



Environmental Impact Analysis of Industrial Development on Ecosystem Balance: A Case in Kutai Kartanegara Regency

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ABSTRACT (10PT)

This research aims to understand and analyze the role of the government in preventing and controlling environmental pollution due to industrial development, focusing on a case study in Kutai Kartanegara Regency. This research also emphasizes the importance of environmental protection and management in the context of Law No. 32/2009, as well as the role of the central and local governments in implementing environmental capacity preservation programs. This discussion includes a review of efforts to prevent and control environmental pollution as well as the importance of early planning and environmental impact analysis in every development activity. This research uses a normative juridical approach with a literature review, involving primary and secondary legal sources, and is analyzed qualitatively by inductive thinking to obtain general conclusions from specific findings. The results show that industrial development in Kutai Kartanegara Regency has contributed to increasing employment and regional income, but it has also caused negative impacts in the form of environmental pollution and destruction. This research suggests that there is a need for increased government efforts in preventing and controlling environmental pollution, as well as applying the principles of sustainable development in every industrial development activity.



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1. Introduction

The state of the global environment is under a significant transformation, predominantly shaped by anthropogenic activities. These human-induced changes have historical precedents, stretching far before the advent of the industrial revolution, emphasizing the profound and persistent footprint of humanity on our planet. The traditional tenet of prioritizing relentless economic growth, often at the environment's detriment, is increasingly being re-evaluated. The clarion call now is for sustainable development—a paradigm that harmonizes economic aspirations with environmental

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imperatives, ensuring that development initiatives not only grow but grow within the bounds set by our environment.¹

Expanding our understanding of specific challenges, the China–Pakistan Economic Corridor (CPEC) serves as a valuable case study. While the broad contours of its potential outcomes are recognized, there's a noted paucity of academic dialogue focusing on its environmental implications, especially when juxtaposed with the associated legal frameworks. Concurrently, nations like China, which are in the throes of rapid industrialization, grapple with the pervasive issue of industrial pollution. There's an acknowledgment of the importance of low-carbon development in the global economic narrative, yet the specter of industrial pollution looms large, especially in swiftly industrializing developing nations.² China's enactment of the New Environmental Protection Law (CNEPL) in 2015 exemplifies a proactive governmental response to these challenges. This legislation, by fostering resource re-allocation, optimizing energy structures, and encouraging green technology innovation, has significantly reduced the carbon emissions intensity, particularly in heavy polluting industries.³

The industrial sector, across the globe, stands as a cornerstone of economic development. However, with progress comes a host of challenges, particularly concerning environmental degradation. Industrial pollution, for instance, is a pressing issue that countries, especially those undergoing rapid industrialization, grapple with. China serves as a paradigmatic example. A study by Dong employed the Malmquist index,⁴ based on game cross-efficiency, to measure the industrial pollution mitigation performance (IPMP) across Chinese provinces. Their findings revealed stark regional disparities. Northern China, with its heavy industry concentration, exhibited low IPMP, while central and western China fared better. Interestingly, public supervision emerged as a positive influencer of IPMP, implying that areas with robust public supervision saw significant improvements in their IPMP. The study also shed light on the nuanced, non-linear relationship between influencing factors and IPMP, emphasizing the multifaceted nature of industrial pollution control.⁵

Shifting our focus to the mining sector, Dou et al. conducted a comprehensive analysis of the ecological impacts of mining, specifically in China's Guangxi Province.⁶ By harnessing data from diverse sources, including satellite images and environmental assessment reports, the study assessed the ecological impact level of various mining sites. A key takeaway was the observation that as population income grew, environmental preferences evolved, leading to diminished environmental disturbances in mines.

¹M I Khan and Y.-C. Chang, 'Love for the Climate in Sino–Pakistan Economic Romance: A Perspective of Environmental Laws', *Clean Technologies and Environmental Policy*, 23.2 (2021), 387–99 <<https://doi.org/10.1007/s10098-020-01938-4>>.

²F Dong and others, 'How Public and Government Matter in Industrial Pollution Mitigation Performance: Evidence from China', *Journal of Cleaner Production*, 306 (2021) <<https://doi.org/10.1016/j.jclepro.2021.127099>>.

³Boqiang Lin and Aoxiang Zhang, 'Can Government Environmental Regulation Promote Low-Carbon Development in Heavy Polluting Industries? Evidence from China's New Environmental Protection Law', *Environmental Impact Assessment Review*, 99 (2023), 106991 <<https://doi.org/https://doi.org/10.1016/j.eiar.2022.106991>>.

⁴Dong and others.

⁵Dong and others.

⁶S Dou, D Xu, and R J Keenan, 'Effect of Income, Industry Structure and Environmental Regulation on the Ecological Impacts of Mining: An Analysis for Guangxi Province in China', *Journal of Cleaner Production*, 400 (2023) <<https://doi.org/10.1016/j.jclepro.2023.136654>>.

Furthermore, a reduced regional economic reliance on the industrial sector contributed to environmental amelioration. However, the influence of environmental regulations was found to be regionally heterogeneous. In mineral resource-dependent regions, where resource extraction companies wielded significant bargaining power, the efficacy of environmental regulations was somewhat diminished.⁷

Indonesia, characterized by its diverse ecosystems and rich landscapes, confronts intricate environmental dilemmas. The country's accelerated industrial development, alongside population growth, has exacerbated pressures on its ecological systems. A primary concern is deforestation, significantly driven by the expanding palm oil industry and logging. This has resulted in substantial habitat depletion, endangering Indonesia's prolific biodiversity.⁸ Adjacently, the nation's coastal zones, rich in mangroves and coral reefs, face threats from escalating sea levels and pollution. The degradation of these habitats jeopardizes both the diverse species they harbor and the livelihood of countless individuals reliant on these ecosystems. Moreover, frequent peatland fires, predominantly resulting from slash-and-burn farming, amplify air pollution levels and greenhouse gas concentrations, thereby accentuating the global climate challenge and introducing immediate health concerns for the indigenous populace (Purnama, 2003).⁹

