a preventive, risk-based management model oriented toward the comprehensive protection of the right to health.

From the perspective of human rights, particularly the right to health as recognized under the International Covenant on Economic, Social and Cultural Rights (ICESCR) and further elaborated in General Comments No. 14 and No. 15, states are obligated to respect, protect, and fulfill the public's right to safe water. These obligations include providing water management systems capable of effectively preventing health risks. However, Indonesia's predominantly reactive regulatory approach demonstrates that the state has not yet fully discharged its obligations to protect and fulfill the public's right to health (Committee on Economic, Social and Cultural Rights, 2000, 2002), as it has not adopted the risk-based preventive mechanisms recommended by the WHO and UNEP. Accordingly, the inadequate incorporation of the precautionary principle into Indonesia's national legal framework constitutes one of the principal factors contributing to the suboptimal protection of the public's right to health in the context of water pollution.

The normative gap between Indonesia's water pollution control regulations and the international standards developed by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP) lies not only in technical regulatory aspects but also in the fundamental difference in paradigms concerning the protection of

the right to health. Indonesia's approach demonstrates that the law functions primarily as an instrument of formal regulatory control rather than as a mechanism for protecting public health. In contrast, international standards regard water pollution as a health risk that must be prevented from the outset through hazard identification, risk assessment, and continuous monitoring (Ukpai, 2022; UNEP & WHO, 2022). Therefore, the existing gap does not merely reflect differences in legal instruments but also reveals that Indonesia's regulatory paradigm remains rooted in threshold-based governance, whereas global developments have advanced toward risk-based governance. This tendency is reflected in various modern water governance instruments developed by the WHO, the OECD, and numerous national jurisdictions that have begun integrating Water Safety Plans, adaptive governance, and risk management approaches into water quality management systems (Majahana et al., 2025; OECD, 2014; Ukpai, 2022).

The paradigm shift from the traditional command-and-control approach, which emphasizes administrative compliance, toward a more preventive, adaptive and risk-based governance approach has continued to evolve by placing risk identification, continuous monitoring, and the capacity to adapt to uncertainty as the primary elements of decision-making (Koop et al., 2022; Santos, 2025; Ukpai, 2022). This development underscores that the protection of water quality is no longer regarded as a static process but rather as a dynamic mechanism requiring continuous risk evaluation (Ahopelto et al., 2024). This paradigmatic shift has also been driven by the increasing complexity of water resource management challenges, including industrial pollution, urbanization, climate change, and the emergence of new contaminants that often cannot be fully identified through conventional threshold-based approaches. Accordingly, risk-based regulation is considered more capable of responding effectively to scientific uncertainty and changing environmental conditions (Saikia et al., 2022; Soomro et al., 2026).

The paradigm shift and the weaknesses of threshold-based regulation may also be examined through the perspective of the Progressive Legal Theory developed by Satjipto Rahardjo. According to Satjipto Rahardjo, law should not be understood merely as a set of rules operating mechanically through procedures and administrative formalities but should instead be oriented toward the protection of human beings and social welfare as its ultimate objectives (Rahardjo, 2009). Accordingly, the effectiveness of a regulatory framework should not be measured solely by the level of compliance with administrative norms but also by its ability to prevent harm and safeguard the interests of society. However, Indonesia's water pollution control regulations continue to demonstrate a tendency toward legal formalism, as the existence of pollution and legal intervention are determined primarily based on violations of environmental quality standards. Consequently, the law functions more as an instrument for verifying violations than as a mechanism for protecting public health.

Within the context of water pollution control, the orientation of the Environmental Protection and Management Law (UUPPLH), which continues to regard the exceedance of environmental quality standards as the principal indicator of pollution, demonstrates a tendency toward legal formalism. The state is only able to intervene optimally once pollution parameters have exceeded the prescribed threshold or when administrative

violations have occurred. Consequently, the law functions primarily as an instrument for verifying violations rather than as a mechanism for protecting public health. Such conditions are inconsistent with the principles of Progressive Legal Theory, which place human safety as the primary objective of the law. From this perspective, the state should not wait until an administrative violation has occurred before taking action (Nations, 1992; OECD, 2014); instead, it is obliged to undertake preventive measures as soon as risks to public health begin to be identified. Therefore, the threshold-based regulatory paradigm demonstrates that Indonesia's water pollution control framework remains trapped within a formalistic approach that has yet to fully position the protection of the right to health as its primary regulatory objective.

