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RESEARCH ARTICLE

UTILIZATION OF THE WATER FOOTPRINT REGULATION CONCEPT AS AN INSTRUMENT FOR CONTROLLING INDUSTRIAL WATER CONSUMPTION IN PROTECTING WATER RESOURCES

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ABSTRACT

This study aims to analyze the legal framework governing industrial water resource utilization in Indonesia and to examine the potential application of the *water footprint* concept as a legal instrument for controlling industrial water consumption in support of sustainable water resource protection. This research employs a normative legal research method using statutory, conceptual, and comparative approaches. Data were collected through a library study comprising primary, secondary, and tertiary legal materials and were analyzed qualitatively. The findings indicate that the regulation of water resource utilization in Indonesia has been governed under Law Number 17 of 2019 on Water Resources, Law Number 32 of 2009 on Environmental Protection and Management, and regulations concerning risk-based business licensing. However, these legal frameworks have not comprehensively accommodated mechanisms for measuring and controlling industrial water consumption. The *water footprint* concept, through the measurement of *blue*, *green*, and *grey water footprints*, offers significant potential to be integrated into the water resource management and licensing system through mechanisms of measurement, reporting, and monitoring of industrial water use. Therefore, integrating the *water footprint* concept into Indonesia's legal framework can serve as a preventive legal instrument to enhance water-use efficiency, strengthen water resource protection, and promote sustainable industrial development.

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1. Introduction

Water is a natural resource that plays a strategic role in human life, environmental sustainability, and economic activity. Water availability is not only necessary to meet basic community needs but also serves as a crucial production factor in various industrial sectors. Therefore, the utilization of water resources must be carried out in a planned, equitable, and sustainable manner to avoid compromising the quality or quantity of water available for current and future generations. In a constitutional context, Article 33, paragraph (3) of the 1945 Constitution of the Republic of Indonesia affirms that the land, water, and natural resources contained therein are controlled by the state and used for the greatest prosperity of the people. This provision forms the basis for the state's authority to regulate, manage, administer, and supervise the utilization of water resources for the public interest (Mishra et al., 2021).

The state's obligation to maintain the sustainability of water resources is further emphasized in Law Number 17 of 2019 concerning Water Resources. The law stipulates that water resource management is aimed at protecting the people's right to water, ensuring sustainable water availability, preserving water functions, and providing benefits for public welfare (Ahmad, 2020). In its implementation, the state utilizes a licensing mechanism as a control instrument for water use for business activities. Any use of water resources for commercial or industrial purposes must, in principle, obtain a permit and take into account water availability, social functions, community interests, and environmental. This mechanism reflects that state control over water resources is not private ownership, but rather a public authority to ensure that their use remains oriented towards the prosperity of the people (Priadi et al., 2024).

The urgency of controlling water use is increasing with the growth of industrial activities that require large amounts of water. Water is used in various stages of production, such as washing raw materials, cooling machines, product processing, facility sanitation, and waste management. Although the percentage of water use by the industrial sector remains lower than that of the agricultural sector, its consumption tends to increase in line with the expansion of production activities (Ma'Mun et al.,

2021). These conditions can put pressure on surface and groundwater sources, particularly when water extraction is carried out continuously without considering the environmental carrying capacity and the needs of communities surrounding industrial areas. Uncontrolled industrial water use also has the potential to reduce water availability, lead to pollution, conflicts over water use, and reduce public access to clean water sources (Hoekstra, 2017).

Indonesia already has several regulations related to water use by industrial activities. These regulations are contained in Law Number 17 of 2019 concerning Water Resources, Law Number 32 of 2009 concerning Environmental Protection and Management, as amended by Law Number 6 of 2023, Government Regulation Number 5 of 2021 concerning the Implementation of Risk-Based Business Licensing, and Regulation of the Minister of Public Works and Public Housing Number 2 of 2024 concerning Procedures for Licensing Businesses Using Water Resources. These regulations address licensing requirements, environmental approvals, pollution control, water use efficiency, and oversight of business activities. The risk-based licensing system also links the type of permit with the level of risk of business activities to health, safety, the environment, and the use of natural resources.