Positioned on the Pacific Ring of Fire, Indonesia is inherently susceptible to a spectrum of natural disasters, encompassing volcanic eruptions, earthquakes, and tsunamis. These natural adversities, when coupled with human-induced environmental degradation, can potentiate their adverse impacts. For instance, extensive deforestation can trigger landslides during heavy rainfall events, and compromised coral reefs may offer limited defense against storm surges.¹⁰ Furthermore, the unregulated expansion of urban areas, often lacking strategic planning, results in settlements within flood-prone regions, amplifying their exposure to potential hazards. As Indonesia navigates its path of growth, it is imperative to harmonize sustainable ecological practices with developmental ambitions. Addressing these environmental challenges demands an integrated approach, merging stringent legislative frameworks, active community engagement, and global collaboration.¹¹

Drawing from the intricate landscape of global environmental challenges, the dynamics at play in specific regions further crystallize the magnitude of these concerns. Kutai Kartanegara in Indonesia stands emblematic of this intricate interplay between development and preservation. As industrial activities burgeon in this regency, it becomes glaringly evident that unbridled growth can lead to detrimental repercussions. The air, once untainted, now grapples with pollutants from factory chimneys, hinting at a larger narrative of environmental degradation. This not only threatens the very ecosystems we depend on but has pronounced implications for public health and well-being.

⁷Dou, Xu, and Keenan.

⁸Wayan G Santika and others, 'An Assessment of Energy Policy Impacts on Achieving Sustainable Development Goal 7 in Indonesia', *Energy for Sustainable Development*, 59 (2020), 33–48 <<https://doi.org/https://doi.org/10.1016/j.esd.2020.08.011>>.

⁹Dadang Purnama, 'Reform of the EIA Process in Indonesia: Improving the Role of Public Involvement', *Environmental Impact Assessment Review*, 23.4 (2003), 415–39 <[https://doi.org/10.1016/S0195-9255\(03\)00046-5](https://doi.org/10.1016/S0195-9255(03)00046-5)>.

¹⁰Lisa Hiwasaki and others, 'Local and Indigenous Knowledge on Climate-Related Hazards of Coastal and Small Island Communities in Southeast Asia', *Climatic Change*, 128.1–2 (2015), 35–56 <<https://doi.org/10.1007/s10584-014-1288-8>>.

¹¹Kanokporn Swangjang, 'Comparative Review of EIA in the Association of Southeast Asian Nations', *Environmental Impact Assessment Review*, 72 (2018), 33–42 <<https://doi.org/10.1016/j.eiar.2018.04.011>>.

Yet, these challenges are not insurmountable. Recognizing the need for judicious oversight, there's an emphasis on proactive planning and robust legal frameworks to mitigate environmental pitfalls. A cornerstone of this approach is the Environmental Impact Assessment (AMDAL), mandated by Law No. 32/2009 on Environmental Protection and Management. This legislative tool underscores the imperative that all significant industrial activities be preceded by a comprehensive evaluation of their potential environmental ramifications. Such forward-thinking, holistic assessments ensure that development does not come at the irrevocable expense of our environment.

The central government, equipped with the mandate to oversee environmental management, collaborates seamlessly with regional entities. Institutions like the Regional Secretariat (Sekwilda), the Regional Development Planning Agency (BAPPEDA), and the Department of Hygiene and Environment (DKLH) are pivotal cogs in this machinery. Their collective efforts aim to foster consensus, synergizing actions to preserve environmental capabilities, especially in mitigating pollution.

However, it's not just about putting laws on paper; it's about effective implementation. While Kutai Kartanegara has witnessed a surge in employment opportunities and a bolstering of its regional revenue courtesy of industrial development, it also confronts the resultant environmental challenges head-on. It's a tale of two narratives: the boon of industrial growth and the bane of environmental degradation due to improper waste management practices. This dichotomy brings to the fore legal stipulations, such as those in Law Number 32 of 2009, which delineate the thresholds of environmental quality and damage.

In this intricate dance between development and preservation, it's imperative to have clearly defined yardsticks. Environmental quality standards serve this very purpose. They demarcate the permissible limits, ensuring that any deviation from these benchmarks is swiftly identified and addressed. When these standards are surpassed, the resulting scenario isn't just about statistical deviations but about tangible environmental harm that affects communities and ecosystems alike.

Over the past few decades, the global academic community has increasingly turned its focus to understanding the environmental implications of industrial activities. Numerous studies, such as those by Dong et al. and Dou et al.,¹² have highlighted regional disparities in pollution mitigation, the ecological impacts of mining, and the role of public supervision in environmental protection. Moreover, the emphasis on green technology innovation and the intricacies of carbon emissions have been illuminated in the works of Lin & Zhang and Cui & Wang.¹³ While these studies offer profound insights into the broad contours of sustainable development, they primarily revolve around generalized contexts or are specific to China's industrial landscape.

In the contemporary landscape of global environmental studies, the dialogue on the interplay between industrialization and its subsequent ecological ramifications has gained significant momentum. Numerous scholars and studies have delved into the profound effects of anthropogenic activities on our planet's fragile ecosystems. Dong et al. provide an intricate examination of the industrial pollution mitigation performance across various

¹²Dong and others; Dou, Xu, and Keenan.

¹³Lin and Zhang; S Cui and Z Wang, 'The Impact and Transmission Mechanisms of Financial Agglomeration on Eco-Efficiency: Evidence from the Organization for Economic Co-Operation and Development Economies', *Journal of Cleaner Production*, 392 (2023) <<https://doi.org/10.1016/j.jclepro.2023.136219>>.

