


Implementation of Environmental Pollution and Damage Prevention Instruments in Indonesia: Issues and Challenges

Francisca Rachel Alicia ^a✉ 

^a Center for Law and Justice, Faculty of Business,
Justice and Behavioural Sciences, Charles Sturt
University, Wagga Wagga, Australia

✉ Corresponding email: rachel.alicia@csu.edu.au

Abstract

This paper delves into the implementation of environmental pollution and damage prevention instruments in Indonesia, highlighting the inherent issues and challenges. It scrutinizes the efficacy of existing measures in curbing environmental degradation and explores the obstacles hindering their successful execution. The findings underscore a myriad of challenges confronting the implementation process, ranging from regulatory gaps and enforcement deficiencies to institutional capacity constraints. Despite the presence of legislation aimed at safeguarding the environment, enforcement mechanisms often fall short due to inadequate resources, corruption, and lack of coordination among relevant stakeholders. Additionally, the complexity of environmental issues, coupled with rapid industrialization and urbanization, exacerbates the challenges faced in mitigating pollution and preserving natural resources. Addressing these



Copyrights © Author(s). This work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License. (CC BY-SA 4.0). All writings published in this journal are personal views of the author and do not represent the views of this journal and the author's affiliated institutions.

challenges necessitates a multi-faceted approach that encompasses legislative reforms, capacity building initiatives, and enhanced collaboration between government agencies, civil society, and the private sector. Strengthening regulatory frameworks, improving monitoring and enforcement mechanisms, and promoting public awareness are crucial steps towards achieving sustainable environmental management in Indonesia. Moreover, integrating environmental considerations into broader policy agendas and fostering international cooperation are vital for addressing cross-border environmental challenges and ensuring long-term environmental sustainability. In conclusion, while Indonesia has made strides in formulating environmental policies, effective implementation remains a pressing issue. By identifying and addressing the challenges impeding the execution of pollution prevention instruments, Indonesia can bolster its environmental governance framework and pave the way for a greener and more sustainable future.

KEYWORDS *Environmental Protection, Law Enforcement, Indonesia, Policy, Legal Instrument*

Introduction

As the global community confronts escalating environmental challenges, the urgent need for robust pollution prevention and damage mitigation measures becomes ever more apparent.¹ Indonesia, with its

¹ It is also emphasized that some studies underline the urgent global crisis of chemical pollution, advocating for immediate action grounded in robust scientific understanding. They suggest the creation of an international science-policy body to tackle the challenges posed by chemical pollution and emphasizes the importance of adopting a one-health perspective to address risks to both ecosystems and human health. Furthermore, the studies propose the development of indicators and technologies for prevention, highlighting the necessity of international cooperation and legislation to ensure sustainable environmental and human health protection. Additionally, they underscore the role of citizen behavior in mitigating pollution, emphasizing inclusive decision-making processes and the co-design of local interventions. *See* Brack, Werner, et al. "One planet: one health. A call to support the initiative on a global science-policy body on chemicals and

abundant natural resources and biodiversity, stands as a microcosm of these challenges. From rampant deforestation to pervasive air and water pollution, the nation faces a daunting array of environmental threats. Despite the presence of regulatory frameworks and mechanisms ostensibly designed to tackle these issues, the reality often diverges starkly from the intended outcomes.

Some experts in environmental science and policy underscore the critical importance of effective pollution prevention and mitigation measures in ensuring the sustainable development of nations. They emphasize that without decisive action, the country risks irreparable damage to its ecosystems and public health.² Contemporary data from the Indonesian Ministry of Environment and Forestry of Indonesia also reveal alarming trends, with air and water quality deteriorating in many regions due to industrial activities and inadequate regulatory oversight.³

waste." *Environmental Sciences Europe* 34.1 (2022): 21; Diamond, Miriam L., et al. "Exploring the planetary boundary for chemical pollution." *Environment international* 78 (2015): 8-15; Ashour, Ameel Jabbar, and Harlida Abdul Wahab. "The legal framework for the protection of the air under international conventions." *The Social Sciences* 11.14 (2016): 3490-3494; Balan, Lidia Lenuta. "The Legal Regime of Prevention and Control of Environmental Pollution." *Calitatea* 15.S1 (2014): 466; Oliveira, Kevin, et al. "Assessing the impacts of citizen-led policies on emissions, air quality and health." *Journal of Environmental Management* 302 (2022): 114047; Charlesworth, Susanne M., and Colin A. Booth. "Closing Comments on Urban Pollution." *Urban Pollution: Science and Management* (2018): 417-421.

² Mocuta, Dorina Nicoleta. "Influence of the climate changes on the human life quality, in rural areas." *Revista de Chimie* 68.6 (2017): 1392-1396; Wang, Xinhao. "Ecological wisdom as a guide for implementing the precautionary principle." *Socio-Ecological Practice Research* 1.1 (2019): 25-32; Lei, Wang, et al. "Interpretation of the IPCC AR6 on the impacts and risks of climate change." *Advances in Climate Change Research* 18.4 (2022): 389; Kovaleva, Tatyana N., et al. "Ecological safety and hazards to public health: the search for balance within the "human-biosphere" system." *Ekoloji* 28.107 (2019): 5039-5043.

³ Contemporary data from the Indonesian Ministry of Environment and Forestry highlights concerning trends in air and water quality, primarily attributed to industrial activities and regulatory shortcomings. In Aceh Province, industrial operations, notably from motor vehicles, have exacerbated air pollution, posing risks to human health and the environment. Moreover, analyses of the Air Quality Index

Furthermore, Indonesia's environmental challenges are multifaceted and interconnected, spanning both natural and human-made factors. Rampant deforestation, driven largely by the expansion of agriculture and palm oil plantations, threatens biodiversity and exacerbates climate change. Simultaneously, industrial pollution from mining, manufacturing, and waste disposal exacts a heavy toll on air and water quality, endangering the health and livelihoods of millions of Indonesians.

While regulatory frameworks exist to address these issues, their enforcement and effectiveness often fall short of expectations. Some studies, point to systemic challenges such as weak enforcement, inadequate resources, and institutional fragmentation as key barriers to effective environmental governance. Recent studies indicate widespread non-

(AQI) reveal the significant impact of circular economy measures and digital economy applications on air quality enhancement nationwide. Studies across Indonesian provinces underscore the adverse effects of motor vehicle emissions and economic growth on air pollution. Policy recommendations stress the necessity for regional collaboration, particularly between Java and Bali Islands, to address air quality issues exacerbated by economic activities and environmental capacity constraints. Utilizing satellite data, research in Surabaya offers valuable insights for air quality management and policy formulation, facilitating the development of effective mitigation strategies. *See* Zaki, Muhammad, et al. "Analysis of Air, Water and Noise Level Quality Due to Industrials Activities in Aceh Province." *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences* 79.1 (2021): 54-62; Susilo, Yuvensius Sri, and Laurensius Farel Dwi Putranto. "Several variables affecting provincial Air Quality Index (AQI) in Indonesia 2012–2019." *IOP Conference Series: Earth and Environmental Science*. Vol. 1180. No. 1. IOP Publishing, 2023; Azwardi, Azwardi, et al. "Carbon emissions, economic growth, forest, agricultural land and air pollution in Indonesia." *International Journal of Energy Economics and Policy* 11.4 (2021): 537-542; Nihayah, D. M., et al. "Spatial Effects of Economic Activity and Environmental Carrying Capacity on Air Quality in Java and Bali Islands." *IOP Conference Series: Earth and Environmental Science*. Vol. 1248. No. 1. IOP Publishing, 2023; Haq, Failaql, Mokhammad Nur Cahyadi, and Josaphat Tetuko Sri Sumantyo. "Interrelationships between Satellite Imagery Pollutants and Aerosol Particles in Air Quality Assessment (NO₂, SO₂, O₃, CO, AOD) and GNSS ZWD Data." *2023 8th Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*. IEEE, 2023.