Table 1. Gaps in Industrial Water Consumption Regulation in Indonesia

Regulatory Aspect	Existing Regulation	Limitation
Water-resource use licensing	Law No. 17 of 2019 and Regulation of the Minister of Public Works and Housing No. 2 of 2024 require permits for the use or exploitation of water resources	Focuses primarily on the legality and volume of direct water abstraction
Environmental approval	Law No. 32 of 2009 and its implementing regulations govern Environmental Impact Assessments (AMDAL), Environmental Management and Monitoring Efforts (UKL-UPL), and environmental-impact control	Does not yet calculate total water use throughout the production process
Risk-based business licensing	Law No. 6 of 2023 and Government Regulation No. 5 of 2021 link licensing requirements to the level of business risk	Does not yet use *water footprint* intensity as a risk indicator
Water-use reporting	Business actors are required to comply with technical and reporting obligations under their permits	Reporting is generally limited to water directly withdrawn
Control of water consumption	Existing regulations impose efficiency obligations and require the protection of water-resource functions	No industrial standards have yet been established for *blue, green,* and *grey water footprints*

Source: Compiled by the authors (2026)

Based on Table 1, the Indonesian legal system already provides instruments for licensing, environmental approval, reporting, and supervision of water-resource use. However, these instruments do not yet employ a measurement framework capable of capturing both direct and indirect water use throughout the production chain. This limitation demonstrates the need for a more comprehensive measurement instrument to control industrial water consumption. The existing framework remains primarily oriented toward the legality of water abstraction, compliance with environmental documentation, and the control of pollution generated by industrial activities. It has not yet established a comprehensive mechanism for measuring total water use throughout the production process. Assessments of industrial water consumption generally focus on the volume of water directly withdrawn from water sources, even though the production of goods also involves indirect water use through raw materials, energy, supply chains, and waste-treatment processes (Hoekstra, 2017). Consequently, the

licensing system has not fully captured the actual pressure exerted by industrial activities on the availability and quality of water resources.

Accordingly, the legal issue does not lie in the absence of regulation concerning water-resource utilization, but in the lack of a measurement instrument capable of integrating water-use volume, production-process characteristics, the carrying capacity of water sources, and environmental impacts within a single control mechanism. Regulations that focus solely on water-abstraction permits may overlook indirect water use and environmental pressures arising throughout the production chain. This condition indicates the need to strengthen preventive legal instruments within the water-resource management system, particularly for industries with high levels of water-use intensity (Makanda et al., 2022).

One concept that may address this weakness is the *water footprint*. A *water footprint* is an indicator that measures the amount of water used directly and indirectly to produce goods or services. It comprises the *blue water footprint*, referring to the use of surface water and groundwater; the *green water footprint*, referring to rainwater stored in the soil; and the *grey water footprint*, referring to the volume of water required to assimilate pollutant loads while maintaining compliance with applicable water-quality standards (Chen, 2024). Through this approach, the government can obtain a more comprehensive understanding of water-use intensity at each stage of production and the pressure exerted by industrial activities on water resources.

In the industrial context, the *water footprint* is useful not only for identifying the volume of water directly withdrawn by companies but also for evaluating water embedded in raw materials, energy, and supply chains. This approach enables both the government and business actors to identify the most water-intensive stages of production, assess pollution impacts, and formulate more appropriate efficiency measures (Onuigbo et al., 2025). The *water footprint* can therefore be developed beyond its role as an environmental analytical tool into a legal instrument supporting the measurement, reporting, supervision, and control of industrial water consumption.

Previous studies have examined the *water footprint* as a method for measuring water use and as an approach to sustainable water-resource management (Hoekstra, 2017; Hogeboom, 2020). However, these studies have primarily addressed environmental management, agriculture, production, and water-use efficiency. Research specifically connecting the *water footprint* with business licensing, water-resource use permits, and preventive legal instruments for controlling industrial water consumption in Indonesia remains limited. This study offers novelty by proposing a regulatory framework for integrating the *water footprint* into Indonesia's positive law through three principal mechanisms: measurement, reporting, and control of industrial water consumption.