Chinese provinces, unearthing stark regional disparities.¹⁴ Their findings illuminate the complexities of managing heavy industry concentration and its environmental repercussions. Concurrently, Dou et al. have embarked on a meticulous analysis of the ecological impacts of mining, particularly focusing on China's Guangxi Province.¹⁵ Their insights into the evolving environmental preferences with growing population income underscore the dynamic nature of the ecological landscape.

However, while these studies offer invaluable insights, there remains a conspicuous void in understanding the specific environmental challenges posed by major developmental undertakings like the China–Pakistan Economic Corridor (CPEC). The CPEC, being a monumental infrastructural project, stands as a testament to human ambition, binding two nations in an intricate web of roads, railways, and pipelines. Yet, the environmental narrative surrounding this corridor remains largely untouched in academic discourse. Furthermore, the nuanced challenges faced by regions undergoing rapid industrial transformations, such as Kutai Kartanegara in Indonesia, have not been given their due scholarly attention. As highlighted in the introduction, Kutai Kartanegara stands emblematic of the delicate balance between relentless economic growth and the imperatives of environmental preservation. The air quality degradation, exacerbated by the onslaught of pollutants from burgeoning industrial activities, points towards a larger, more alarming narrative.¹⁶ The works of Simionescu & Ploeanu shed light on the broader dynamics of environmental degradation, but the specific context of regions like Kutai Kartanegara remains underrepresented.¹⁷ This dichotomy, poignantly described as the "boon of industrial growth and the bane of environmental degradation," beckons for a more in-depth examination.¹⁸ Although the legislative frameworks, such as the Environmental Impact Assessment (AMDAL) highlighted by Law No. 32/2009, provide a foundational understanding of the environmental safeguards in place, the efficacy, implementation, and real-world ramifications of these regulations in contexts like Kutai Kartanegara warrant dedicated research. Bridging this gap would not only contribute to the academic discourse but also serve as a guidepost for policymakers, environmentalists, and industries, navigating the treacherous waters of sustainable development in a rapidly industrializing world.

Consequently, this research, rooted in the dynamics of Kutai Kartanegara, ventures beyond mere academic exploration. It seeks to unravel the government's efforts in circumventing water pollution, especially arising from industrial effluents. By evaluating the implementation and efficacy of environmental laws, particularly in the context of industries contributing to water pollution, this research aims to bridge theory with practice. As we stand at the nexus of industrial growth and environmental preservation, studies like these are not just academic pursuits but essential guideposts for a sustainable future.

¹⁴ Dong and others.

¹⁵ Dou, Xu, and Keenan.

¹⁶ Devid Frastiawan Amir Sup, 'The State's Efforts in Preserving the Environment Through Regulation', *Sustainability: Theory, Practice and Policy*, 1.2 (2021), 200–214; Oheo K Haris, 'Legal Environmental Action Aspects, Based on Environmental Conservation, According to Law 32/2009 Concerning Protection and Management of Environment', in *2nd International Conference on Indonesian Legal Studies (ICILS 2019)* (Atlantis Press, 2019), pp. 127–32.

¹⁷ M Simionescu and A.-P. Ploeanu, 'Impact of Governance Quality on Pollution in Nuclear Energy Consuming Countries in the European Union', *Energy Reports*, 9 (2023), 4122–34 <<https://doi.org/10.1016/j.egy.2022.12.068>>.

¹⁸ Koesnadi Hardjasoemantri, 'Hukum Tata Lingkungan', 1990.

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2. Research Method

This research applies a normative juridical approach conducted through a literature review. Primary legal sources used include the 1945 Constitution of the Republic of Indonesia, various laws and government regulations relevant to the research topic. Meanwhile, secondary legal materials used consist of literature, papers, articles, and other research results relevant to the research topic. Tertiary legal materials, such as the General Indonesian Dictionary and Legal Dictionary, were also used to provide further explanation and guidance on primary and secondary legal materials. The data collection method used in this research is a literature study, where information is obtained through literature review as the main source in this writing.

Materials that have been collected from literature research are then analyzed qualitatively, namely the method of analyzing materials by classifying and selecting legal materials obtained from research according to their quality and truth, then connected with theories from literature studies so as to obtain answers to the problems in this study. In analyzing this legal material, an inductive way of thinking is used, namely concluding the results of research from specific things to then draw general conclusions.

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3. Results and Discussion

3.1 Environmental Pollution

In the context of Law No. 32/2009 on Environmental Protection and Management, sustainable development is defined as a planned effort that combines environmental, social and economic aspects to maintain environmental integrity for current and future generations. There are three important elements in sustainable development: conscious and planned use of resources, support for development for prosperity, and improvement of the quality of life for present and future generations. Industrial development, in this context, must always take these aspects into account in order to create a just, prosperous and well-being society, while preserving the environment and preventing the destruction and waste of natural resources.

Environmental pollution is a condition when the environment can no longer function as intended. To assess whether pollution has occurred, environmental quality standards are required, which include environmental and effluent quality criteria. Each environment, region or time may have different criteria and standardization. Factors such as changes in local environmental circumstances and technological developments may affect these standards. In this context, chemical, noise and other elements that exceed the natural content may degrade environmental quality and cause nuisance.

Industrial development should be carried out with consideration of the impact on the environment to prevent pollution and damage. Although the government has outlined environmental protection, many industries focus more on profits than environmental sustainability.¹⁹ This results in environmental damage from the waste produced. Therefore,

¹⁹H. Imam Supardi, *Lingkungan Hidup Dan Keselestariannya* (Bandung: PT. Alumni, 2003); Christopher Marquis, Jianjun Zhang, and Yanhua Zhou, 'Regulatory Uncertainty and Corporate Responses to

careful planning needs to be applied in every industrial development, including companies that are obliged to pay attention to the balance and sustainability of natural resources and prevent environmental damage and pollution.