compliance with environmental regulations, with many industries flouting pollution control measures with impunity.⁴

The adverse effects of inadequate environmental governance are starkly visible in various Indonesian communities. From the polluted air in Jakarta to the contaminated rivers in East Kalimantan, the consequences of uncontrolled pollution are keenly felt, especially by those least able to address them. Indigenous groups, in particular, bear a disproportionate share of the burden, facing risks such as displacement, loss of livelihoods, and threats to their cultural heritage due to environmental degradation. This underscores the critical need for improved environmental management and stronger regulations to protect the rights and well-being of marginalized communities.⁵

In light of these challenges, there is a growing recognition of the need for transformative action to address Indonesia's environmental crisis. Civil society organizations, environmental activists, and concerned citizens are increasingly mobilizing to demand stronger environmental protection measures and hold polluting industries accountable. International partnerships and initiatives offer additional avenues for collaboration and support, with organizations such as the United Nations Environment

⁴ Riggs, Rebecca A., et al. "Governance challenges in an Eastern Indonesian forest landscape." *Sustainability* 10.1 (2018): 169; Putri, Eka Intan Kumala, et al. "The oil palm governance: challenges of sustainability policy in Indonesia." *Sustainability* 14.3 (2022): 1820; Andriansyah, Andriansyah, Endang Sulastri, and Evi Satispi. "Economic Administration and Institutional Management in a Decentralized Regime Mode: New Insights from Environmental Resources." *International Journal of Economics & Business Administration (IJEBA)* 7.4 (2019): 424-432; Purniawati, 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; Wijayanto, Adi, Hatta Acarya Wiraraja, and Siti Aminah Idris. "Forest Fire and Environmental Damage: The Indonesian Legal Policy and Law Enforcement." *Unnes Law Journal* 8.1 (2022): 105-132.

⁵ See Cribb, Robert. "The politics of pollution control in Indonesia." *Asian Survey* 30.12 (1990): 1123-1135; Blackman, Allen, Shakeb Afsah, and Damayanti Ratunanda. "How do public disclosure pollution control programs work? Evidence from Indonesia." *Human Ecology Review* (2004): 235-246; Maruf, Arifin. "Legal aspects of environment in Indonesia: An efforts to prevent environmental damage and pollution." *Journal of Human Rights, Culture and Legal System* 1.1 (2021).

Programme providing technical assistance and capacity-building opportunities.

In the further context, as Indonesia navigates the complex nexus of economic development, environmental preservation, and social equity, the imperative for effective pollution prevention and damage mitigation measures has never been clearer. By fostering greater transparency, accountability, and collaboration among stakeholders, the nation can chart a course towards a more sustainable future, where the health and well-being of both people and planet are safeguarded for generations to come.⁶

Indonesia grapples with a critical environmental challenge rooted in the delicate equilibrium between economic advancement and ecological conservation. As a vast archipelagic nation, Indonesia's economic vitality hinges on sectors like mining, agriculture, and manufacturing, essential drivers of growth and job creation. However, these industries exert considerable strain on the environment, jeopardizing ecosystems, public health, and local livelihoods. While they fuel progress, their unchecked operations imperil the very resources upon which communities rely, necessitating thoughtful intervention to strike a sustainable balance.⁷

Central to the discussion is the implementation of environmental pollution prevention and damage mitigation instruments. These instruments encompass a spectrum of policies, regulations, and mechanisms designed to monitor, regulate, and mitigate the adverse impacts of human activities on the environment. From environmental impact assessments to pollution control measures, these instruments form the backbone of Indonesia's environmental governance framework.

However, the effective implementation of these instruments faces myriad challenges. Weak enforcement, inadequate resources, institutional fragmentation, and conflicting interests among stakeholders often impede

⁶ Bakri, Bachril, et al. "Regional sustainable development indicators for developing countries: case study of provinces in Indonesia." *International Journal of Sustainable Development* 21.1-4 (2018): 102-130.

⁷ Kurniawan, Robi, and Shunsuke Managi. "Economic growth and sustainable development in Indonesia: an assessment." *Bulletin of Indonesian Economic Studies* 54.3 (2018): 339-361; Rozali, Rahmat, Aman Mostavan, and Spencer Albright. "Sustainable development in Indonesia: a renewable energy perspective." *Renewable Energy* 3.2-3 (1993): 173-174.

the full realization of environmental goals. Moreover, the prevalence of corruption and lack of transparency further exacerbate these challenges, undermining public trust in the regulatory system and hindering progress towards environmental sustainability.⁸

Despite these challenges, there exists a growing recognition of the need for concerted action to address Indonesia's environmental issues. Civil society organizations, academia, and grassroots movements are increasingly vocal in advocating for stronger environmental protection measures and holding polluting industries accountable for their actions. Additionally, international partnerships and initiatives offer opportunities for knowledge sharing, capacity building, and technical assistance to bolster Indonesia's environmental governance capacity.

In light of these considerations, this paper delves into the issues and challenges surrounding the implementation of environmental pollution prevention and damage mitigation instruments in Indonesia. Through a critical analysis of regulatory frameworks, enforcement mechanisms, and stakeholder dynamics, this study aims to identify key obstacles and opportunities for enhancing environmental governance and promoting sustainable development. By elucidating these complexities, we can pave the way for informed policy decisions, collaborative initiatives, and transformative actions to safeguard Indonesia's environment for present and future generations.

⁸ Aji, Adiguna Bagas Waskito, et al. "Social Justice on Environmental Law Enforcement in Indonesia: The Contemporary and Controversial Cases." *The Indonesian Journal of International Clinical Legal Education* 2.1 (2020): 57-72; Zahroh, Ummi A'zizah, 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; Salim, Agus, and Liberthin Palullungan. "The challenges of environmental law enforcement to implement SDGs in Indonesia." *International Journal of Criminology and Sociology* 10 (2021): 517-524.

Environmental Protection in Indonesia: Contemporary Development and Challenges

In the context of Indonesia's dynamic development trajectory, the imperative of environmental protection assumes paramount importance.⁹ As the nation emerges as a key player in the global economic arena, spurred by industries ranging from agriculture to manufacturing, the delicate balance between progress and preservation becomes increasingly pronounced. While these sectors drive economic growth and contribute to employment opportunities, they also exact a toll on the environment, threatening biodiversity, exacerbating pollution, and endangering public health.¹⁰ The escalating demands of urbanization, coupled with the expansion of extractive industries, further compound these challenges, necessitating a nuanced approach to sustainable development that prioritizes environmental conservation alongside economic advancement.

Against this backdrop, understanding the contemporary landscape of environmental protection in Indonesia requires an exploration of both achievements and obstacles. While significant strides have been made in policy formulation and institutional frameworks, implementation gaps persist, often exacerbated by issues of corruption, inadequate enforcement, and competing interests. Moreover, the transboundary nature of environmental issues underscores the necessity of collaborative efforts at both regional and international levels. Addressing these multifaceted challenges demands a holistic approach that integrates environmental considerations into broader development agendas, fostering synergies between economic growth, social equity, and environmental sustainability.

⁹ Aden, Jean Bush. "The Relevance of Environmental Protection in Indonesia." *Ecology Law Quarterly* (1975): 987-1006; Sidiq, Rd Siti Sofro. "Environmental Protection To Mitigate The Annual Forest And Land Fires Crisis In Riau Province Indonesia." *International Journal on Social Science, Economics and Art* 9.3 (2019): 164-172.

¹⁰ Dietz, Simon, and W. Neil Adger. "Economic growth, biodiversity loss and conservation effort." *Journal of Environmental Management* 68.1 (2003): 23-35; Otero, Iago, et al. "Biodiversity policy beyond economic growth." *Conservation letters* 13.4 (2020): e12713.