Based on these issues, the study addresses two main questions. First, how is industrial-sector licensing for the utilization and management of water resources regulated in Indonesia? Second, how can the *water footprint* concept be implemented as a preventive legal instrument for controlling industrial water consumption? This study aims to assess the adequacy of the existing legal framework and formulate the possible integration of the *water footprint* into environmental approvals and water-resource use permits. Such integration is expected to improve water-use efficiency, strengthen government supervision, prevent excessive exploitation, and support the sustainable protection of water resources.

2. Methodology

This study employs normative legal research to assess the adequacy of Indonesia's legal framework governing industrial water use and to formulate the integration of the water footprint concept into the national legal system. Rather than empirically measuring the water consumption of a particular company, the study examines legal norms, principles, and licensing instruments to identify the gap between the existing regulatory framework and the need to measure both direct and indirect water use (Christiani, 2016).

The study applies statutory, conceptual, and comparative approaches. The statutory approach examines Law Number 17 of 2019 concerning Water Resources, Law Number 32 of 2009 concerning

Environmental Protection and Management, Law Number 6 of 2023, Government Regulation Number 5 of 2021, and Regulation of the Minister of Public Works and Housing Number 2 of 2024. It assesses whether the current systems of licensing, environmental approval, reporting, and supervision are sufficient to control total industrial water consumption. The conceptual approach examines the blue, green, and grey water footprints and direct and indirect water use throughout the production chain, positioning the water footprint as both an environmental assessment tool and a preventive legal instrument. The comparative approach reviews relevant practices in the Netherlands, Spain, the United Kingdom, and China to identify elements adaptable to Indonesia.

The study uses primary, secondary, and tertiary legal materials. Primary materials consist of legislation on water resources, environmental protection, risk-based licensing, and commercial water use. Secondary materials include books, journal articles, research findings, and institutional reports, while tertiary materials clarify relevant terms and concepts. These materials were collected through library research, inventoried, and classified according to two main focuses: the regulation of industrial water use and the integration of the water footprint into the licensing system (Pringgar & Sujatmiko, 2021).

The materials were analyzed qualitatively and prescriptively by identifying the applicable legal norms, assessing their limitations in measuring direct and indirect water use and pollution loads, comparing those limitations with the water footprint framework, and formulating an integration model covering measurement, reporting, licensing, supervision, incentives, and sanctions. The analysis was used to answer the research questions and develop normative recommendations for strengthening the control of industrial water consumption in Indonesia.

3. Results and discussion

3.1 Legal Regulation of Water Resource Utilization by the Industrial Sector in Indonesia

Water is a resource controlled by the state and must be utilized for the greatest prosperity of the people, as affirmed in Article 33 paragraph (3) of the 1945 Constitution of the Republic of Indonesia. State control over water resources is not understood as ownership in the private-law sense, but as public authority to formulate policies, regulate, administer, manage, and supervise the utilization of water resources. This authority provides the legal basis for the state to restrict industrial water use when such utilization has the potential to undermine public interests or environmental sustainability (Putra et al., 2025).

Within this framework, licensing serves as the principal legal instrument for controlling the utilization of water resources by business activities. Law Number 17 of 2019 concerning Water Resources requires the use of water resources for business purposes to obtain government authorization. The granting of a permit must take into account water availability, the social function of water resources, environmental sustainability, public interests, and water resource management plans. The law also requires permit holders to use water efficiently, comply with technical requirements, and preserve water sources. Violations of these obligations may result in administrative sanctions, including warnings, restrictions on activities, suspension, and permit revocation.

This regulatory framework is reinforced by Law Number 32 of 2009 concerning Environmental Protection and Management, as amended through Law Number 6 of 2023. The environmental protection regime requires every business activity that may have environmental impacts to prepare an Environmental Impact Assessment (AMDAL) or Environmental Management and Monitoring Efforts document (UKL-UPL) and obtain environmental approval. In the context of water-intensive industries, environmental approval serves to assess the impacts of water abstraction, wastewater discharge, declining water quality, and potential disturbances to the surrounding environment and communities. Therefore, environmental approval should function not merely as an administrative requirement but also as a preventive instrument to avert damage to water resources before business operations commence.

Changes to the licensing system introduced through Law Number 6 of 2023 and Government Regulation Number 5 of 2021 established a risk-based business licensing mechanism. Under this system, the type of business license is determined according to the level of risk that business activities pose to health, safety, the environment, and the utilization of natural resources. Industrial activities are classified into low, medium-low, medium-high, and high-risk categories. Industries that consume large quantities of water or generate significant environmental impacts should therefore be placed in categories subject to stricter requirements and more intensive supervision.