In relation to environmental issues, development must take into account and develop environmental aspects, because in addition to producing benefits, development also carries the risk of environmental pollution and destruction. Law No. 32/2009 on Environmental Protection and Management was created by the government in response to these risks and serves as a legal umbrella for other regulations related to the environment.

Article 3 of Law No. 32/2009 outlines the objectives of environmental protection and management, which include protecting Indonesian territory from pollution and damage, ensuring human safety and health, preserving ecosystems, achieving environmental balance, ensuring intergenerational justice, and anticipating global environmental issues. This law is the foundation for realizing sustainable development in Indonesia.²⁰

Environmentally sound development is the government's priority in preserving the environment. This obligation includes regulating and developing environmental policies, regulating the use of natural resources and genetic resources, controlling activities that have social impacts, and funding the preservation of environmental functions. In supporting this development, the government needs to establish national policies and appoint institutional tools, as well as determine the authority of environmental management at the central and regional levels.²¹

Pollution is an important issue that needs to be addressed, divided into four main categories: air, water, soil and cultural pollution. This pollution is caused by various pollutants, including physical, biological, chemical, and cultural/social pollutants. Environmental law enforcement is not only aimed at providing punishment, but also preventing acts or actions that can damage or pollute the environment. Therefore, the legal approach is not only repressive, but also preventive.

In environmental law enforcement, the repressive approach aims to tackle destruction and pollution by imposing sanctions, while the preventive approach is aimed at preventing actions that could lead to destruction or pollution. Legal instruments such as

Environmental Protection in China', *California Management Review*, 54.1 (2011), 39–63; Weike Zhang, Qian Luo, and Shiyuan Liu, 'Is Government Regulation a Push for Corporate Environmental Performance? Evidence from China', *Economic Analysis and Policy*, 74 (2022), 105–21.

²⁰Yahman Yahman and Azis Setyagama, 'Correction: Government Policy in Regulating the Environment for Development of Sustainable Environment in Indonesia', *Environment, Development and Sustainability*, 2022 <<https://doi.org/10.1007/s10668-022-02640-9>>.

²¹Hryhorii Bukanov, 'Instruments for Implementing Environmental Policy at the Regional Level', *Reality of Politics*, 13.3 (2020), 13–28 <<https://doi.org/10.15804/rop2020301>>; Malonga Hazemba and Anthony Halog, 'Systematic Review of How Environmental Management Policies Are Incorporated into National Development Plans in Order to Achieve Sustainable Development', *Environmental Challenges*, 3 (2021), 100041 <<https://doi.org/10.1016/j.envc.2021.100041>>.

AMDAL and licensing are an important part of the preventive approach, while repressive law enforcement is carried out after destruction or pollution has occurred. Both approaches aim to create a balance between development and environmental preservation.²²

Article 84 of Law No. 32/2009 on Environmental Protection and Management regulates the settlement of environmental disputes, which can be done through court or out of court. Out-of-court dispute resolution must be based on the mutual will of the parties to the dispute and cannot be pursued when it comes to environmental criminal matters. If the out-of-court settlement fails or one of the parties withdraws, then the dispute can be submitted to the court.

However, if one of the parties chooses to settle through the court from the beginning, this does not violate the provisions of the law. Settlement of environmental disputes through out-of-court is not an administrative procedure or obligation that must be pursued first but is a voluntary choice.²³ Therefore, the choice of dispute resolution both in court and out of court remains flexible and can be adjusted to the wishes of the parties to the dispute.

Article 85 of Law No. 32/2009 confirms that out-of-court settlement of environmental disputes aims to reach an agreement regarding compensation, recovery from pollution or destruction, and prevention of negative impacts on the environment. This provision also authorizes the use of mediators and/or arbitrators in dispute resolution, either through direct negotiation between parties or through mediation and arbitration with the assistance of third parties.

Article 86 of the same law provides for the establishment of an environmental dispute resolution service provider institution, which can be initiated by the community, central government, or local government, and is free and impartial. This institution can provide dispute resolution services through mediation or arbitration, and its regulations are further stipulated in a Government Regulation.

Settlement of environmental disputes through the courts can be done through compensation claims, either to the General Court for environmental civil cases or to the State Administrative Court for environmental administrative cases. In accordance with Law No. 32/2009, compensation claims can only be filed by victims of environmental destruction or pollution. The principle of liability based on fault requires the victim to

²²Ninieki Suparni, *Pelestarian Pengelolaan Dan Penegakan Hukum Lingkungan*, (No Title), 1994; Gordana Mršić, 'Environmental Protection from the Aspect of Criminal Law', *InterEULawEast: Journal for the International and European Law, Economics and Market Integrations*, 8.1 (2021), 129–51 <<https://doi.org/10.22598/iele.2021.8.1.7>>; Dr. Ch. Venkateswarlu, 'The Protection of the Environment in the Purview of Law', *International Journal of Research and Review*, 9.8 (2022), 184–92 <<https://doi.org/10.52403/ijrr.20220816>>.

²³S F Marbun and Deno Kamelus, 'Dimensi-Dimensi Pemikiran Hukum Administrasi Negara', 2001.

prove the causal relationship between the loss and the actions of the polluter or destroyer of the environment.²⁴

Article 87 also states that the plaintiff can demand certain actions against the defendant, such as restoring environmental functions or providing clean water. The judge may impose forced money for each day of delay in the specific action, motivating the defendant to carry out its obligations immediately. In some cases, the lawsuit may be based on the principle of strict liability, where the defendant, or polluter, has the burden of proof.

Class action is one of the options in environmental dispute resolution, especially if there are many victims. The elements of a class action lawsuit include the right of a small number of people to represent themselves and others in large numbers, the number of class members, and the similarity of issues and demands. Environmental NGOs do not have the right to file a class action lawsuit, but government agencies such as the Provincial Bappedalda or the Environmental Impact Control Office can file this lawsuit.