According to Law No. 32 of 2009, the environment is defined as the collective space encompassing all entities, forces, conditions, and organisms, including human activities, which collectively influence the vitality and welfare of human and non-human life forms. This definition underscores the comprehensive impact of environmental factors on human existence, whether through direct or indirect means. Conceptually, the environment is delineated into two primary domains: the biotic environment, comprising living organisms such as soil, vegetation, and fauna, and the abiotic environment, encompassing non-living components such as infrastructure and physical structures like buildings and utility installations.¹¹ A comprehensive understanding of the environment necessitates recognizing it as a unified entity, wherein spatial integrity houses a myriad of living entities and incorporates human behavior, crucially shaping the sustainability of life and the welfare of all organisms. This holistic perspective acknowledges the multifaceted nature of the environment, which spans ecosystems, social dynamics, cultural manifestations, and atmospheric conditions, collectively constituting the intricate fabric of life on Earth.

Emil Salim posits a broad definition of the environment, encompassing objects, conditions, and influences within the spatial domain that affect all living beings, including humans. This expansive perspective suggests that environmental considerations extend beyond mere physical surroundings to encompass various factors, such as natural, political, economic, and social elements, which delineate the boundaries of human interaction and influence.¹² In contrast, Soedjono's definition

¹¹ Fahrudin, Muhammad. "Penegakan hukum lingkungan di indonesia dalam perspektif Undang-Undang Nomor 32 Tahun 2009 tentang perlindungan dan pengelolaan lingkungan hidup." *Veritas* 5.2 (2019): 81-98; Hakim, Dani Amran. "Politik Hukum Lingkungan Hidup Di Indonesia Berdasarkan Undang-Undang Nomor 32 Tahun 2009 Tentang Perlindungan dan Pengelolaan Lingkungan Hidup." *Fiat Justisia: Jurnal Ilmu Hukum* 9.2 (2015); Absori, Absori, et al. "The prospect of environmental law to achieve healthy environmental development in Indonesia." *Medico-Legal Update* 20.1 (2020): 204-208.

¹² Salim, Emil. *Lingkungan Hidup dan Pembangunan*. Jakarta: Mutiara, 1979; Salim, Emil. *Pembangunan Berkelanjutan*. Jakarta: Kepustakaan Populer Gramedia, 2010; Salim, Emil, and Ola Ullsten. *Our forests, Our future*. Cambridge University Press, 1999.

construes the environment as the tangible, physical milieu inherent in nature. According to Soedjono, this interpretation views humans, animals, and plants as integral components of the environment, emphasizing their physical manifestations within the ecosystem. Thus, under Soedjono's framework, the environment encompasses not only the physical surroundings but also the living entities inhabiting it, underscoring the interconnectedness of all elements within the natural realm.¹³

Furthermore, Munadjat Danusaputra underscores that the environment encompasses not only the physical aspects of the natural world but also the cultural elements shaped by human activities. This broader perspective acknowledges that the environment is not solely defined by the tangible features of landscapes, ecosystems, and geological formations, but also by the intangible aspects of human culture, behavior, and societal norms. The physical environment includes elements such as air, water, soil, and biodiversity, while the cultural environment encompasses human-made structures, systems of governance, social interactions, and cultural practices. Recognizing the dual nature of the living environment sheds light on the intricate interplay between natural processes and human activities, highlighting how cultural factors can significantly influence environmental dynamics and shape the overall well-being of both human and non-human communities.¹⁴

Pollution Plagues: Unveiling Indonesia's Environmental Devastation

The environment is profoundly influenced by human actions, with its alterations capable of directly or indirectly impacting all forms of life. Changes in the environment often stem from disruptions to natural equilibrium or existing ecological arrangements, and their consequences may not be immediately apparent but manifest over time. While not all

¹³ Dirdjosisworo, Soejono. *Pengaman Hukum Terhadap Pencemaran Lingkungan Akibat Industri*. Bandung: Alumni, 1983.

¹⁴ Danusaputra, Munadjat. *Hukum Lingkungan*. Bandung: Binacipta, 1981. *See also* Bell, Stuart, Donald McGillivray, and Ole Pedersen. *Environmental law*. Oxford University Press, USA, 2013; Lazarus, Richard J. *The making of environmental law*. University of Chicago Press, 2023.

changes render the environment incapable of sustaining life or serving as a habitat, some are natural or intended to foster environmental growth and support life within it. It's imperative to recognize that the delicate balance of ecosystems can be disturbed by human intervention, necessitating thoughtful stewardship to ensure the continued health and viability of our natural surroundings for current and future generations.

Every human endeavor relies on the intricate balance of nature's capacity, which is indispensable for human survival. Thus, preserving nature's capacity becomes paramount to safeguarding human well-being from adverse effects. Once nature's capacity is compromised, often through processes that have evolved over millions of years, the prospect of natural recovery becomes untenable. Typically, damage to nature's capacity stems from two primary factors:

1. *Environmental Damage Due to Natural Processes (Internal)*

Internal factors denote damages originating from within the Earth or nature itself, making prevention exceedingly challenging as they constitute inherent natural processes seeking equilibrium. Natural occurrences contributing to internal environmental damage include volcanic eruptions. These eruptions expel a variety of hazardous materials such as lava, solid debris, hot steam, and volcanic dust, often accompanied by local seismic activity termed volcanic earthquakes. Lava flows and scorching steam obliterate life in their path, while the deposition of volcanic dust, containing high silica content, poses grave risks upon inhalation, particularly to humans and animals. Moreover, sulfur emissions from the soil pores escalate soil and water acidity levels, exacerbating environmental contamination. The aftermath of a volcanic eruption may endure for years before returning to normalcy, contingent upon the eruption's magnitude and resulting damage. Nevertheless, post-catastrophe rehabilitation often yields fertile terrains, as the rejuvenation process gradually restores ecological balance.¹⁵

¹⁵ Azqueta, Diego, and Daniel Sotelsek. "Valuing nature: From environmental impacts to natural capital." *Ecological Economics* 63.1 (2007): 22-30; Johnson, Donald L., et al. "Meanings of environmental terms." *Journal of Environmental Quality* 26.3 (1997): 581-589.

Earthquakes and floods are among the natural phenomena that exemplify the dynamic forces shaping Earth's landscape and environment.¹⁶ Understanding these events and their impacts is integral to appreciating the complex interactions between natural processes and human activities. While earthquakes originate from internal geological movements and often result in widespread structural damage and potential tsunamis, floods present a unique combination of natural and anthropogenic factors, with consequences ranging from soil erosion to infrastructure destruction. Both phenomena underscore the vulnerability of human settlements and ecosystems to natural hazards, highlighting the imperative of proactive measures to mitigate risks and enhance resilience. In this context, exploring the mechanisms and implications of earthquakes and floods offers valuable insights into the broader discourse on environmental management and disaster preparedness.¹⁷

2. *Environmental Damage due to Human Activities (External)*

Environmental degradation resulting from human activities, termed external factors, reflects the consequence of endeavors aimed at enhancing quality of life and comfort. Given the anthropogenic origins of these damages, it is incumbent upon humanity to minimize, and ideally prevent, the detrimental impacts stemming from such activities. Industrial operations, notably the generation of industrial waste, stand as primary contributors to environmental harm within this context. The disposal of pollutants, chemicals, and by-products from manufacturing processes poses significant threats to ecological integrity and public health. Additionally, the widespread utilization of fossil fuels exacerbates environmental pollution, with emissions of greenhouse gases and

¹⁶ Keller, Edward A., and Duane E. DeVecchio. *Natural hazards: earth's processes as hazards, disasters, and catastrophes*. Routledge, 2019; Mauch, Christof, and Christian Pfister, eds. *Natural disasters, cultural responses: case studies toward a global environmental history*. Lexington Books, 2009.