More detailed provisions are contained in Regulation of the Minister of Public Works and Housing Number 2 of 2024 concerning Procedures for Business Licensing for the Use of Water Resources. This regulation stipulates that every individual or business entity using water resources for commercial activities must obtain a water resource exploitation permit or water-use approval. The granting of such authorization must consider water availability, environmental balance, public interests, and water resource management plans. Through this regulation, Indonesia's legal system has established a normative basis for controlling industrial water abstraction by regulating its volume, location, duration, and the obligations imposed on permit holders. To clarify the relationship among these regulations, Table 2 presents a more concise summary.

Table 2. Legal Instruments for Controlling Water Utilization by Industry

Regulation	Control Instrument	Primary Function
The 1945 Constitution of the Republic of Indonesia	State control over water resources	Ensures that water resources are utilized for the greatest prosperity of the people
Law No. 17 of 2019	Water-resource use and exploitation permits	Controls water abstraction and protects public interests
Law No. 32 of 2009 in conjunction with Law No. 6 of 2023	Environmental Impact Assessment (AMDAL), Environmental Management and Monitoring Efforts (UKL-UPL), and environmental approval	Prevents and controls environmental impacts
Government Regulation No. 5 of 2021	Risk-based business licensing	Determines licensing requirements according to the level of business risk
Regulation of the Minister of Public Works and Housing No. 2 of 2024	Water-resource exploitation permits and water-use approvals	Regulates the technical requirements for water-resource utilization

Source: Processed by the authors (2026)

Based on this legal framework, Indonesia does not face an absolute legal vacuum in regulating industrial water use. The existing legal system already governs licensing obligations, environmental approvals, water-use efficiency, reporting, supervision, and sanctions. However, the current regulatory framework remains focused on the legality of water abstraction, the permitted volume of water withdrawal, and pollution control after the production process has taken place. Its main weakness lies in the absence of a mechanism capable of calculating the total amount of water used to produce a particular product. Water-resource use permits generally measure only the water directly withdrawn from rivers, lakes, reservoirs, or groundwater sources. This approach does not yet account for water used indirectly through raw materials, energy, previous production stages, supply chains, or the volume of water required to assimilate pollutants. In fact, all of these components determine the actual pressure exerted by industrial activities on water resources (Hoekstra, 2017).

Therefore, the more appropriate term is not a “legal vacuum” in the sense of a complete absence of regulation, but rather a regulatory gap. This gap arises because existing licensing instruments do not yet provide standardized indicators for comprehensively assessing water-use intensity. The current system also fails to connect water consumption with product characteristics, the location of water sources, regional carrying capacity, indirect water use, and pollution loads. As a result, two industries withdrawing the same volume of water may be treated similarly even though they have different water footprints and environmental impacts.

This condition indicates that the licensing system needs to be strengthened through a measurement instrument capable of illustrating the relationship between production activities and total water-resource use. Such an instrument is necessary to ensure that risk assessment is based not only on the type of business and the volume of water withdrawn, but also on water-use intensity, the condition of water sources, pollution loads, and water consumption throughout the production chain. In this context, the *water footprint* concept can be used to complement the existing legal instruments.

3.1 Integration of the Water Footprint as a Preventive Legal Instrument

The *water footprint* is an indicator used to measure the total amount of water required to produce goods or services. This measurement includes both direct water use within production facilities and indirect water use at earlier stages of the supply chain. Therefore, the *water footprint* provides a more comprehensive assessment than conventional measurements that merely record the volume of water withdrawn from a particular source. The *water footprint* concept consists of three components. First, the *blue water footprint* refers to the volume of surface water and groundwater consumed during the production process. This includes water that evaporates, becomes part of the product, or is not returned to the same water source. Second, the *green water footprint* refers to rainwater stored in the soil and used in biological processes, particularly in the production of agricultural raw materials. Third, the *grey water footprint* refers to the theoretical volume of water required to dilute or assimilate pollutants so that water quality complies with the applicable standards (Hamzah, 2016).