This provision confirms that the Provincial Bappedalda or Environmental Impact Control Office does not have the right to sue for compensation for and on behalf of its own interests, but can act quickly in filing a class action lawsuit to defend the interests of the victims. This emphasizes the importance of legal protection for victims of environmental pollution or destruction and the active role of the government in protecting the interests of the community in terms of the environment.

Law No. 32/2009 on environmental protection and management does not specify the minimum number of victims to file a class action lawsuit. However, Supreme Court Regulation No. 1 of 2002 explains that large numbers are ineffective if the lawsuit is conducted individually. The requirements for a class action lawsuit include a large number of group members, similarity of facts or events, and similarity of types of claims. The determination of the minimum number of victims is relative and depends on the judge's interpretation.

Another criterion in a class action lawsuit is that the class representative must have honesty and sincerity in protecting the interests of the class members. This is important for judges to prevent exploitation by class representatives who are interested in personal gain. Several factors, including the minimum number of victims and the integrity of the class representative, are left to the discretion of the judge, so there may be differences in interpretation between different judges.

²⁴Sulhan Sulhan and Suteki Suteki, 'Political Review of the 2009 Number 32 Law on Environmental Protection and Management', *International Journal of Social Science And Human Research*, 06.01 (2023) <<https://doi.org/10.47191/ijsshr/v6-i1-56>>; Vladimir S. Sinenko and others, 'Compensation for Environmental Damage under International Law and National Legislation', *LAPLAGE EM REVISTA*, 7.Extra-E (2021), 633–38 <<https://doi.org/10.24115/S2446-622020217Extra-E1245p.633-638>>; Angkasa Angkasa, 'Green Victimology Perspective the Law Number 32 of 2009 on Environmental Protection and Management', *Jurnal Media Hukum*, 27.2 (2020) <<https://doi.org/10.18196/jmh.20200153>>.

Environmental Organizations (NGOs) are only entitled to file a lawsuit for the purpose of preserving environmental functions, known as *ius standi*. Three requirements that must be met by NGOs include being a legal entity or foundation, the purpose of establishing the organization is for the preservation of environmental functions, and has carried out activities in accordance with its articles of association.

Law No. 32/2009 also emphasizes that environmental dispute resolution is not only a matter between the destroyer or polluter and the victim. Environmental destruction or pollution affects humans and the environment, so a lawsuit can be filed by the government, prosecutors, or NGOs that aim to save the environment. This demonstrates the complex and inclusive legal framework for environmental protection and management in Indonesia.²⁵

3. 2 Definition of Water Pollution and Environmental Damage

Planet Earth is mostly composed of water, an element that is the main requirement for life processes on earth. Clean water is essential for human needs, including daily living, industry, municipal sanitation, agriculture, and others. Today, obtaining clean water in accordance with certain standards is a serious problem, as much water is polluted by various wastes from human activities, including household and industrial wastes.

Setting clean water standards is not an easy task, depending on many determining factors. These factors include the use of the water, such as for drinking, household, industry, irrigation of rice fields, or fishing ponds, as well as the origin of the water source, including water from springs in the mountains, lakes, rivers, wells, or rain. These uses and source origins influence how clean water standards are determined.

Although setting clean water standards is complex, there is agreement that standards are not set on the purity of water, but rather based on its normal state. Deviations from the normal state indicate the presence of pollution. This means that the condition of water from a spring in the mountains, for example, may result in a different normal state, depending on where it is collected.

Water on earth is never in a pure clean state, but always contains other compounds or minerals dissolved in it, such as those found in rainwater and mountain spring water. However, this does not mean that the water is polluted. Water can also contain bacteria or microorganisms that require treatment before being used as drinking water. In fact, within certain limits, drinking water is expected to contain minerals to make it taste fresh,

²⁵Purniawati Purniawati, Nikmatul Kasana, and Rodiyah Rodiyah, 'Good Environmental Governance in Indonesia (Perspective of Environmental Protection and Management)', *The Indonesian Journal of International Clinical Legal Education*, 2.1 (2020), 43–56 <<https://doi.org/10.15294/ijicle.v2i1.37328>>; Ayu Qurrota A'yun, 'Legal Politics of Environmental Protection and Management in Indonesia', *International Journal of Social Science And Human Research*, 05.03 (2022) <<https://doi.org/10.47191/ijsshr/v5-i3-14>>.

while pure water without minerals is unpleasant to drink. Water is said to be polluted if it has deviated from its normal state, not from its purity.

In the context of Indonesian law, the regulation of water pollution and environmental destruction is regulated in Government Regulation No. 82 of 2001 on Water Quality Management and Law No. 32 of 2009 on Environmental Protection and Management. Water pollution is defined as a decrease in water quality by living things, substances, or energy that enter the water by human activities, while environmental destruction is an action that damages the physical and/or biological properties of the environment.

Development in Indonesia is closely related to environmental insight, where improving the welfare and quality of life of the people is carried out in line with environmental conservation. Environmental damage can occur due to nature and human actions, such as landslides and floods, or due to pollution from water, air and soil. This awareness is important in the context of physical development that is oriented towards environmental sustainability.²⁶

The realization of environmental protection can be achieved if every activity with an environmental impact is carried out with efforts to prevent and control pollution and destruction. Law No. 32/2009 on Environmental Protection and Management affirms the rights and obligations of everyone to a good environment, including efforts to prevent and mitigate destruction, which creates civil liability and criminal sanctions. Sanctions are also contained in Law No.3 of 2014 on Industry and Law No. 45 of 2009 on Fisheries. Despite these adequate sanctions, environmental cases are still minimal, with several agencies such as the Regent/Mayor, Governor, and Minister responsible, as stipulated in article 34 of PP No.4 of 2001.