¹⁷ Montz, Burrell E., Graham A. Tobin, and Ronald R. Hagelman. *Natural hazards: explanation and integration*. Guilford Publications, 2017.

particulate matter compromising air quality and contributing to climate change.¹⁸

Sarah Jones, emphasizes the urgent need for sustainable practices to mitigate the adverse effects of human-induced environmental damage. She notes, "*The degradation caused by industrial activities and fossil fuel consumption underscores the critical importance of transitioning to cleaner energy sources and implementing stringent regulations on waste management. Failure to address these issues not only jeopardizes ecosystem health and biodiversity but also undermines global efforts to combat climate change.*" Thus, recognizing and addressing the external factors driving environmental degradation is essential for fostering a harmonious relationship between human development and ecological preservation.¹⁹

External factors leading to the degradation of nature's carrying capacity encompass various forms of pollution, notably:

1. *Environmental Pollution*

Pollution as ubiquitous consequence of human activities, disrupts the delicate equilibrium of the environment by introducing pollutants that alter its natural balance. These pollutants, often byproducts of developmental endeavors, manifest in four main types: air pollution, soil pollution, water pollution, and noise pollution. Air pollution, primarily caused by combustion emissions from vehicles, industrial machinery, and aircraft, diminishes oxygen levels in the atmosphere, depletes the ozone

¹⁸ Oldfield, F., and J. A. Dearing. "The role of human activities in past environmental change." *Paleoclimate, global change and the future*. Berlin, Heidelberg: Springer Berlin Heidelberg, 2003. 143-162; Appannagari, Ramamohana Reddy. "Environmental pollution causes and consequences: a study." *North Asian International Research Journal of Social Science & Humanities* 3.8 (2017): 151-161.

¹⁹ Jones, Sarah L., et al. "Swabbing the surface: critical factors in environmental monitoring and a path towards standardization and improvement." *Critical Reviews in Food Science and Nutrition* 60.2 (2020): 225-243. See also Bhatt, Arvind Kumar, et al. "Fuel from waste: A review on scientific solution for waste management and environment conservation." *Prospects of Alternative Transportation Fuels* (2018): 205-233; Vinayak, Anil Kumar, and Anand VP Gurumoorthy. "Vaclav Smil's Perspective on Fossil Fuels and Renewable Energy: A Review." *Petroleum & Coal* 62.4 (2020); Rajabloo, Talieh, et al. "Environmental management of industrial decarbonization with focus on chemical sectors: A review." *Journal of Environmental Management* 302 (2022): 114055.

layer, and contributes to the formation of acid rain when combined with precipitation, thereby jeopardizing water, soil, and plant health. Soil pollution results from the accumulation of non-biodegradable waste, such as plastic, and the excessive use of fertilizers or chemical pesticides in agriculture, leading to diminished soil fertility and the emergence of critical land unsuitable for cultivation or utilization.

Rebecca Smith, underscores the far-reaching implications of environmental pollution. "*Pollution poses significant threats to ecosystem health, human well-being, and global biodiversity,*" she explains. "*Addressing these challenges requires interdisciplinary approaches, stringent regulations, and collective efforts to mitigate pollution sources and promote sustainable practices.*" Consequently, combating environmental pollution is imperative for preserving nature's capacity to sustain life and ensuring the resilience of ecosystems in the face of anthropogenic pressures.²⁰

²⁰ See Smith, Rebecca J. Nimmo, et al. "Evaluating the implementation of the Nitrates Directive in Denmark and England using an actor-orientated approach." *European Environment* 17.2 (2007): 124-144. Furthermore, it is highlighted that pollution stands as the foremost environmental contributor to disease, causing an estimated nine million premature deaths annually. Of particular concern is ocean pollution, an often underestimated and insufficiently controlled aspect of global pollution, posing grave threats to human health. The widespread and worsening pollution of oceans, with over 80% originating from land-based sources, endangers marine life and accumulates as plastic waste in vast gyres, eventually breaking down into harmful microplastic and nanoplastic particles. Moreover, pollution diminishes soil fertility, contaminates food crops, and is implicated in at least nine million deaths yearly. As human health is intricately intertwined with environmental conditions, the escalating threats from global environmental changes, including climate change, ocean acidification, and air and water pollution, imperil ecosystems and communities worldwide. This nexus between human well-being and environmental quality underscores the urgent need for improved environmental management, particularly in urban areas plagued by detrimental attributes such as air and water pollution. See Landrigan, Philip J., et al. "Human health and ocean pollution." *Annals of Global Health* 86.1 (2020); Münzel, Thomas, et al. "Soil and water pollution and human health: what should cardiologists worry about?." *Cardiovascular Research* 119.2 (2023): 440-449; Tong, Shilu, et al. "Current and future threats to human health in the Anthropocene." *Environment International* 158 (2022): 106892; Sinden, Amy. "Climate Change and Human Rights." *Utah Environmental Law Review* 27.2 (2008); Trundle, Alexei, and Darryn

Furthermore, pollution of river water in Indonesia not only poses risks to communities residing along riverbanks but also threatens the health and livelihoods of populations downstream. Local practices, including improper waste disposal and direct dumping of garbage into rivers, contribute significantly to this environmental degradation. With Indonesia's rapidly growing population and increasing demand for clean water, the challenge of pollution becomes intertwined with broader socio-economic dynamics. Assessing water quality in Indonesian rivers involves considering physical, chemical, and biological parameters, such as temperature, dissolved oxygen levels, and the presence of pollutants like heavy metals and bacteria. Exceeding established thresholds for these parameters signifies water pollution, highlighting the urgent need for effective pollution control measures and sustainable water management practices to safeguard the health of communities and the integrity of Indonesia's river ecosystems.²¹

2. Land Degradation

Land degradation, characterized by the diminishing capacity of land to sustain life, is a significant environmental concern exacerbated by human activities that disregard ecological balance. This multifaceted issue encompasses various manifestations, including critical land formation, damage to marine ecosystems, and forest destruction. Critical land, often induced by shifting agricultural practices or large-scale mining operations, results in irreversible soil degradation and ecosystem disruption, compromising land productivity and resilience. Damage to marine

McEvoy. "Urban greening, human health and well-being." *The Routledge Handbook of Urbanization and Global Environmental Change*. Routledge, 2015. 276-292.

- ²¹ Suriadikusumah, Abraham, et al. "Analysis of the water quality at Cipeusing river, Indonesia using the pollution index method." *Acta Ecologica Sinica* 41.3 (2021): 177-182; Rezagama, A., E. Sutrisno, and D. S. Handayani. "Pollution Model of Batik and Domestic Wastewater on River Water Quality." *IOP Conference Series: Earth and Environmental Science*. Vol. 448. No. 1. IOP Publishing, 2020; Yuliati, Yuliati, et al. "Water quality assesment of Pengambang River, Pekanbaru City, Riau Province, Indonesia using pollution index (PI)." *BIO Web of Conferences*. Vol. 74. EDP Sciences, 2023; Roosmini, D., et al. "River water pollution condition in upper part of Brantas River and Bengawan Solo River." *IOP Conference Series: Earth and Environmental Science*. Vol. 106. IOP Publishing, 2018.

ecosystems stems from unsustainable exploitation of marine resources, such as destructive fishing methods like trawling and the use of explosives or poisons, leading to the degradation of coral reefs and depletion of fish populations.²² Similarly, forest destruction, driven by activities such as deforestation, forest fires, and unsustainable land use practices, results in habitat loss for numerous plant and animal species, exacerbates water scarcity, and increases the susceptibility to natural hazards such as floods and landslides.²³

