**Gunung Djati Conference Series, Volume 61 (2025)**
**International Conference of the 17th OISAA's International Symposium Türkiye**
**ISSN: 2774-6585**
**Website: https://conferences.uinsgd.ac.id/**

# Quantifying Ecological Loss: Legal Recognition and Challenges In Climate Litigation

***Obbie Afri[1]****
*[1] PhD Candidate in Law and Political Sciences, Károli Gáspár University, Budapest Hungary*
*H-1091 Budapest, Kálvin tér 9 Hungary*
**Email: elaoln@kre.hu*

***Abstract***

*As climate litigation widens in Indonesia, courts increasingly recognize and quantify "ecological loss," yet enforcement remains the weak link. This article examines how Indonesian law defines ecological loss, how courts and experts measure it in practice (especially in land- and forest-fire cases), and why conversion from judgment to restoration frequently fails. Using doctrinal and comparative analysis, we map valuation methods grounded in Law No. 32/2009 and Permen LHK No. 7/2014 and benchmark them against the US NRDA/HEA model and the EU Environmental Liability Directive's restoration-first approach. We find that courts often blur ecolosgical loss and remedial costs, rely on simplified carbon pricing, and face procedural barriers and execution bottlenecks. Although large awards exist, collections are rare and restoration outcomes are unclear. We propose litigation-centric reforms: a Supreme Court standard operationalizing Permen 7/2014 for evidence and methods; fast-track execution and ring-fenced restoration funds; and concise judicial guidance to avoid double counting. These steps would align valuation, judgment, and enforcement, so damages translate into verifiable ecological repair rather than symbolic numbers.*

***Keywords***: *Ecological Loss, Climate Litigation, Indonesia Climate Case, Environmental Law, Strict Liability, Valuation.*

## 1. INTRODUCTION

As a government auditor, the author has frequently encountered cases involving unpaid debts linked to state finances. One of the most high-profile examples is the case of PT Timah Tbk, a prominent Indonesian state-owned enterprise, which drew nationwide attention due to the staggering allegation of IDR 271 trillion in losses—making it the second-largest corruption-related figure in Indonesian legal history (Larasati, 2025, pp. 206–208).Yet, what is often overlooked is that this figure did not represent direct financial embezzlement or misappropriated funds. Instead, it reflected the estimated ecological loss arising from widespread illegal tin mining activities. This distinction is crucial: unlike conventional corruption cases that involve measurable financial flows, ecological loss encompasses damages to ecosystems and natural resources that are not easily translated into monetary terms. The PT Timah case therefore exposes both the novelty and the controversy of

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

integrating ecological loss into legal and financial frameworks—an aspect that remains poorly understood not only by the public, but also within academic and legal communities.

Many people think it is about stolen or embezzled money, not about environmental harmas noted by Wijaya (2022). Several news outlets and even public commentators described it as "the second-largest corruption loss" in Indonesian history. But in fact, most of that number came from ecological damages—like ecosystem destruction, carbon storage loss, and restoration costs—not from stolen cash. Even the defendant, Harvey Moeis, seemed confused about where the number came from In the end, he was only ordered to pay a much smaller restitution, around IDR 210 billion (Muliawati, 2024). Besides this confusion in calculation, there is also the problem of weak enforcement. In the civil case Ministry of Environment and Forestry v. PT Bumi Mekar Hijau (2015), The MoEF must rely on civil enforcement tools, such as asset seizure and court execution orders. These processes are often slow and politically sensitive (Yuliati D, 2020), especially because many companies involved are state-owned or belong to large conglomerates (as in the PT Timah case). Finally, the current method of calculation is also criticized. It is seen as too simple (Kusumawijaya, I., & Setyowati, A., 2021) because it undervalues broader ecosystem services—like biodiversity, water cycles, and cultural values—and it does not capture the long-term impacts of climate change. Other countries have developed more advanced methods to address these weaknesses.

The author sees a research gap that is still underexplored: the full chain from valuation to judgment to enforcement. First, how do courts and experts actually measure ecological loss in real cases? Second, how do these numbers move between criminal and civil courts? Third, why do collection of awards and ecosystem restoration often fail or only happen partly, even after the court finds liability?