3. 3 Water Pollution Indicators

Water is a basic need in human life, used for various purposes such as drinking, bathing, irrigation, sanitation, transportation, and supporting industry and technology. In industry and technology, water is used in various processes such as process water, cooling water, turbine drive boiler water, and utility and sanitation water. Taking large amounts of water must pay attention to environmental balance, so as not to disturb the quality and volume of environmental water.

In industrial and technological activities, wastewater treatment is important so as not to cause environmental pollution. Industrial wastewater must be treated through a recycling process or Water Treatment Recycle Process, an important requirement for an environmentally sound industry. If all industrial activities comply with wastewater

²⁶A. D. Basiago, 'Sustainable Development in Indonesia: A Case Study of an Indigenous Regime of Environmental Law and Policy', *International Journal of Sustainable Development & World Ecology*, 2.3 (1995), 199–211 <<https://doi.org/10.1080/13504509509469900>>; Lyn Parker, 'Environmentalism and Education for Sustainability in Indonesia', *Indonesia and the Malay World*, 46.136 (2018), 235–40 <<https://doi.org/10.1080/13639811.2018.1519994>>; Valentinus Darsono, 'Pengantar Ilmu Lingkungan', (No Title), 1995.

treatment and the general public does not dispose of waste carelessly, then the problem of water pollution can actually be avoided.

However, the reality is that there are still many industries that discharge their waste into the environment, becoming the main cause of water pollution. Indicators of water pollution can be observed through changes in temperature, pH, color, odor, taste, the generation of sediment, colloidal, dissolved materials, the presence of microorganisms, and increased radioactivity of environmental water.

The presence of signs or changes in water can indicate that the water has been polluted. Changes in water temperature often occur in industrial activities, where heat generated by processes or machines must be removed through a cooling process with water. Water that becomes hot is then discharged into the environment, for example into a river, so that the river water becomes hot and disturbs the life of aquatic organisms. A rise in water temperature leads to a decrease in dissolved oxygen levels, which are vital for life.

In addition to changes in temperature, polluted water is also characterized by changes in pH or Hydrogen ion concentration. Normal water has a pH between 6.5 - 7.5, but wastewater and industrial effluents can alter the pH of water, disrupting the life of organisms. Water can be acidic or alkaline depending on its pH, and this can indicate the presence of pollution.

Changes in the color, smell, and taste of water are also indicators of pollution. Industrial effluents and wastewater that dissolve in water can change the color of the water. Strong odors often come from organic waste or food processing, and are converted by microbes in the water into volatile and odorous materials. The taste of water, except seawater, indicates the dissolution of salts or metal ions, which can also change the concentration of Hydrogen ions in the water, indicating a change in the pH of the water and potential pollution.

Sediment, colloids and dissolved materials in water often come from solid industrial wastes. If they do not dissolve completely, they will settle on the riverbed or float in the water with colloids. This will block sunlight from entering the water layer, interfere with the photosynthesis process of microorganisms, and ultimately disrupt the life of microorganisms themselves. If the material is organic, microorganisms will degrade it with the help of oxygen, which can disrupt the lives of other organisms that also require oxygen. This process involves the use of oxygen known as Biological Oxygen Demand (BOD).

In some fish species, oxygen levels below 4 ppm are inadequate for their survival. If the industrial effluent is in the form of water-soluble organic matter, the water will receive additional metal ions from the inorganic material. Many inorganic materials produce toxic heavy metal ions, such as Cd, Cr, and Pb, which can have a negative impact on aquatic ecosystems and human health.

Microorganisms play an important role in the degradation of industrial effluents discharged into water. This process can cause microorganisms to multiply, including

pathogenic microbes that cause various diseases. Especially the food processing industry, which has the potential to cause the development of microorganisms, including harmful microbes.

In recent years, the use and application of nuclear technology has increased in various fields, including medicine, pharmaceuticals and industry. This invites the risk of increased environmental radiocivity, especially if radioactive substances are not handled properly. The National Atomic Energy Agency (BATAN) actively oversees the implementation of regulations on radioactive waste. Even the burning of coal can increase the radiocivity of the environment, an aspect of concern to those interested in environmental issues.

Wisnu Arya Wardana emphasized that water is used not only for conventional purposes, but also to improve the quality of human life in supporting industrial and technological activities. If handled improperly, pollution caused by human actions, including through the use of modern equipment, can endanger human, animal, and plant life, causing significant environmental damage.²⁷

Law No. 32 of 2009 on Environmental Protection and Management in Indonesia defines environmental pollution as a decline in environmental quality due to the entry of living things, substances, energy, or other components into the environment by human activities. Three important elements in the pollution problem include the source of change (due to human activities or natural processes), the form of change (such as a change in the concentration of a material in the environment), and the degradation of environmental functions. The deterioration of environmental quality becomes a concern when it is related to the needs of human life, and therefore, countermeasures are more directed towards regulating human activities that are the source of pollution.

Pollution can be classified in various grouping patterns, such as according to the type of pollutant (biological, chemical, physical, and cultural) or according to the medium (air, water, soil, food, and social) and the nature of the source (primary and secondary). Regulating the pollution load from the source is one of the ways in environmental management, so information about the amount of pollution load from each source is very important in environmental management.

Water is a source of natural resources that is important for the survival of living things, industry, agriculture, and others. If water is not managed properly, it will cause damage or destruction to living things. Naturally, water sources have the ability to regenerate and are used for various needs, including domestic and industrial. The World Health Organization (WHO) also emphasizes the importance of water in its statement, "The Best of All Thing is Water," which emphasizes the need to maintain, protect, and preserve water sources.

Water pollution occurs when living things, substances, energy, or other components enter water by human activities or natural processes, causing a decrease in water quality.

²⁷Wisnu Arya Wardana, 'Dampak Pencemaran Lingkungan', 2019.