From a human rights perspective, this reactive regulatory approach demonstrates the state's failure to fully internalize its protection obligations. It is insufficient for the state merely to provide access to water; it must also ensure that such water is safe and does not endanger public health (Committee on Economic, Social and Cultural Rights, 2002; Jiwantara et al., 2026). When regulations fail to establish systematic mechanisms for risk prevention, the state indirectly allows potential violations of the right to health to occur. This indicates that the protection provided remains formal rather than addressing the substantive essence of the right itself. Accordingly, the weaknesses of Indonesia's national regulatory framework reflect the state's still suboptimal performance as the duty-bearer responsible for guaranteeing the public's right to health.

Accordingly, it may be concluded that the normative gap between Indonesia's regulatory framework and the standards developed by the WHO and UNEP lies in the inconsistency of their fundamental orientations toward water quality management. Indonesia's national regulations continue to emphasize resource utilization and administrative control, whereas international standards have evolved toward a preventive, risk-based approach centered on the protection of public health. This inconsistency has resulted in the inability of Indonesia's legal framework to provide effective protection for the public's right to health. Therefore, the existing gap confirms that the principal problem within Indonesia's water pollution control regulations does not lie in the absence of legal norms but rather in a legal paradigm that continues to perceive water pollution as an administrative violation instead of a public health risk that must be prevented from the earliest stage. Consequently, a paradigmatic shift toward a preventive and risk-based governance model is required to ensure more effective protection of the right to health and to align Indonesia's regulatory framework with the development of international standards (Majahana et al., 2025; OECD, 2014; UNEP & WHO, 2022).

Reconstructing Water Pollution Control Regulations Based on Risk-Based Water Governance for the Protection of the Right to Health

The growing implications and challenges in water resource management in the modern era demonstrate that the threshold-based governance approach is no longer adequate to ensure the protection of public health (Koop et al., 2022). Increasing pressures arising from urbanization, climate change, industrial activities, and the emergence of

various new contaminants have expanded the spectrum of risks that water quality management systems must address (Bayat et al., 2025; Soomro et al., 2026). Consequently, the protection of water quality, when understood merely as a static process of pollution control, can no longer be effectively implemented under such conditions. Therefore, water quality protection must be positioned within a governance framework capable of continuously identifying, anticipating, and managing risks (Rosso, 2025). This global paradigmatic shift toward a preventive protection framework has also been reinforced through the international standards developed by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP).

The paradigmatic differences between Indonesia and the international community underscore the urgent need to reconstruct Indonesia's water pollution control regulations. Globally, the shift toward a water governance model places risk identification, continuous monitoring, institutional integration, and the capacity to adapt to uncertainty as the primary elements of decision-making in water resource management. Under this paradigm, the effectiveness of regulations is no longer measured solely by the degree of administrative compliance but by the effectiveness of the system in preventing risks to human health and environmental sustainability. By contrast, Indonesia's water pollution control regulations continue to be dominated by a threshold-based regulatory approach that regards the exceedance of environmental quality standards as the principal indicator of pollution. This orientation demonstrates that the national legal system remains focused on responding to violations after they occur rather than preventing risks that may give rise to long-term health impacts. This reflects a significant gap between the development of the global paradigm and Indonesia's national regulatory framework, which remains sectoral, administrative, and reactive.

The principal weakness of Indonesia's threshold-based regulatory paradigm lies in the absence of an integrated water quality management system within a governance framework oriented toward protecting public health. Regulations concerning environmental protection, public health, and water resources remain dispersed across different legal regimes, resulting in a fragmented and sectoral management system. Consequently, coordination among institutions in identifying, monitoring, and controlling health risks arising from water pollution has yet to function effectively (Rosso, 2025; Santos, 2025). Furthermore, Indonesia's national regulatory framework has not yet adopted the Water Safety Plan (WSP) recommended by the WHO as the primary instrument for risk control from the water source to the point of consumption. The absence of a Water Safety Plan causes water quality management to remain focused on end-product testing rather than on preventing risks throughout the entire water supply chain (UNEP & WHO, 2022). National law also does not establish risk assessment as a mandatory operational obligation in decision-making processes. As a result, government intervention generally occurs only after administrative violations or exceedances of environmental quality standards have been identified.