Prior studies show that Indonesia already has ministerial rules to guide economic valuation in civil cases. However, courts often mix up objective ecological damage with remedial costs, and they sometimes accept numbers from hypothetical projects instead of verified restoration costs (Wibisana & Dewaranu, 2018, pp. 225–228). The law also mentions remedial funds and environmental insurance, but in practice these tools are not clearly used, so collection and restoration often underperform after judgment as noted by Wibisana & Dewaranu (2018, pp. 225–228). In many Indonesian cases, climate harm appears through experts, indictments, or short judicial notes, not through a standardized valuation method (Sulistiawati, 2023, pp. 3, 9–10, 19). From 2010–2020, there were about 112 cases across criminal, civil, administrative, and judicial-review tracks, and around 71% were criminal—showing that most "numbers" and their impact are found in penal proceedings, as shown by Sulistiwati (2023, pp. 8–9). Even when plaintiffs win, follow-through is weak (for example, civil wins later annulled on review) and institutional capacity varies, which breaks the link between valuation to judgment and enforcement Sulistiawati (2023, pp. 15–17).

This paper asks one main question: How do Indonesian laws and courts recognize and measure ecological loss, why do these numbers often fail to produce real restoration, and what reforms can close the enforcement gap and fix method problems? To answer this, the study looks at: (1) the legal rules that define ecological loss and liability; (2) the ways judges

and experts calculate damages—and where these methods are weak; (3) how court decisions work in practice (how much money is awarded versus how much is actually collected). Taken together, these points show a serious gap in both public understanding and legal clarity about environmental harm and how to value it.

## 2. RESEARCH METHOD

This study employs a qualitative doctrinal legal method, which is widely recognised as the central methodology of legal scholarship as noted by the Council of Australian Law Deans [CALD] (2009). In line with methodological accounts, doctrinal work organizes statutes, cases, and regulations to identify settled rules, gaps, and possible reforms (Mark Van Hoecke ,2011, pp. 1–6, 11–15). Doctrinal research involves the analysis of statutes, regulations, and case law, systematically organising and restating the law to identify settled rules, emerging uncertainties, and areas for reform (Hutchinson, 2010). It may also extend to "recasting projects," grouping cases across jurisdictions to expose discrepancies and develop new frameworks (Minow, 2012, pp. 1–30).

Alongside doctrinal analysis, the research uses a comparative approach, drawing on the experience of the United States, European Union, and Australia to illustrate how different legal systems quantify ecological harm. This dimension reflects the broader methodological view that comparative analysis enriches doctrinal research and helps reveal alternative institutional responses (Van Hoecke, 2011, pp. 11–17). The study uses qualitative content analysis. Laws and court decisions are read carefully to see how judges recognize ecological loss, how they calculate it, and what legal reasons they use. A comparative approach is also used to look at differences and similarities between countries. When numbers about ecological damages are available, they are added to show the problems of valuation. The analysis also uses thematic coding, putting legal arguments into groups like causation, valuation, remedy, and enforcement. This helps to see the main problems and possible solutions for better recognition of ecological loss in climate cases.

The paper incorporates limited empirical insights through climate litigation databases and enforcement reports, illustrating the gap between judicial awards and actual collections. Such integration is consistent with the recognition that doctrinal research may legitimately summarise and assess empirical findings produced by others, in order to test legal propositions and evaluate institutional effectiveness (Partington & Wheeler, 2006). This paper also employs real-world cases and data from climate litigation databases (Sabin Center for Climate Change Law, 2025). Data comes from three sources: primary (laws, court decisions, treaties), secondary (books, articles, commentaries), and empirical (climate litigation databases, NGO reports, and policy briefs). Cases were chosen with a purposive sampling method, focusing on important and typical cases that deal with ecological loss and climate harm, from both Global North and Global South. By mixing doctrinal analysis and empirical evidence, the study shows not only how courts think about ecological loss but also how it works in real practice.