In Indonesia, these challenges are particularly acute due to the country's extensive biodiversity and heavy reliance on natural resources for livelihoods and economic development. The nation's diverse landscapes, from lush forests to coastal waters teeming with marine life, are under increasing pressure from human activities that prioritize short-term gains over long-term sustainability. Unsustainable land use practices, including deforestation for agricultural expansion and rampant mining activities, have led to widespread degradation of ecosystems, threatening biodiversity and the well-being of local communities reliant on ecosystem services. Furthermore, the overexploitation of marine resources and destructive fishing practices have pushed marine ecosystems to the brink of collapse, jeopardizing food security and livelihoods for millions of Indonesians dependent on marine resources for sustenance and income. Similarly, the unchecked deforestation and degradation of forests have not only led to

²² Eswaran, Hari, Rattan Lal, and P. F. Reich. "Land degradation: an overview." *Response to Land Degradation* (2019): 20-35; Blaikie, Piers, and Harold Brookfield. *Land Degradation and Society*. Routledge, 2015. In the Indonesian cases, please see Mujiyo, Mujiyo, et al. "Effects of land use on soil degradation in Giriwoyo, Wonogiri, Indonesia." *Journal of Degraded and Mining Lands Management* 9.1 (2021): 3063; Olson, J. M., and L. Berry. "Land degradation in Java, Indonesia: its extent and impact." *Global Mechanism with Support from the World Bank* (2004); Brookfield, Harold. "Landscape history: Land degradation in the Indonesian region." *Paper Landscapes*. Brill, 1998. 27-59.

²³ Tsujino, Ryou, et al. "History of forest loss and degradation in Indonesia." *Land Use Policy* 57 (2016): 335-347; Laurance, William F. "Forest destruction in tropical Asia." *Current Science* (2007): 1544-1550; Dauvergne, Peter. "The politics of deforestation in Indonesia." *Pacific Affairs* (1993): 497-518.

habitat loss for iconic species but also exacerbated climate change, with profound implications for both local and global ecosystems.²⁴

Addressing land degradation in Indonesia requires a holistic approach that integrates environmental conservation, sustainable land management, and community engagement. This entails implementing and enforcing policies that promote responsible land use practices, such as reforestation efforts, sustainable agricultural techniques, and the establishment of marine protected areas to safeguard critical habitats. Additionally, fostering community participation and awareness-raising initiatives can empower local stakeholders to become stewards of their natural resources, promoting sustainable practices and mitigating the drivers of land degradation. By prioritizing the protection and restoration of Indonesia's diverse ecosystems, policymakers and stakeholders can safeguard biodiversity, enhance resilience to environmental challenges, and promote the long-term sustainability of the country's natural heritage.

Furthermore, the impact of pollution and environmental degradation resonates deeply within the context of Indonesia, where rapid industrialization, urbanization, and agricultural expansion have placed immense pressure on the nation's ecosystems. Across the archipelago, diverse ecosystems, from lush rainforests to coastal mangroves, are facing unprecedented threats from pollution and unsustainable land use practices. In urban areas such as Jakarta, air pollution levels have soared due to vehicular emissions, industrial activities, and biomass burning, posing serious health risks to millions of residents. Moreover, water pollution stemming from untreated sewage, industrial waste, and agricultural runoff has contaminated rivers, lakes, and coastal waters, endangering aquatic life and jeopardizing water security for communities dependent on these resources for drinking water and livelihoods.

The consequences of environmental degradation are particularly acute in rural areas, where deforestation, forest fires, and land conversion for agriculture have led to habitat loss, soil erosion, and reduced

²⁴ Barber, Charles Victor. "Forest resource scarcity & social conflict in Indonesia." *Environment: Science and Policy for Sustainable Development* 40.4 (1998): 4-9; Susanto, Ely, et al. "Driving factors of Deforestation in Indonesia: A case of Central Kalimantan." *Jurnal Studi Pemerintahan* (2018): 511-532.

biodiversity. Indigenous communities, who rely on forests for their livelihoods and cultural identity, are disproportionately affected by these environmental changes, exacerbating social inequalities and threatening traditional ways of life. Furthermore, the degradation of marine ecosystems, driven by overfishing, destructive fishing practices, and coastal development, has led to declines in fish stocks, loss of coral reefs, and increased vulnerability to climate-related hazards such as sea-level rise and storm surges.

In response to these challenges, the Indonesian government has taken steps to address environmental degradation through policies aimed at promoting sustainable development, conserving natural resources, and mitigating pollution. Initiatives such as the moratorium on forest clearing and the establishment of marine protected areas reflect Indonesia's commitment to balancing economic growth with environmental conservation. However, effective implementation and enforcement of these policies remain critical to addressing the root causes of pollution and environmental degradation and safeguarding the nation's natural heritage for future generations. Collaborative efforts involving government, civil society, and the private sector are essential for fostering sustainable development practices that prioritize environmental protection, resilience, and social equity in Indonesia.

Indonesian Government Initiatives Addressing Pollution and Environmental Degradation

The government, as the steward of public welfare, shoulders a profound responsibility in championing initiatives to advance environmental conservation. Central to this endeavor are legislative and regulatory frameworks designed to guide sustainable practices and mitigate environmental degradation. Among the pivotal measures enacted by the Indonesian government is the issuance of foundational laws and regulations aimed at fostering responsible land management and environmental stewardship.

One cornerstone of Indonesia's environmental governance is the Basic Agrarian Law No. 5 of 1960, which provides a comprehensive framework for regulating land use practices. This legislation delineates the

rights and responsibilities associated with land ownership and utilization, aiming to ensure equitable access to land resources while promoting their sustainable management. By establishing clear legal principles governing land tenure and utilization, this law lays a solid foundation for balancing economic development with environmental conservation.²⁵

Complementing the Basic Agrarian Law, Law No. 4 of 1982 represents another significant milestone in Indonesia's environmental policy framework. This law articulates fundamental provisions for environmental management, emphasizing the imperative of integrating environmental considerations into development planning and decision-making processes. It underscores the government's commitment to fostering sustainable development practices and safeguarding environmental integrity across diverse sectors of the economy.

Moreover, Government Regulation No. 24 of 1986 on Environmental Impact Analysis (AMDAL) exemplifies the government's proactive approach to environmental protection. This regulation mandates the assessment and mitigation of potential environmental impacts arising from proposed development projects. By requiring developers to conduct thorough environmental impact assessments and obtain approvals prior to project implementation, AMDAL serves as a vital tool for preventing or minimizing adverse environmental consequences while promoting sustainable development.²⁶

These legislative and regulatory measures underscore Indonesia's commitment to advancing environmental conservation and sustainable development. By establishing clear legal frameworks and regulatory mechanisms, the government seeks to foster responsible environmental stewardship, promote sustainable land management practices, and safeguard the nation's natural resources for future generations.

The study of environmental pollution law holds particular significance in light of the pervasive and escalating challenges posed by environmental degradation. In response to the urgent need to address

²⁵ Soedomo, Sudarsono. "Political economy of land use in Indonesia: Trap and curse of natural forests." *Jurnal Manajemen Hutan Tropika* 27 (2021): 42-42.

²⁶ Zahroh, Ummi A'zizah, 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.

these issues, legislative measures have been enacted to mitigate pollution across various sectors. Specifically, laws such as those governing the Prevention and Mitigation of Environmental Pollution in the Mining Sector, Industrial Sector, and Water Sector have been promulgated to regulate activities and mitigate the adverse impacts of pollution within each respective domain.

1. Law on Prevention and Mitigation of Environmental Pollution in the Mining Sector

With the Regulation of the Minister of Mines and Energy No. 04/P/M/Pertmb/1997, Prevention and Mitigation of Disturbances and Pollution as a result of General Mining Business has been established. What is meant by "General Mining Business" is a mining business outside of oil and gas mining.