Another weakness of the national regulatory paradigm lies in its inability to anticipate dynamically evolving health risks. The national legal system tends to experience regulatory lag, as intervention occurs only after exceedances of environmental

quality standards have been formally identified (Ukpai, 2022; UNEP & WHO, 2022). Moreover, the legal framework remains heavily dependent on threshold indicators, which may create a false sense of safety, namely a condition in which a water body is considered legally safe despite still posing health risks that have not yet been fully detected (Soomro et al., 2026). This weakness is further aggravated by institutional fragmentation that separates environmental supervision from public health protection into distinct administrative regimes (Aguirre & Paredes Cuervo, 2023). Consequently, water pollution control has not yet been able to function effectively as an instrument for protecting the right to health (Committee on Economic, Social and Cultural Rights, 2000, 2002; Triana et al., 2023).

Accordingly, there is an urgent need to reconstruct water pollution control regulations so that they are no longer oriented solely toward pollution control. The lack of effectiveness and long-term impact of Indonesia's existing water pollution regulations must be transformed into a framework centred on the preventive management of health risks. Such reconstruction can be realized through a risk-based water governance model that integrates the precautionary principle, health-based water quality standards, continuous monitoring systems, and a human rights-based approach as the foundation for protecting public health. The implementation of risk-based water governance may be carried out through a seven-step model based on the principles of Progressive Legal Theory, which regards law as an instrument for protecting human beings. Accordingly, regulatory design should no longer focus merely on procedural certainty but rather on the state's ability to prevent health risks before they materialize. The optimal seven-step model for implementing the paradigm shift toward risk-based water governance is as follows:

A. Operationalization of the Precautionary Principle

The precautionary principle constitutes the primary pillar that must be reconstructed from merely serving as a normative principle into an operational obligation applicable at every stage of the water quality management process. Through the implementation of this principle, the government is required to undertake preventive measures (precautionary approach) whenever there are indications of pollution risks, even where a causal relationship has not yet been scientifically established with certainty (Hidayat et al., 2024). This approach is consistent with Principle 15 of the Rio Declaration on Environment and Development, which affirms that the absence of full scientific certainty shall not be used as a reason for postponing preventive measures against threats of serious or irreversible environmental damage (Nations, 1992). The precautionary principle has also become an essential element in the implementation of risk-based water governance as it has evolved in international practice (Rosso, 2025), because such protection is intended not only to preserve the sustainability of natural resources but also to guarantee the fulfillment of the public's right to health and to a good and healthy environment (Triana et al., 2023).

B. Health-Based Water Standards

Water quality standards, which have traditionally been based on environmental quality thresholds and oriented toward administrative compliance,

should be reconstructed into standards that directly take into account their impacts on public health. Under this model, the determination of water quality parameters should no longer be based solely on environmental pollution limits but should also consider the health risks arising from exposure to specific contaminants. This health-based water standards approach is consistent with the WHO's Framework for Safe Drinking-Water, which positions the protection of public health as the primary objective of water quality management (UNEP & WHO, 2022). Recent studies have further demonstrated that integrating health indicators into water governance significantly enhances the effectiveness of protecting communities against long-term pollution risks (Soomro et al., 2026).

C. Mandatory National Water Safety Plan

The integration of the Water Safety Plan (WSP) as a mandatory instrument within the national water quality management system also represents an essential measure that should be implemented by the government. The WSP is a preventive approach encompassing hazard identification, risk assessment and control, as well as continuous monitoring throughout the entire water supply chain, from the source to the consumer. The WHO identifies the WSP as a core component of the Framework for Safe Drinking-Water because of its capacity to prevent health risks before pollution occurs (Ukpai, 2022; UNEP & WHO, 2022). The implementation of the WSP is also consistent with the development of modern water governance, which emphasizes the integration of risk management, system resilience, and adaptive capacity in addressing increasingly complex environmental threats. Through this approach, water quality protection is no longer regarded as a static process of administrative supervision but rather as a dynamic and sustainable management system capable of responding more effectively to changing environmental conditions and scientific uncertainty (Aguirre & Paredes Cuervo, 2023).