Gunung Djati Conference Series, Volume 61 (2025)
International Conference of the 17th OISAA's International Symposium Türkiye
ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

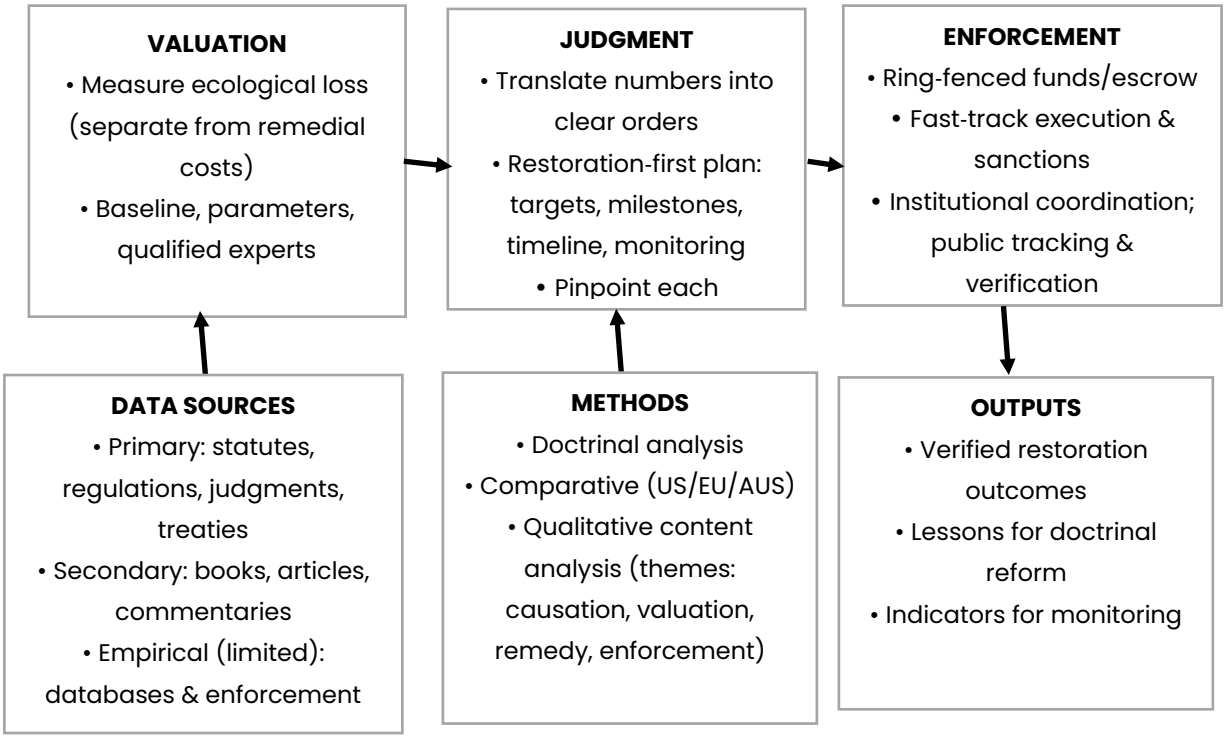


**Figure 1: Analytical framework (flow chart) clarifying the relationships among components.**

The subject of this study is climate litigation cases that involve claims of ecological loss. The object of this study is the legal recognition, methodologies, and challenges associated with quantifying ecological loss within such cases (Peel, J., & Lin, J, 2019, pp. 679–726). Key reference points include statutes ((Indonesian Law No. 32 of 2009, arts. 87–93), international

instruments (e.g., Paris Agreement 2015), and judicial precedents (Urgenda Foundation v. State of the Netherlands, 2015).

The research was conducted from February to Auguts 2025, with the primary location being academic institutions and legal research databases accessible from Budapest, Hungary, and Jakarta, Indonesia. The study also uses global online legal repositories and case databases to access relevant judgments and secondary literature.