In the industrial context, these distinctions are important because pressure on water resources does not arise solely from water abstraction at production facilities. The food and beverage industry, for example, also generates a water footprint through the agricultural production of its raw materials. The textile industry uses water directly in washing and dyeing processes while also generating a *grey water footprint* associated with pollution loads. Consequently, an industry that withdraws a relatively small amount of water directly may not necessarily have a low *water footprint* when its raw materials and supply chain require substantial amounts of water (Sahin et al., 2016).

This concept can be constructed as a preventive legal instrument through three principal elements: measurement, reporting, and control. First, measurement requires the establishment of standardized methodologies for calculating the *blue, green,* and *grey water footprints*. These standards should be adapted to the characteristics of each sector because the water requirements of the textile, food and beverage, chemical, paper, and mining industries differ. The results may be expressed as the volume of water used per unit of product, enabling the government to compare water-use efficiency among companies operating within the same sector.

Second, industrial operators should be required to submit periodic *water footprint* reports to the government. Such reports should include information on water sources, abstraction volumes, water use at each stage of production, recycled water, returned water, pollution loads, and material indirect water use throughout the supply chain. To ensure data reliability, the reporting process may be supported by verification or audits conducted by parties with relevant expertise in water resources and environmental management.

Third, the measurement and reporting results should serve as the basis for regulatory control. The government may establish water-use intensity thresholds for specific sectors, adjust water-

abstraction quotas, require efficiency plans, and determine water-reuse standards. Companies that successfully reduce their *water footprint* may be granted incentives. At the same time, those that exceed the prescribed thresholds or fail to comply with reporting obligations may be subject to administrative sanctions. Through this mechanism, the *water footprint* would no longer function merely as environmental information but would also have legal consequences for the rights and obligations of business actors.

The integration of the *water footprint* into Indonesia's positive law does not necessarily require the enactment of a new statute. The concept may be introduced gradually through existing legal instruments. At the initial stage, the government may establish technical calculation standards through ministerial regulations or sector-specific guidelines. Measurement obligations may subsequently be incorporated into the requirements for water-resource use permits and environmental approvals for industries with high levels of water consumption.

Within Environmental Impact Assessment (AMDAL) or Environmental Management and Monitoring Efforts (UKL-UPL) documents, companies may be required to provide estimates of direct and indirect water use as well as pollution loads. These data would enable the government to assess whether a proposed activity is compatible with the carrying capacity of water resources at the business location. Under the risk-based business licensing system, *water footprint* intensity may also be used as an indicator for determining the level of business risk. The greater the water consumption and pressure on water resources, the stricter the applicable licensing, monitoring, and reporting requirements. The proposed integration model is illustrated in the following figure.

Figure 1: Water Footprint Regulation Scheme in Indonesia

Source: Processed by the researchers (2026)

Figure 1 illustrates the application of the *water footprint* as an instrument for controlling industrial water consumption through three stages: calculating water use and establishing intensity limits by industry, periodic reporting accompanied by auditing, verification, and public transparency, and government supervision through compliance inspections and the imposition of sanctions for violations. This flow demonstrates that the *water footprint* functions not only as a measurement tool but also as a basis for reporting, supervision, and legal enforcement in industrial water management. Beyond licensing

instruments, the implementation of the *water footprint* can also be linked to environmental economic instruments. Industries that reduce water use, implement water recycling, adopt water-efficient technologies, or decrease pollution loads may receive incentives. These may take the form of administrative facilitation, reductions in certain charges, environmental performance awards, or priority access to development and assistance programs. Conversely, industries with high water-use intensity may be subject to restoration obligations, higher water-use charges, or administrative disincentives.

This approach is consistent with the *polluter pays principle*. Business actors that cause pollution or place substantial pressure on water resources should bear the costs of environmental control and restoration. However, within the *water footprint* framework, its application is not merely reactive after pollution has occurred. Water-footprint measurement enables the government to identify potential pressures from the planning stage, allowing control measures to be taken before environmental damage or water scarcity emerges. The experience of several countries shows that the *water footprint* has developed more commonly as a policy-analysis tool than as an obligation explicitly stipulated in legislation. The Netherlands uses *water footprint* analysis to assess the impact of national consumption patterns on water resources in producing countries. This approach demonstrates that consumption in one country may place pressure on water resources in other regions through international trade and global supply chains (Willet et al., 2019).