D. Continuous Monitoring System

The reconstruction of water pollution control regulations must also be accompanied by the implementation of a continuous monitoring system as an instrument for real-time and continuous water quality surveillance. The existing periodic monitoring system is often incapable of detecting changes in water quality promptly, thereby creating delays in responding to pollution threats. Within the risk-based water governance paradigm, continuous monitoring constitutes an essential component of an early warning mechanism designed to identify potential risks before they produce broader impacts on public health or the environment. The application of emerging water resource management technologies, including the Internet of Things (IoT), artificial intelligence (AI), and real-time data analytics, has the potential to enhance the effectiveness of water quality surveillance while supporting more responsive and evidence-based decision-making regarding pollution risks (Reljić et al., 2023). Furthermore, the smart water governance approach also positions continuous monitoring systems as a primary instrument for developing adaptive, transparent, and data-driven water governance (Beça et al., 2023).

E. Integrated Multi-Sector Governance

Institutional integration linking the functions of environmental protection, public health, and water resource management is essential to support the implementation of the risk-based water governance model. Water quality monitoring in Indonesia, which continues to be carried out on a sectoral basis through the division of authority among different government agencies, has frequently suffered from inadequate coordination. Consequently, information concerning environmental pollution, water quality, and their impacts on public health tends to remain fragmented, thereby hindering timely and effective decision-making. Within the risk-based governance paradigm, water quality management requires cross-sectoral coordination because the health risks arising from water pollution cannot be separated from environmental protection or water resource governance. Therefore, an integrated mechanism involving the Ministry of Environment, the Ministry of Health, and local governments should be established through data-sharing systems, joint monitoring, and coordinated policy formulation, consistent with modern water governance, which emphasizes the importance of inter-institutional collaboration in addressing the growing complexity of water resource management and public health protection (Koehler, 2023; Koop et al., 2022). Multi-stakeholder governance supported by effective inter-agency coordination has also been shown to strengthen the implementation of environmental policies, improve information exchange, and promote more responsive decision-making regarding water quality risks (Li et al., 2025).

F. Independent Supervision Mechanism

The implementation of risk-based water governance should not rely solely on inter-agency coordination but must also be supported by an independent and participatory supervisory mechanism to ensure accountability in the implementation of water pollution control. The reconstruction of Indonesia's water pollution control regulations may therefore be accompanied by the establishment of an Independent National Water Quality Supervisory Council as a cross-sectoral oversight body. The need for such an independent supervisory institution is based on the importance of ensuring objectivity in evaluation, transparency in policy implementation, and accountability in water pollution control involving multiple institutions and stakeholders. Furthermore, public participation in water environmental governance has been demonstrated to contribute significantly to improving the effectiveness of water governance and environmental policy oversight (Peng et al., 2025). The Independent National Water Quality Supervisory Council may function as an autonomous body responsible for evaluating the implementation of the Water Safety Plan, overseeing the execution of risk assessments, receiving public complaints, and preparing periodic reports on the condition of national water quality. A supervisory mechanism involving representatives from government, academia, civil society, and local communities would also strengthen transparency, accountability, and the long-term effectiveness of environmental policy implementation (Li et al., 2025).

G. Human Rights-Based Water Governance

The reconstruction of water pollution control regulations must also be founded upon a human rights-based approach, which places the protection of the right to health as the primary objective of regulation. Under this approach, water quality is no longer regarded merely as a technical environmental issue but also as an integral component of the fulfillment of human rights that the state is obligated to guarantee (Jack Donnelly, 2003). Accordingly, every water resource management policy should be designed in accordance with the principles of availability, quality, accessibility, participation, and accountability. Consequently, water pollution control should no longer be oriented solely toward administrative compliance but rather toward providing substantive protection for the health and well-being of the public as the holders of rights (Jiwantara et al., 2026).

No.	Reconstruction Component	Current Regulatory Framework	Risk-Based Water Governance Model	Protection Objective
1	Operationalization of the Precautionary Principle	The precautionary principle remains normative and declaratory.	The precautionary principle is established as an operational obligation in decision-making processes.	To prevent pollution risks and health impacts at an early stage.
2	Health-Based Water Standard	Water quality standards are primarily oriented toward administrative environmental compliance.	Water quality standards are based on public health risks.	To ensure water quality that is safe for human health.
3	Mandatory National Water Safety Plan	There is no nationwide requirement for the implementation of a Water Safety Plan.	The Water Safety Plan is implemented throughout the entire water supply chain.	To identify and control risks before pollution occurs.
4	Continuous Monitoring System	Water quality monitoring is still conducted periodically.	A technology-based, real-time, and continuous monitoring system is implemented.	To accelerate early detection and response to pollution risks.