## 3. RESULTS AND DISCUSSION

### 3.1. The Legal Basis of Ecological Loss in Indonesia

Indonesia's legal system has progressively recognized ecological loss as a compensable and enforceable component of environmental harm. This recognition is grounded in a combination of statutory, administrative, and judicial frameworks, most notably Law No. 32 of 2009 on Environmental Protection and Management and Ministerial Regulation No. 7 of 2014 issued by the Ministry of Environment and Forestry (Permen LHK No. 7/2014).

#### a. Statutory Recognition of Ecological Loss

Indonesia's principal environmental statute—Law No. 32 of 2009 on Environmental Protection and Management (PPLH Law)—recognizes ecological interests as legally protectable rights and embeds remedial pathways when those interests are impaired. First, the statute articulates a rights-based foundation: "every person has the right to a good and healthy environment" and to education, information, participation, and access to justice to vindicate that right (KLHK, (2014), Art. 65(1)–(2).). This rights architecture positions ecological harm (*kerusakan/pencemaran lingkungan hidup*) not merely as a private loss but as an infringement of a legally cognizable public interest.

Doctrinally, the PPLH Law couples this rights basis with liability rules tailored to environmental degradation. Article 87 imposes a duty on operators whose unlawful acts cause pollution or environmental damage to pay compensation (ganti rugi) and/or perform specific acts (tindakan tertentu) ordered by the court (KLHK (2014, Permen LHK No. 7/2014, art. 87(1)–(4)). This provision is central to the recognition of ecological loss because it authorizes recovery for harm to "lingkungan hidup" itself, in addition to losses suffered by individuals. Crucially, the statute introduces strict liability (tanggung jawab mutlak) to overcome evidentiary hurdles common in environmental cases. Article 88 provides that any person whose activities use hazardous and toxic substances (B3), generate or manage B3 waste, or otherwise pose a serious threat to the environment is strictly liable for resultant losses—without the need to prove fault (KLHK (2014, Permen LHK No. 7/2014, art. 88). In practice, this doctrinal choice lowers plaintiffs' burdens in complex causal settings (e.g., diffuse pollution or multi-actor harm) and reflects the preventive-protective logic of environmental law.

Institutionally, the law empowers the state to act as guardian of environmental interests. Article 90 confers standing on government agencies (central and local) responsible for the environment to bring actions for compensation and specific measures against activities that cause pollution or damage resulting in environmental loss; it also mandates that the technical contours of "environmental loss" be further regulated by ministerial regulation (KLHK (2014, Permen LHK No. 7/2014, art. 90(1)–(2)). This explicit authorization underwrites state-led civil enforcement for ecological injury and provides the legal bridge to the government's valuation regulations. The PPLH Law's remedial system also situates ecological loss within a broader enforcement ecology. While it allows out-of-court dispute resolution for certain environmental conflicts, the statute clarifies that such mechanisms do not apply to environmental crimes—a separation that preserves the punitive and deterrent function of criminal enforcement where warranted (KLHK (2014, Permen LHK No. 7/2014, art. 85(2)). Read together, these provisions demonstrate a legislative design that: (i) recognizes ecological integrity as a legal interest; (ii) supplies liability rules (including strict liability) responsive to the nature of environmental harm; and (iii) equips public authorities and affected communities with standing and remedies to pursue restoration and compensation.

Finally, the statute's preambular and explanatory materials anchor this framework in constitutional values and the national development paradigm. The "Menimbang" clauses acknowledge both the fundamental right to a good and healthy environment and the exacerbating effect of climate change on environmental quality—justifying strengthened legal protections (KLHK (2014, Permen LHK No. 7/2014, Preamble "Menimbang"). The General Elucidation further emphasizes that the state, government, and all stakeholders bear obligations to protect and manage the environment in the service of sustainable development, reinforcing the principle often described as "state responsibility" for environmental protection (KLHK (2014, Permen LHK No. 7/2014, General Elucidation § I). Together, these elements form the statutory bedrock for recognizing and quantifying ecological loss in Indonesian litigation.