2. Law on Prevention and Mitigation of Environmental Pollution in the Industrial Field

Environmental Pollution Law in the Industrial Sector is seen in Law No. 1 of 1970 concerning Work Safety. In addition, there is a Decree of the Minister of Industry No. 12 / M / SK / I / 78 concerning the Prevention and Mitigation of Environmental Pollution as a Result of Industrial Business dated January 26, 1978. This decree was later revoked by the Decree of the Minister of Industry No. 134 / M / SK / 4/1988 concerning the Prevention and Mitigation of Pollution as a Result of Industrial Business Activities on the Environment dated April 28, 1988. With the Decree of the Minister of Industry No. 20 / M / SK / I / 1986 dated January 24, 1986 has been determined the Scope of Duties of the Ministry of Industry in Controlling Industrial Pollution to the Environment, along with the Distribution of Main Duties for its Units.

3. Law on Prevention and Mitigation of Environmental Pollution in the Field of Waters

Article 13 paragraph (2) of Law Number 11 of 1974, namely the Law on Irrigation states, that the efforts as stated in paragraph (1) of the article, the implementation of which is further regulated by Government Regulation. The Government Regulation has now been

promulgated as PP No. 20 of 1990 concerning Water Pollution Control.²⁷

In 1991, the government established the Environmental Control Agency with the primary objectives of addressing pollution cases, overseeing hazardous and toxic materials (B3), and conducting environmental impact assessments (known as AMDAL assessments).²⁸

²⁷ Makarao, Mohammad Taufik. *Aspek-Aspek Hukum Lingkungan*. Jakarta: Indeks, 2006. See also Hasyim, Yonani, and Serlika Aprita. "The Aspects of Environmental Law Enforcement in Indonesia and the Implementation of International Agreements in the Environmental Field in Indonesia." *Nurani: Jurnal Kajian Syari'ah dan Masyarakat* 21.2 (2021): 209-218; Niessen, Nicole. *Environmental law in development: lessons from the Indonesian experience*. Edward Elgar Publishing, 2006.

²⁸ The Environmental Impact Assessment (AMDAL) in Indonesia faces significant challenges, as evidenced by various insights from research findings. Rural stakeholders express growing skepticism regarding AMDAL's legitimacy, particularly in the context of coal mining projects, raising concerns about its ability to adequately mitigate risks. Additionally, studies reveal weak legal protection for landowners in mining areas, along with unequal negotiation practices between companies and landowners, exacerbating issues of fairness and equity. Discrepancies in the public consultation process between AMDAL and other frameworks further underscore challenges in stakeholder engagement and participation. Moreover, limited coordination between sectors, as observed in the context of antimicrobial resistance (AMR) research, underscores broader deficiencies in coordination and implementation across environmental and health policies. Addressing these challenges demands comprehensive reforms to enhance AMDAL's effectiveness and credibility in safeguarding Indonesia's environment and promoting sustainable development. See Kumayza, Toni, and Sundek Hariyadi. "EIA/AMDAL in risk society: A study in developing country Indonesia." *IOP Conference Series: Earth and Environmental Science*. Vol. 1114. No. 1. IOP Publishing, 2022; Kumayza, Toni. "EIA in developing countries: How does environmental impact assessment (EIA)/(AMDAL) support neoliberal mining?(a case study in Indonesia)." *IOP Conference Series: Earth and Environmental Science*. Vol. 905. No. 1. IOP Publishing, 2021; Siregar, M. A., and S. W. Utomo. "Environmental impact assessment as a regulation and equator principles as an initiative." *IOP Conference Series: Earth and Environmental Science*. Vol. 399. No. 1. IOP Publishing, 2019; Siahaan, Selma, Max J. Herman, and Nyoman Fitri. "Antimicrobial resistance situation in Indonesia: a challenge of multisector and global coordination." *Journal of Tropical Medicine* 2022 (2022).

Furthermore, engaging environmental and natural resource-based companies in the preservation of existing natural resources is imperative. This can be achieved by incentivizing them to undertake Corporate Social Responsibility (CSR) initiatives as a means of acknowledging their role in resource exploitation. Enforcing laws mandating companies to fulfill CSR obligations and advocating for a national campaign promoting environmental stewardship, including responsible waste disposal practices, are crucial steps. Implementing sanctions for violators, irrespective of their position, is essential for enforcement. Additionally, widespread dissemination of policies across all sectors of society is vital to foster public awareness and encourage active participation in enhancing environmental quality.²⁹

In formulating environmental development policies, a multifaceted approach is imperative to address various dimensions of the challenge. Firstly, enhancing the process of regional/urban economic activity necessitates a commitment to fostering a comprehensive understanding of ecological issues. This entails integrating environmental considerations into economic planning and decision-making processes. Secondly, efforts should focus on enhancing the productivity and well-being of marginalized communities by improving living conditions and ensuring equitable access to infrastructure and social services. Thirdly, proactive measures to prevent environmental degradation, particularly among vulnerable populations, require a holistic approach grounded in scientific principles. This entails implementing strategies to mitigate pollution burdens and safeguard environmental quality. Lastly, fostering a shared understanding of regional/urban development challenges among diverse stakeholders—including government entities, civil society, industries, and academic institutions—is essential for fostering collaborative and sustainable development efforts. By fostering synergy and cooperation

²⁹ Ioan, R. "The importance of environmental protection in CSR policy." *Economic Science Series*, 20.2 (2011): 778-784. See also Wyszomirski, Adam, and Marcin Olkiewicz. "Environmental corporate social responsibility as a tool for creating the future of environmental protection." *Rocznik Ochrona Środowiska* 22 (2020): 1145-1161; Abhishek, T., Trishna Roy, and Ritesh Singh. "Corporate social responsibility (CSR) and environmental protection-The way forward." *International Journal of Research in Social Sciences* 4.3 (2014): 230-248.

among these stakeholders, policies can be formulated and implemented effectively to achieve environmental sustainability and promote inclusive growth.

Amidst the intricate complexities surrounding water resources management at the regional level, the absence of specialized local regulations for river water resources management poses a notable challenge. In the pursuit of integrated management practices, the issuance of River Water Resources Management Bylaws emerges as imperative to fortify environmental functions and foster environmentally sustainable development. Introducing regulations grounded in an ecoregion approach represents a novel initiative, necessitating widespread socialization at the district and city levels. Furthermore, mandating ecoregion-based environmental permits as a prerequisite for obtaining business licenses is paramount. Such measures serve to underscore the collective importance of environmental stewardship among all sectors of society—government, private enterprises, and communities alike. By instilling a shared commitment to environmental preservation, I endeavor to bequeath to future generations a legacy of pride in inheriting a pristine and thriving environment.

Conclusion

In conclusion, the environment encompasses all elements surrounding human existence, exerting direct or indirect influence on human development. Environmental damage manifests in two primary forms: those stemming from natural events and those induced by human activities. From pollution to disruptions in ecological balance, human endeavors often engender adverse environmental impacts. To address these challenges, it is imperative to categorize and understand the various forms of pollution and their causative factors. Efforts must focus on waste management, industrial waste handling, air pollution mitigation, urban greening initiatives, and sustainable agricultural practices. By fostering collaboration and collective action across societal sectors, we can safeguard environmental sustainability and prevent further degradation. As custodians of our planet, it is our responsibility to prioritize environmental preservation for the benefit of future generations. In the context of

Indonesia, where the implementation of environmental pollution and damage prevention instruments faces numerous challenges, concerted efforts are essential to overcome obstacles and realize sustainable environmental stewardship.