5	Integration Multi-Sector Governance	Water quality management remains sectoral and fragmented.	Integration among the Ministry of Environment, the Ministry of Health, and Local Governments.	To improve coordination and the effectiveness of risk management.
6	Independent Supervision Mechanism	Supervision remains dispersed across various institutions.	The establishment of an independent and participatory supervisory mechanism.	To ensure accountability, transparency, and effective implementation.
7	Human Rights-Based Water Governance	Water quality is regarded primarily as an administrative environmental issue.	Water governance is based on the right to health and the right to water.	To place the protection of human beings as the primary objective of regulation.
	Ultimate Paradigm	**Threshold-Based Regulation (Reactive)**	**Risk-Based Water Governance (Preventive)**	**Protection of the Right to Health**

Table 2. *Reconstruction Model of Water Pollution Control Regulations Based on Risk-Based Water Governance*

Source: Prepared by the Authors based on the above-mentioned sources

This paradigmatic shift is consistent with the perspective of Progressive Legal Theory advanced by Satjipto Rahardjo. Progressive law is a legal philosophy that seeks to liberate the law because it is fundamentally concerned with humanity rather than functioning merely as a body of legal dogma or normative rules (Siregar, 2024). Progressive Legal Theory rejects the view that law should be maintained in a rigid and static form when it is no longer capable of responding to the needs of society. Satjipto Rahardjo believed that the law must continue to evolve and be willing to undergo reform to achieve broader humanitarian objectives. The orientation of Indonesia's national regulatory framework, which continues to regard the exceedance of environmental quality standards as the primary indicator of pollution, demonstrates a tendency toward legal formalism. Consequently, legal protection for the public is provided only after health risks can be established through measurable administrative violations. In contrast, Progressive Legal Theory evaluates the effectiveness of law based on its ability to prevent harm and provide genuine protection for human interests, rather than merely on the fulfillment of procedural requirements (Rahardjo, 2005). Accordingly, the transformation from threshold-based regulation to risk-based water governance represents not only a technical reform of water quality governance but also a fundamental shift in legal philosophy from a reactive approach toward one that is preventive and human-centered.

Conclusion

This study demonstrates that Indonesia's current water pollution control regulatory framework remains predominantly based on a threshold-based regulatory paradigm, in which legal intervention is generally triggered only after environmental quality standards have been exceeded or administrative violations have occurred. Such an approach reflects a reactive and formalistic legal orientation that has yet to effectively protect the public's right to health. In contrast, international standards developed by the World Health Organization (WHO) and the United Nations Environment Programme (UNEP) have shifted toward a risk-based water governance paradigm that emphasizes prevention, continuous risk assessment, precautionary measures, and health-centered water quality management. Accordingly, a significant normative and paradigmatic gap exists between Indonesia's national regulatory framework (das sein) and the ideal standards promoted at the international level (das sollen).

This research contributes to the existing body of legal scholarship by moving beyond a normative comparison of legal provisions and demonstrating that the principal weakness of Indonesia's regulatory framework lies not in the absence of legal norms but in its underlying legal paradigm. Through the analytical framework of Satjipto Rahardjo's Progressive Legal Theory, this study proposes a reconstruction of Indonesia's water pollution control regulations based on a risk-based water governance model consisting of seven integrated components: the operationalization of the precautionary principle, health-based water standards, a mandatory national Water Safety Plan, a continuous monitoring system, integrated multi-sector governance, an independent supervision mechanism, and a human rights-based approach to water governance. This reconstruction is intended to reposition water pollution control from an administrative compliance mechanism toward a preventive system that prioritizes the protection of the public's right to health.

Practically, the proposed reconstruction may serve as a reference for legislators and policymakers in reformulating Indonesia's environmental and water resource regulations to better align with international standards and contemporary public health governance. Future research is recommended to examine the practical implementation of the proposed risk-based water governance model through empirical or comparative studies involving institutional readiness, policy implementation, and governance capacity at both the national and regional levels.

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Generative AI Statement

During the preparation of this manuscript, the authors used ChatGPT (OpenAI, GPT-5.5) to assist with language refinement, academic translation, grammar improvement, structural organization, and readability enhancement. Following this process, the authors critically reviewed, edited, and validated all AI-generated content to ensure its accuracy, consistency, and scientific integrity. The authors maintain full responsibility and accountability for the final content of this manuscript. Generative AI was used solely as a supportive writing tool and was not credited with authorship. No original legal analysis, research findings, or interpretations were generated by AI without human oversight.