**b. Regulatory Framework for Valuation: Permen LHK No. 7/2014**

Indonesia operationalizes the measurement of ecological loss through the Minister of Environment Regulation No. 7 of 2014 concerning Environmental Losses Resulting from Pollution and/or Environmental Damage (Permen LHK 7/2014). Adopted to implement Article 90(2) of Law No. 32/2009 on Environmental Protection and Management, this regulation provides a structured administrative–technical pathway for determining and calculating "*kerugian lingkungan hidup*" and for channeling payments into the state treasury. It thereby links scientific valuation, evidentiary rules, and fiscal treatment of environmental losses within a single instrument (KLHK (2014, Permen LHK No. 7/2014, art. 90(1)–(2)). Article 2 states the regulation aims to guide central and regional environmental agencies in (a) determining environmental loss and (b) calculating its magnitude (KLHK (2014, Permen LHK No. 7/2014, art. 2). Article 3 then classifies compensable environmental losses into four categories that recur across Indonesian litigation and out-of-court settlements: (1) losses due to exceedance of environmental quality standards (Baku Mutu Lingkungan Hidup, BMLH), (2) costs of environmental

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

dispute resolution (verification, laboratory analysis, experts, and supervision of payments), (3) costs of pollution/damage control and environmental recovery, and (4) ecosystem loss (kerugian ekosistem), (KLHK (2014, Permen LHK No. 7/2014, art. 3). These categories cover both transactional (administrative) costs and intrinsic ecological harms, creating a bridge between economic and non-economic forms of damage.

Article 1 adopts the statutory definitions used in the 2009 framework law, emphasizing that "environmental loss" is a loss arising from pollution and/or environmental damage that is not a matter of private property rights. It also defines "pollution" as the introduction of living organisms, substances, energy, and/or other components into the environment by human activity beyond prescribed quality standards, and "environmental damage" as direct or indirect adverse changes to environmental physical, chemical, and/or biological properties beyond baseline damage criteria (KLHK (2014, Permen LHK No. 7/2014, art. 1). These definitions matter because they tie valuation to scientifically cognizable thresholds (BMLH/Kriteria Baku Kerusakan Lingkungan Hidup, KBKLH) rather than to subjective claims.

### c. Method of Calculation of Loss in Indonesia

Permen LHK No. 7/2014 turns "ecological loss" from a slogan into numbers. It prescribes who calculates the loss, what evidence anchors it, which parameters adjust it, and how component costs are added into a single, auditable figure. The core approach is restoration-cost: quantify the necessary costs to restore lost environmental functions, add associated control, verification, and dispute-handling costs, and update everything to current prices. The result is replicable across cases, suitable for courts, regulators, companies, and communities alike (KLHK (2014, Permen LHK No. 7/2014, Annex II).

Calculations are carried out by appointed experts in environmental damage/pollution and/or environmental economic valuation (formal letter of appointment). Their result serves as an initial assessment for out-of-court settlement or court use and can be revised as new information emerges (KLHK (2014, Permen LHK No. 7/2014, Annex I). The regulation lists technical factors (e.g., duration of damage, volume and parameters exceeding standards, impacted area and spread, land status) and non-technical factors (e.g., inflation, policy changes) that legitimately alter the figure over time (KLHK (2014, Permen LHK No. 7/2014, arts. 6(4)–(5)).

Proof that pollution or damage occurred is normally tied to environmental quality standards (BMLH) and damage criteria (KBKLH). Where these do not exist, the regulation allows scientific studies and expert testimony to establish the condition and the loss. This avoids paralysis in data-poor or novel contexts (KLHK (2014, Permen LHK No. 7/2014, Annex II).

Across components, Annex II use a price index to convert base-year unit costs to current prices (ratio of index in the year of damage, $IH_t$, to base-year index, IHd), and a time horizon (TH) where appropriate to capture interim loss, the period until full restoration (KLHK (2014, Permen LHK No. 7/2014, Annex II).

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

**The 12 ecosystem-function components (KLHK (2014, Permen LHK No. 7/2014, Annex II) includes:**

1. Water regulation (restoring infiltration, storage, baseflow)
2. Reservoir/storage replacement
3. Water-system management
4. Erosion & runoff control
5. Soil formation
6. Nutrient recycling
7. Waste decomposition
8. Biodiversity
9. Genetic resources
10. Carbon release
11. Erosion (treated as a distinct additional item in Annex II's enumeration)
12. Biodiversity restoration.