Spain primarily uses the *water footprint* approach to assess the sustainability of water use in agricultural production and river-basin management. The analysis helps identify regions and commodities with high water-use intensity and provides a basis for formulating water-efficiency strategies. The United Kingdom applies water-footprint calculations to examine the relationship between domestic consumption and the use of water resources abroad through imported goods and food products. Meanwhile, studies in China use the *water footprint* to examine the relationship between economic activity, water consumption, and pollution through input-output analysis and the *grey water footprint*. This approach provides information on the economic sectors that exert the greatest pressure on water availability and quality.

The experiences of these countries demonstrate that the *water footprint* can serve as a scientific basis for planning, priority setting, and water-use control, although the regulatory forms differ across jurisdictions. This comparison does not imply that Indonesia should directly replicate the policies of other countries. Indonesia's institutional conditions, legal system, water availability, and industrial structure have their own characteristics. Nevertheless, three lessons can be adapted. First, water policy should consider water use throughout the production chain. Second, *water footprint* data should serve as a basis for decision-making rather than merely as voluntary corporate information. Third, regulation should be adjusted to sectoral characteristics and the condition of water resources in each region.

Based on this analysis, the integration of the *water footprint* into Indonesia's legal system can be implemented through four stages. The first stage is the formulation of national standards and sector-specific methodologies. The second is the gradual introduction of mandatory requirements for industries with high water consumption. The third is the integration of measurement results into Environmental Impact Assessments (AMDAL), Environmental Management and Monitoring Efforts (UKL-UPL), water-resource use permits, and risk-based business licensing. The fourth is the use of such data as a basis for supervision, quota determination, efficiency targets, incentives, disincentives, and sanctions.

Accordingly, the main contribution of the *water footprint* concept is not to replace the existing licensing system, but to strengthen the quality of its assessment and control mechanisms. Licensing remains the principal legal instrument, while the *water footprint* functions as an indicator that provides more comprehensive information on direct and indirect water use and pollution loads. The integration of both instruments can establish a more preventive, measurable, transparent, and sustainable system for controlling industrial water consumption.

4. Conclusion

The regulation of water resource utilization by the industrial sector in Indonesia already has a legal foundation through Law Number 17 of 2019 concerning Water Resources, Law Number 32 of 2009 concerning Environmental Protection and Management, Law Number 6 of 2023, Government Regulation Number 5 of 2021, and Regulation of the Minister of Public Works and Housing Number 2 of 2024. These regulations govern water-use permits, environmental approvals, risk-based business licensing, efficiency obligations, supervision, and administrative sanctions. However, the existing regulatory framework remains primarily oriented toward the legality of direct water abstraction and pollution control. It has therefore not yet been possible to measure total water consumption throughout industrial production processes.

The concept of the water footprint can address this regulatory gap because it measures both direct and indirect water use through the components of blue, green, and grey water footprints. This approach provides a more comprehensive understanding of water-use intensity, the sources of water utilized, water consumption throughout the production chain, and the resulting pollution load. Accordingly, the water footprint is relevant not only as an environmental analytical tool but also as a preventive legal instrument for controlling industrial water consumption.

The integration of the water footprint into Indonesia's positive law can be implemented gradually through the formulation of sector-specific calculation standards, mandatory periodic reporting, audits and verification, and the incorporation of measurement results into Environmental Impact Assessments (AMDAL) or Environmental Management and Monitoring Efforts (UKL-UPL), water resource use permits, and risk-based business licensing. The measurement results may subsequently serve as the basis for determining water quotas, efficiency targets, incentives, disincentives, supervision, and administrative sanctions. Thus, the water footprint would not replace the existing licensing system but would strengthen the quality of its assessment and control mechanisms.

The implementation of water footprint based regulation is expected to improve transparency, accountability, and efficiency in industrial water use while preventing the excessive exploitation of water resources. Such a policy should be adapted to the characteristics of each industrial sector and the water availability conditions of each region. Through this integration, water resource management can become more measurable, preventive, and sustainable, thereby protecting public interests and ensuring the continued availability of water resources for present and future generations.

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