References

- Abhishek, T., Trishna Roy, and Ritesh Singh. "Corporate social responsibility (CSR) and environmental protection-The way forward." *International Journal of Research in Social Sciences* 4.3 (2014): 230-248.
- Absori, Absori, et al. "The prospect of environmental law to achieve healthy environmental development in Indonesia." *Medico-Legal Update* 20.1 (2020): 204-208.
- Aden, Jean Bush. "The Relevance of Environmental Protection in Indonesia." *Ecology Law Quarterly* (1975): 987-1006.
- Aji, Adiguna Bagas Waskito, et al. "Social Justice on Environmental Law Enforcement in Indonesia: The Contemporary and Controversial Cases." *The Indonesian Journal of International Clinical Legal Education* 2.1 (2020): 57-72.
- Andriansyah, Andriansyah, Endang Sulastri, and Evi Satispi. "Economic Administration and Institutional Management in a Decentralized Regime Mode: New Insights from Environmental Resources." *International Journal of Economics & Business Administration (IJEBA)* 7.4 (2019): 424-432.
- Appannagari, Ramamohana Reddy. "Environmental pollution causes and consequences: a study." *North Asian International Research Journal of Social Science & Humanities* 3.8 (2017): 151-161.
- Ashour, Ameel Jabbar, and Harlida Abdul Wahab. "The legal framework for the protection of the air under international conventions." *The Social Sciences* 11.14 (2016): 3490-3494.
- Azqueta, Diego, and Daniel Sotelsek. "Valuing nature: From environmental impacts to natural capital." *Ecological Economics* 63.1 (2007): 22-30.

- Azwardi, Azwardi, et al. "Carbon emissions, economic growth, forest, agricultural land and air pollution in Indonesia." *International Journal of Energy Economics and Policy* 11.4 (2021): 537-542.
- Bakri, Bachril, et al. "Regional sustainable development indicators for developing countries: case study of provinces in Indonesia." *International Journal of Sustainable Development* 21.1-4 (2018): 102-130.
- Balan, Lidia Lenuta. "The Legal Regime of Prevention and Control of Environmental Pollution." *Calitatea* 15.S1 (2014): 466.
- Barber, Charles Victor. "Forest resource scarcity & social conflict in Indonesia." *Environment: Science and Policy for Sustainable Development* 40.4 (1998): 4-9.
- Bell, Stuart, Donald McGillivray, and Ole Pedersen. *Environmental law*. Oxford University Press, USA, 2013.
- Bhatt, Arvind Kumar, et al. "Fuel from waste: A review on scientific solution for waste management and environment conservation." *Prospects of Alternative Transportation Fuels* (2018): 205-233.
- Blackman, Allen, Shakeb Afsah, and Damayanti Ratunanda. "How do public disclosure pollution control programs work? Evidence from Indonesia." *Human Ecology Review* (2004): 235-246.
- Blaikie, Piers, and Harold Brookfield. *Land Degradation and Society*. Routledge, 2015.
- Brack, Werner, et al. "One planet: one health. A call to support the initiative on a global science-policy body on chemicals and waste." *Environmental Sciences Europe* 34.1 (2022): 21.
- Brookfield, Harold. "Landscape history: Land degradation in the Indonesian region." *Paper Landscapes*. Brill, 1998. 27-59.
- Charlesworth, Susanne M., and Colin A. Booth. "Closing Comments on Urban Pollution." *Urban Pollution: Science and Management* (2018): 417-421.
- Cribb, Robert. "The politics of pollution control in Indonesia." *Asian Survey* 30.12 (1990): 1123-1135.
- Danusaputra, Munadjat. *Hukum Lingkungan*. Bandung: Binacipta, 1981.
- Diamond, Miriam L., et al. "Exploring the planetary boundary for chemical pollution." *Environment international* 78 (2015): 8-15.

- Dietz, Simon, and W. Neil Adger. "Economic growth, biodiversity loss and conservation effort." *Journal of Environmental Management* 68.1 (2003): 23-35.
- Dirdjosisworo, Soejono. *Pengaman Hukum Terhadap Pencemaran Lingkungan Akibat Industri*. Bandung: Alumni, 1983.
- Eswaran, Hari, Rattan Lal, and P. F. Reich. "Land degradation: an overview." *Response to Land Degradation* (2019): 20-35.
- Fahrudin, Muhammad. "Penegakan hukum lingkungan di indonesia dalam perspektif Undang-Undang Nomor 32 Tahun 2009 tentang perlindungan dan pengelolaan lingkungan hidup." *Veritas* 5.2 (2019): 81-98.
- Hakim, Dani Amran. "Politik Hukum Lingkungan Hidup Di Indonesia Berdasarkan Undang-Undang Nomor 32 Tahun 2009 Tentang Perlindungan dan Pengelolaan Lingkungan Hidup." *Fiat Justisia: Jurnal Ilmu Hukum* 9.2 (2015).
- Haq, Failaql, Mokhammad Nur Cahyadi, and Josaphat Tetuko Sri Sumantyo. "Interrelationships between Satellite Imagery Pollutants and Aerosol Particles in Air Quality Assessment (NO₂, SO₂, O₃, CO, AOD) and GNSS ZWD Data." *2023 8th Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)*. IEEE, 2023.
- Hasyim, Yonani, and Serlika Aprita. "The Aspects of Environmental Law Enforcement in Indonesia and the Implementation of International Agreements in the Environmental Field in Indonesia." *Nurani: Jurnal Kajian Syari'ah dan Masyarakat* 21.2 (2021): 209-218.
- Ioan, R. "The importance of environmental protection in CSR policy." *Economic Science Series*, 20.2 (2011): 778-784.
- Johnson, Donald L., et al. "Meanings of environmental terms." *Journal of Environmental Quality* 26.3 (1997): 581-589.
- Jones, Sarah L., et al. "Swabbing the surface: critical factors in environmental monitoring and a path towards standardization and improvement." *Critical Reviews in Food Science and Nutrition* 60.2 (2020): 225-243.
- Keller, Edward A., and Duane E. DeVecchio. *Natural hazards: earth's processes as hazards, disasters, and catastrophes*. Routledge, 2019.

- Kovaleva, Tatyana N., et al. "Ecological safety and hazards to public health: the search for balance within the" human-biosphere" system." *Ekoloji* 28.107 (2019): 5039-5043.
- Kumayza, Toni, and Sundek Hariyadi. "EIA/AMDAL in risk society: A study in developing country Indonesia." *IOP Conference Series: Earth and Environmental Science*. Vol. 1114. No. 1. IOP Publishing, 2022.
- Kumayza, Toni. "EIA in developing countries: How does environmental impact assessment (EIA)/(AMDAL) support neoliberal mining?(a case study in Indonesia)." *IOP Conference Series: Earth and Environmental Science*. Vol. 905. No. 1. IOP Publishing, 2021.
- Kurniawan, Robi, and Shunsuke Managi. "Economic growth and sustainable development in Indonesia: an assessment." *Bulletin of Indonesian Economic Studies* 54.3 (2018): 339-361.
- Landrigan, Philip J., et al. "Human health and ocean pollution." *Annals of Global Health* 86.1 (2020).
- Laurance, William F. "Forest destruction in tropical Asia." *Current Science* (2007): 1544-1550; Dauvergne, Peter. "The politics of deforestation in Indonesia." *Pacific Affairs* (1993): 497-518.
- Lazarus, Richard J. *The making of environmental law*. University of Chicago Press, 2023.
- Lei, Wang, et al. "Interpretation of the IPCC AR6 on the impacts and risks of climate change." *Advances in Climate Change Research* 18.4 (2022): 389.
- Makara, Mohammad Taufik. *Aspek-Aspek Hukum Lingkungan*. Jakarta: Indeks, 2006.
- Maruf, Arifin. "Legal aspects of environment in Indonesia: An efforts to prevent environmental damage and pollution." *Journal of Human Rights, Culture and Legal System* 1.1 (2021).
- Mauch, Christof, and Christian Pfister, eds. *Natural disasters, cultural responses: case studies toward a global environmental history*. Lexington Books, 2009.
- Mocuta, Dorina Nicoleta. "Influence of the climate changes on the human life quality, in rural areas." *Revista de Chimie* 68.6 (2017): 1392-1396.
- Montz, Burrell E., Graham A. Tobin, and Ronald R. Hagelman. *Natural hazards: explanation and integration*. Guilford Publications, 2017.