Each component has its own formula. For example:

**Water regulation (CHTA):**
**CHTA** = KA × BHTA × TH × LA × ($IH_t$/IHd)
Where KA = hydrological coefficient; BHTA = base-year unit cost; TH = time horizon; LA = affected area (ha); $IH_t$/IHd = price index ratio (KLHK (2014, Permen LHK No. 7/2014, Annex II). This formula directly links damages to rewetting, canal blocking, and riparian replanting costs.

**Reservoir/Storage Replacement (CR/CPMR):**
CR = VA × LA × MR (base-year) → CPMR = CR × ($IH_t$/IHd)
Where VA = water volume required per hectare; LA = affected area; MR = unit restoration cost (KLHK (2014, Permen LHK No. 7/2014, Annex II). This serves as a clear capital-expenditure proxy for lost water-storage services.

**Erosion and Runoff Control (CEr):**
CEr = BEr × LA × ($IH_t$/IHd)
Where BEr = base-year erosion-control cost per hectare (KLHK (2014, Permen LHK No. 7/2014, Annex II).
This connects ecological harm to actual expenditures such as gabions or check dams.
**Biodiversity and Genetic Resources (CBD; Cgen):**
Valued per hectare and updated to current prices, capturing non-market ecosystem services often absent from ESG disclosures (KLHK (2014, Permen LHK No. 7/2014, Annex II).

**Carbon Release and Stock Loss (Ccar; Rcar):**

Ccar reflects carbon damages from peat oxidation/combustion, while Rcar quantifies stock losses using restoration costs per ton of carbon (KLHK (2014, Permen LHK No. 7/2014, Annex II). This makes the ecological loss framework compatible with international climate liability metrics.

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

Finally, all components are aggregated into a single ecological-loss figure (CPE/CKH), with transparent summation shown in Annex II Permen LHK No. 7/2014.

Once quantified, the amount becomes legally enforceable either through settlement or a binding court judgment. Payments are then classified as non-tax state revenue (PNBP) and deposited into the state treasury, ensuring accountability and traceability of ecological damages (KLHK (2014, Permen LHK No. 7/2014, Annex II, arts. 7–8).

**d. How Results Are Used**

The regulation requires that calculation be performed by experts in (i) pollution and/or environmental damage and/or (ii) environmental economic valuation, appointed by the central ministry (Echelon I) or by regional environmental authorities (Echelon II) on the basis of research record and/or relevant experience; a standard "letter of appointment" format is provided in Annex I (KLHK (2014, Permen LHK No. 7/2014, arts. 4(1)–(4)). Calculations must follow the "Guideline for Calculating Environmental Loss" in Annex II; notably, this guideline may be used not only by government but also by companies and communities, increasing transparency and contestability of the numbers (KLHK (2014, Permen LHK No. 7/2014, arts. 5(1)–(2)). The expert's result serves as an initial assessment in dispute resolution—either out of court or in court—and may change as the process unfolds. The regulation explicitly recognizes both technical and non-technical drivers of such change (KLHK (2014, Permen LHK No. 7/2014, arts. 6(1)–(3)). Furthermore, Indonesian guidance and practice interpret ecosystem loss to include the time-indexed "interim loss" between the occurrence of damage and the completion of restoration (KLHK (2014, Permen LHK No. 7/2014, Annex II). In other words, compensation accrues over the entire interval during which environmental functions are degraded, not merely at a single point in time. This temporal dimension is explicit in the literature interpreting and applying Annex II in litigation and enforcement settings.

Although the details of quality standards sit outside this regulation, its method assumes that the occurrence of pollution/damage is determined using environmental quality standards (BMLH) and/or environmental damage criteria (KBKLH); where such parameters do not exist, scientific studies and expert testimony can establish the condition and the loss. This evidentiary flexibility is crucial in climate-adjacent or novel contexts (e.g., emerging contaminants, changing baselines) (KLHK (2014, Permen LHK No. 7/2014, Annex III).