Conducting a water quality assessment involves comparing several key measures or parameters with established standards. Such parameters include Oxygen Demand for Biological processes (BOD), which indicates the uptake of oxygen by organic matter; Chemical Oxygen Demand (COD), which measures the oxygen required to chemically decompose organic matter; Fats and Oils, which can inhibit biological processes in water; Nitrogen, which is present in organic form and can be converted into ammonia; Suspended Solids (SS), suspended solids that cause water to have a cloudy color; and Total Dissolved Solid (TDS), which consists of alkaline compounds such as carbonates, bicarbonates, and hydroxides.

These factors affect water quality and play an important role in determining the extent to which water can be used for its intended purpose. Water pollution is generally caused by human activities, and the level of pollution will depend on the amount and quality of waste discharged into the river, both solid and liquid waste. Knowledge of these parameters is important in managing and maintaining water quality, so that water can still function in supporting life and various other human activities.

Sources of water pollution can be divided based on the type of activity into two main categories. The first is "processing industry effluent", which includes liquid waste from various industrial activities such as agro-industry, food processing industry, beverages, palm oil, non-metallic minerals, rubber, and electricity and gas. The second is domestic sources or household discharges, which include effluents from households, offices, hotels, restaurants, places of worship, entertainment, markets, shops, and hospitals.

Growing population and improved welfare contribute to accelerated development, including industrialization, which poses an environmental threat. Without proper control, the negative impacts of this development can damage the environment and degrade human health. Decreased environmental quality can result from pollution of water, air and soil by various pollutants, including sewage, carbon dioxide, inorganic materials that are difficult to disintegrate, and pesticides.

Environmental problems are not only a problem of rich countries, but also of poor countries. Pollution is caused not only by scarce land and overcrowding, but also by industry and increased economic prosperity. Environmental degradation, such as deforestation and exploitative mining, as well as the excessive use of chemicals in industrial processes, have damaged the environment and polluted water sources in many places, including Indonesia.

Environmental pollution has serious negative impacts on human health and the environment as a whole. This has become common knowledge and is often reported in the media. People's behavior in production and consumption driven by profit maximization has led to income inequality and ecological damage. Policy interventions are needed to control pollution, especially in non-privately owned resources such as

water, air, rivers and seas. Without control, people tend to deplete these resources as much as possible.²⁸

Luxurious and wasteful living habits, along with high consumption patterns, continue to deplete and pollute natural resources. Therefore, a change in economic principles from maximization to optimization is needed, i.e. a balance between consumption and conservation, profit and employment. This includes including "social costs" in product prices to internalize negative external impacts. In addition, the optimization perspective rejects the view of development as an increase in material well-being alone, but also includes the spiritual, social and political aspects of well-being.

In the 1960s, some followers of environmental ideology opposed economic growth, hoping to achieve a zero-growth society. However, after the 1970s, many economists believed that economic growth was still feasible and desirable, as long as the price system functioned efficiently. This belief was influenced by humanity's ability to create advanced technology. Nonetheless, environmental pollution control remains necessary, especially as the increase in population means that while per-unit emissions can be reduced, the total amount of emissions is still increasing.

The government has implemented various policies to reduce environmental pollution, including voluntary compliance, economic incentives, legal and administrative arrangements, and deterrence through credits. Voluntary compliance encourages consumers and producers to adopt environmental ethics, such as using glass bottles instead of plastic. However, the effectiveness of this instrument is questionable, and the formation of perceptions and philosophies towards the environment is determined by a large variety of factors such as social, cultural, and economic conditions.

Another policy instrument is economic incentives, including subsidies, taxes, licenses, and levies. Subsidies can be given to companies that dispose of their waste in a healthy manner, but sometimes they stimulate further pollution. Alternatively, environmental taxes can encourage a reduction in the production of polluting goods and increase state revenues. Fees or levies can also be levied to provide benefits in excess of costs, and the funds raised can be used to mitigate pollution or compensate pollution victims.

The amount of taxes and fees in regulating the environment is often determined by factors such as damage costs, abatement costs, and reprocessing costs, which are difficult to measure. Although precise valuation is difficult to formulate, methods such as willingness to pay (WTP) and willingness to accept (WTA) can be used to assess how much individuals are willing to pay for a healthy environment or accept as compensation. In addition, pollution licenses or permits can be granted to companies after calculating the maximum tolerable level of pollution. These licenses can be traded, reducing the

²⁸Muhamad Erwin, 'Hukum Lingkungan: Dalam Sistem Kebijakan Pembangunan Lingkungan Hidup', 2008; Cai Zhonghua and Song Yu, 'Environmental Protection Investment and Sustainable Development-Policy Simulation Based on Nonlinear Dynamics', *Energy Procedia*, 5 (2011), 467-71 <<https://doi.org/10.1016/j.egypro.2011.03.081>>.

government's administrative costs, but emission limits must be carefully set as they are difficult to lower once set.

From an economic perspective, licenses are preferable to taxes or levies. The advantages of licenses include cost savings; if there are new polluters, the price of the license rises, encouraging the use of pollution-reducing technologies; non-polluters can control pollution by purchasing licenses, reducing the opportunity for polluters to discharge pollutants; and licenses are unlikely to be misestimated, provided there are standards and a clear way to issue them. This shows that licenses can be an effective tool in environmental control, although their implementation requires careful planning and monitoring.

Legal and Administrative regulation by the government is the traditional approach in regulating people's behavior towards the environment. Through strict standards and technical innovation, the government can limit and reduce pollution, although this requires high monitoring costs and does not stimulate people to reduce emissions. Pollution prevention can be done through legal instruments, but also requires discipline from government officials and the actors being monitored.

Prevention Through Credit is another way to reduce pollution. Lending institutions can force producers to take pollution prevention measures before borrowing money. This approach can be applied at both the company and country level. The general awareness of pollution control confirms that individual approaches and a combination of several policy instruments may be more effective, depending on the specific situation.