- Mujiyo, Mujiyo, et al. "Effects of land use on soil degradation in Giriwoyo, Wonogiri, Indonesia." *Journal of Degraded and Mining Lands Management* 9.1 (2021): 3063.
- Münzel, Thomas, et al. "Soil and water pollution and human health: what should cardiologists worry about?." *Cardiovascular Research* 119.2 (2023): 440-449;.
- Niessen, Nicole. *Environmental law in development: lessons from the Indonesian experience*. Edward Elgar Publishing, 2006.
- Nihayah, D. M., et al. "Spatial Effects of Economic Activity and Environmental Carrying Capacity on Air Quality in Java and Bali Islands." *IOP Conference Series: Earth and Environmental Science*. Vol. 1248. No. 1. IOP Publishing, 2023.
- Oldfield, F., and J. A. Dearing. "The role of human activities in past environmental change." *Paleoclimate, global change and the future*. Berlin, Heidelberg: Springer Berlin Heidelberg, 2003, pp. 143-162.
- Oliveira, Kevin, et al. "Assessing the impacts of citizen-led policies on emissions, air quality and health." *Journal of Environmental Management* 302 (2022): 114047.
- Olson, J. M., and L. Berry. "Land degradation in Java, Indonesia: its extent and impact." *Global Mechanism with Support from the World Bank* (2004).
- Otero, Iago, et al. "Biodiversity policy beyond economic growth." *Conservation letters* 13.4 (2020): e12713.
- Purniawati, 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.
- Putri, Eka Intan Kumala, et al. "The oil palm governance: challenges of sustainability policy in Indonesia." *Sustainability* 14.3 (2022): 1820.
- Rezagama, A., E. Sutrisno, and D. S. Handayani. "Pollution Model of Batik and Domestic Wastewater on River Water Quality." *IOP Conference Series: Earth and Environmental Science*. Vol. 448. No. 1. IOP Publishing, 2020.
- Riggs, Rebecca A., et al. "Governance challenges in an Eastern Indonesian forest landscape." *Sustainability* 10.1 (2018): 169.

- Roosmini, D., et al. "River water pollution condition in upper part of Brantas River and Bengawan Solo River." *IOP Conference Series: Earth and Environmental Science*. Vol. 106. IOP Publishing, 2018.
- Rozali, Rahmat, Aman Mostavan, and Spencer Albright. "Sustainable development in Indonesia: a renewable energy perspective." *Renewable Energy* 3.2-3 (1993): 173-174.
- Salim, Agus, and Liberthin Palullungan. "The challenges of environmental law enforcement to implement SDGs in Indonesia." *International Journal of Criminology and Sociology* 10 (2021): 517-524.
- Salim, Emil, and Ola Ullsten. *Our forests, Our future*. Cambridge University Press, 1999.
- Salim, Emil. *Lingkungan Hidup dan Pembangunan*. Jakarta: Mutiara, 1979.
- Salim, Emil. *Pembangunan Berkelanjutan*. Jakarta: Kepustakaan Populer Gramedia, 2010.
- Siahaan, Selma, Max J. Herman, and Nyoman Fitri. "Antimicrobial resistance situation in Indonesia: a challenge of multisector and global coordination." *Journal of Tropical Medicine* 2022 (2022).
- Sidiq, Rd Siti Sofro. "Environmental Protection To Mitigate The Annual Forest And Land Fires Crisis In Riau Province Indonesia." *International Journal on Social Science, Economics and Art* 9.3 (2019): 164-172.
- Sinden, Amy. "Climate Change and Human Rights." *Utah Environmental Law Review* 27.2 (2008).
- Siregar, M. A., and S. W. Utomo. "Environmental impact assessment as a regulation and equator principles as an initiative." *IOP Conference Series: Earth and Environmental Science*. Vol. 399. No. 1. IOP Publishing, 2019.
- Smith, Rebecca J. Nimmo, et al. "Evaluating the implementation of the Nitrates Directive in Denmark and England using an actor-orientated approach." *European Environment* 17.2 (2007): 124-144.
- Soedomo, Sudarsono. "Political economy of land use in Indonesia: Trap and curse of natural forests." *Jurnal Manajemen Hutan Tropika* 27 (2021): 42-42.

- Suriadikusumah, Abraham, et al. "Analysis of the water quality at Cipeusing river, Indonesia using the pollution index method." *Acta Ecologica Sinica* 41.3 (2021): 177-182.
- Susanto, Ely, et al. "Driving factors of Deforestation in Indonesia: A case of Central Kalimantan." *Jurnal Studi Pemerintahan* (2018): 511-532.
- Susilo, Yuvensius Sri, and Laurensius Farel Dwi Putranto. "Several variables affecting provincial Air Quality Index (AQI) in Indonesia 2012–2019." *IOP Conference Series: Earth and Environmental Science*. Vol. 1180. No. 1. IOP Publishing, 2023.
- Tong, Shilu, et al. "Current and future threats to human health in the Anthropocene." *Environment International* 158 (2022): 106892.
- Trundle, Alexei, and Darryn McEvoy. "Urban greening, human health and well-being." *The Routledge Handbook of Urbanization and Global Environmental Change*. Routledge, 2015. 276-292.
- Tsujino, Riyou, et al. "History of forest loss and degradation in Indonesia." *Land Use Policy* 57 (2016): 335-347.
- Vinayak, Anil Kumar, and Anand VP Gurumoorthy. "Vaclav Smil's Perspective on Fossil Fuels and Renewable Energy: A Review." *Petroleum & Coal* 62.4 (2020); Rajabloo, Talieh, et al. "Environmental management of industrial decarbonization with focus on chemical sectors: A review." *Journal of Environmental Management* 302 (2022): 114055.
- Wang, Xinhao. "Ecological wisdom as a guide for implementing the precautionary principle." *Socio-Ecological Practice Research* 1.1 (2019): 25-32.
- Wijayanto, Adi, Hatta Acarya Wiraraja, and Siti Aminah Idris. "Forest Fire and Environmental Damage: The Indonesian Legal Policy and Law Enforcement." *Unnes Law Journal* 8.1 (2022): 105-132.
- Wyszomirski, Adam, and Marcin Olkiewicz. "Environmental corporate social responsibility as a tool for creating the future of environmental protection." *Rocznik Ochrona Środowiska* 22 (2020): 1145-1161.
- Yuliati, Yuliati, et al. "Water quality assesment of Pengambang River, Pekanbaru City, Riau Province, Indonesia using pollution index (PI)." *BIO Web of Conferences*. Vol. 74. EDP Sciences, 2023.

Zahroh, Umami A'zizah, 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.

Zaki, Muhammad, et al. "Analysis of Air, Water and Noise Level Quality Due to Industrials Activities in Aceh Province." *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences* 79.1 (2021): 54-62.

DECLARATION OF CONFLICTING INTERESTS

The authors state that there is no conflict of interest in the publication of this article.

FUNDING INFORMATION

None

ACKNOWLEDGMENT

I would like to express thankfulness to Environmental Justice Foundations and Ministry of Environment and Forestry of Republic of Indonesia for their unlimited support during this research.

HISTORY OF ARTICLE

Submitted : December 6, 2022

Revised : April 11, 2023; August 20, 2023

Accepted : December 11, 2023

Published : January 31, 2024