**e. Landmark Cases in Climate Litigation**

There are at least 112 climate-related cases in Indonesia between 2010 and 2024 (Sulistiawati (2023, pp. 8–9), but only 16 of these have been fully adjudicated with final verdicts that include recognition of ecological loss (notably, the PT Timah case among them). This disparity highlights the significant enforcement gap between the number of disputes filed and those that actually produce binding judicial outcomes. In other words, only around 14 percent of total climate-related cases progressed to a legally

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

enforceable judgment, underscoring systemic barriers in moving from claims to remedies.

As shown in the graphic below, the year 2018 marked the peak of climate-related litigation in Indonesia, with nearly 17 new cases filed. Yet, despite this surge in filings, only one case that year reached a final verdict. This illustrates the persistent challenge: a growing volume of litigation reflects rising public demand for accountability, but the pathway from court filing to enforceable ecological loss recognition remains highly constrained (Climate Case Chart, 2024).


**Figure 2. Climate Litigation in Indonesia Per Year (2010-2024)**
Source: Sabin Center for Climate Change Law, Columbia Law School (2025)

The table below presents climate litigation and environmental damage cases in Indonesia, along with an explanation of the ecological loss quantification and the judgment/outcome of each case.

| Case | Year Filed | Climate/Ecological Loss Quantification | Judgment / Outcome |
|---|---|---|---|
| **Ministry of Environment and Forestry (MoEF) v. PT National Sago Prima** | 2016 | 27,000 tC (IDR 2.43 billion) + 945 tC sink loss (IDR 850.5 million); Final damages awarded: **IDR 319.1 billion** | Supreme Court upheld liability (strict liability). |
| **MoEF v. PT Waringin Agro Jaya** | 2016 | 10,979 tC emissions (IDR 988 million) + 3,843 tC sink loss (IDR 345.8 million); Total awarded: **IDR 173.4 billion** | PN, PT, and Supreme Court affirmed liability. |

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

| | | | |
|---|---|---|---|
| **MoEF v. PT Kalimantan Lestari Mandiri** | 2018 | 3,749 tC (IDR 337.3 million) + 1,312 tC sink loss (IDR 118.0 million) | District Court granted claim; Court of Appeal affirmed. |
| **Indonesian Youths v. Republic of Indonesia (Human Rights Petition)** | 2022 | Rights-based petition; **no monetary ecological loss quantified** | Pending before Komnas HAM (National Human Rights Commission). |
| **WALHI v. Governor of Bali (Mangrove reclamation)** | 2012 | Alleged mangrove ecosystem loss; **no monetary valuation** | Rejected (no actual damage proven). |
| **MoEF v. PT Merbau Pelelawan Lestari** | 2013 | Illegal logging, restoration cost valued at **IDR 240 billion** (7,463 ha) | Supreme Court upheld damages in full. |
| **MoE v. PT Selatnasik Indokwarsa & PT Simpang Pesak Indokwarsa** | 2009 | Mining, restoration including GHG emissions: **IDR 11.8 billion** | Supreme Court upheld liability. |
| **MoEF v. PT Rambang Agro Jaya** | 2019 | 2,250 tC (IDR 202.5 million) + 787.5 tC sink loss (IDR 70.8 million); Total claim: IDR 199 billion | District Court awarded **IDR 137 billion**. |
| **MoEF v. PT Asia Palem Lestari** | 2019 | 2,700 tC (IDR 243 million) + 945 tC sink loss (IDR 85 million); Total claim: IDR 173.7 billion | Claim dismissed (procedural defect – plurium litis consortium). |
| **MoEF v. PT Arjuna Utama Sawit** | 2018 | 4,366 tC (IDR 392 million) + 1,528 tC sink loss (IDR 137 million); Total claim: IDR 243.3 billion | District Court granted; Court of Appeal and Supreme Court affirmed. |
| **MoEF v. PT Palmina Utama** | 2016 | 2,299.5 tC (IDR 206.9 million) + sink loss (IDR 188.7 million) | District Court rejected; Court of Appeal reversed, holding negligence. |
| **MoEF v. PT Jatim Jaya Perkasa** | 2015 | 9,000 tC (IDR 810 million) + 3,150 tC sink loss (IDR 283.5 million); Total claim: IDR 371.1 billion | District Court granted; higher courts affirmed. |