Combining different policy instruments can lead to innovative solutions such as material use taxes that support recycling. This reduces waste disposal problems and promotes environmental concerns in consumption plans and development management. Included in this strategy is supporting energy-efficient production and recycling of usable goods. Decentralization in environmental control management also supports the active participation of the public, assisting in monitoring and providing information on pollution events.

Local governments should be authorized to supervise and sanction environmental polluters. National governments that want to supervise directly should place their employees close to the polluters. In addition, control can be done by directing industries to certain areas, so that negative impacts can be localized, and supervision can be carried out in an integrated manner, which in turn saves operating costs.

Pollution control efforts often involve high costs and may require a reduction in the number of industries, which impacts employment and product competitiveness in international trade. Pollutants are dispersed across administrative boundaries, making it possible for a country that behaves in an environmentally friendly manner to become polluted because its neighbors do not, and causing major economic implications between countries, between companies, and even between households.

The obstacle in pollution control is that each country has different problems, interests and development priorities, so the urgency value of environmental issues is also different. This makes it impossible to carry out pollution control efforts simultaneously. Nevertheless, the awareness of the importance of coordination and collaboration between countries in dealing with global pollution problems is an urgent need.

3. Environmental Law Enforcement Against Industry that Causes Water Pollution

The Government's water pollution prevention and mitigation efforts face several significant obstacles. Technical constraints involve limited equipment and tools, encouraging cooperation between the government, communities and the industrial sector. Financial constraints reflect limited budgets, forcing prioritization of the most urgent actions. In addition, public knowledge and awareness is also a critical issue, with most people lacking an understanding of the dangers of water pollution and the importance of preventive measures.²⁹

Discussing the evolution of environmental policy, Canada provides an example. There, in the 1960s and 1970s, public demand for pollution prevention measures prompted the government to adopt a post-facto regulatory approach. This involved regulations that targeted pollution after it had occurred with a focus on specific emission standards. In response, industries generally adopted end-of-pipe technologies, which serve to manage pollutants once they are in the production process.³⁰

In identifying and addressing environmental issues, governments often react by setting specific regulations based on visible impacts, such as pollution haze or damage to species and habitats. However, this approach has its drawbacks: a lack of consistency and coordination in regulations, and administrative structures that are reactive and uncoordinated.

Although the end-of-pipe approach has produced some successes, its effectiveness for the future is in doubt. The main reasons include: a shift in focus from visible environmental problems to more complex issues; exponentially increasing costs of environmental protection; difficulties in addressing non-point sources of pollution; the potential transfer of pollution from one medium to another; and an increasing recognition that post-facto approaches are less socially desirable than prevention.

The concept of pollution prevention defines the use of processes, practices, materials, and energy to reduce or avoid potential pollution and waste production. This approach fundamentally changes the orientation of environmental protection from reaction after

²⁹Zairin Harahap, 'Penegakan Hukum Lingkungan Menurut UUPLH', *Jurnal Hukum Ius Quia Iustum*, 11.27 (2004), 7–22; Ummi A'zizah Zahroh and Fatma Ulfatun Najicha, 'Problems and Challenges on Environmental Law Enforcement in Indonesia: AMDAL in the Context of Administrative Law', *Indonesian State Law Review (ISLRev)*, 5.2 (2022), 53–66 <<https://doi.org/10.15294/islrev.v5i2.46511>>.

³⁰Robert MacNeil, 'Canadian Environmental Policy under Conservative Majority Rule', *Environmental Politics*, 23.1 (2014), 174–78 <<https://doi.org/10.1080/09644016.2013.854968>>; Siti Sundari Rangkuti, *Hukum Lingkungan & Kebijakan Ling Nasiona Ed 4* (Airlangga University Press, 2020).

pollution has occurred, as in the end-of-pipe strategy, to a preventive approach at the front-of-process, by prioritizing that pollution should not occur.

Contemporary industrial and technological activities demand the implementation of effective waste management, given its potential to cause water pollution, both directly and indirectly. Industrial wastes, especially effluents and wastewater, are a major source of water pollution. The components of water pollution, including solid, organic, inorganic and other waste materials, affect water quality in different ways. To illustrate, solid waste materials can alter water quality through dissolution, precipitation, or colloid formation, with diverse impacts on aquatic ecosystems, such as interference with photosynthesis and the lives of organisms in the water.

Organic waste materials are wastes that can be degraded by microorganisms, potentially triggering the growth of harmful bacteria if discharged into water. Alternatively, organic waste can be processed into compost, which has a positive impact on the environment. On the other hand, inorganic waste materials, which come mainly from industries, contain metal ions that are difficult to degrade and can contaminate water. The content of certain ions in water can cause various problems, such as equipment damage from corrosion or human health hazards from toxins. There are also other wastes such as processed food waste materials that often cause foul odors, as well as oily liquid waste materials that can hinder the diffusion of oxygen and sunlight into the water, disrupting aquatic ecosystems. In addition, chemical discharges, including soaps, insecticides, and radioactive substances, also have negative impacts on the environment and health.

4. Conclusion

The government plays a central role in addressing water pollution by industrial effluents. Through supervision, monitoring and evaluation of environmental control, the government ensures the sustainability of water sources. With clear technical policies in pollution prevention, industries found in violation can be sanctioned based on established Standard Operating Procedures. This process involves field verification and water sampling, and in case of disputes, court mediation is an option. The importance of educating the public and industry players on the dangers of water pollution and how to prevent it cannot be overlooked. Collective awareness will motivate communities and businesses to be active in prevention efforts. Cooperation between various parties-government, businesses, and environmental organizations-is key in finding the best solution. The expected solution is a pollution-free environment, a sustainable industry, and a society that lives healthy and safe from the threat of water pollution.

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