| | | | |
|---|---|---|---|
| **MoEF v. PT Bumi Mekar Hijau** | 2015 | 135,000 tC + 5,670 $tCO_2$ (IDR 12.2 billion + IDR 4.3 billion); Total claim: ~IDR 7.986 trillion | District Court dismissed; Court of Appeal overturned, Supreme Court affirmed damages. |
| **MoE v. PT Kalista Alam** | 2012 | 13,500 tC (IDR 1.2 billion) + sink loss (IDR 425.3 million); Total claim: IDR 365 billion | District Court partially granted; upheld on appeal and Supreme Court. |
| **Greenpeace Indonesia v. Governor of Bali (Celukan Bawang Coal Plant)** | 2018 | Environmental permit challenge; no monetary ecological loss quantified | Claim rejected by administrative courts. |
| **PT Timah Corruption & Illegal Tin Mining Case** | 2023–2024 | Total ecological loss estimated at **IDR 271 trillion** (US$ 13–17 billion), covering 170,363 ha (75,346 ha forest, 95,017 ha non-forest); includes mangroves, coral reefs, and freshwater ecosystems | Under criminal corruption and environmental liability investigation; no civil judgment yet. |

Source: Sabin Center for Climate Change Law, Columbia Law School (2024)

From the table above, it can be observed that most MoEF lawsuits applied a flat rate of IDR 90,000 per ton of carbon (tC) to quantify ecological loss, calculated from both carbon release and the loss of carbon sinks. The highest damages awarded were in the PT Bumi Mekar Hijau case, amounting to at least IDR 8 trillion, while the largest ecological loss claim overall was brought against PT Timah, valued at IDR 271 trillion (Tempo ,2024,). Equally notable are the non-monetary cases—such as the Youth Petition (rights-based), the Greenpeace challenge to the Bali coal plant, and WALHI's case on Bali's mangrove reclamation—which emphasized declaratory or injunctive relief rather than financial compensation. The combined total of ecological loss claims so far (per 2025) in Indonesian cases amounts to at least IDR 279.2 trillion (approximately US$17–18 billion).

Furthermore, only a few climate-related cases where damages were awarded have actually resulted in collection. The most prominent example is MoEF v. PT Kalista Alam (2012), where the final judgment of about IDR 366 billion (US$25 million) was eventually paid after enforcement actions between 2017 and 2019, with the company transferring the amount into the state account. Another case, MoEF v. PT National Sago Prima (2016), resulted in a judgment of IDR 319 billion. However, only partial collection has been confirmed—some assets were seized, but there is no public confirmation that the full damages were ever paid.

By contrast, several high-value cases remain unpaid or contested. In MoEF v. PT Bumi Mekar Hijau (2015), the court awarded nearly IDR 8 trillion in damages, but the company denied responsibility, and enforcement officers have struggled for years to execute the judgment. Similarly, in MoEF v. PT Merbau Pelelawan Lestari (2013), with a judgment of IDR 240 billion, public records do not clearly confirm payment. Other companies, including PT Jatim Jaya Perkasa (2015), Waringin Agro Jaya (2016), Rambang Agro Jaya (2019), and Arjuna Utama Sawit (2018), received judgments ranging between IDR 137 billion and IDR 243 billion, yet documentation about collection remains scarce, with the Ministry of Environment and Forestry (MoEF) itself noting difficulties as companies resist enforcement.

Meanwhile, some claims were dismissed or remain ongoing. Cases such as Asia Palem Lestari, Palmina Utama, the Greenpeace Bali coal plant case, and the Youth Petition were rejected on procedural or evidentiary grounds, so no damages were awarded. The PT Timah case stands apart: although ecological losses have been estimated at IDR 271 trillion, the matter is framed as a corruption proceeding and remains under investigation, with no civil damages ordered for ecological restoration.

| Case | Year Filed | Ecological Loss Quantification | Payment / Enforcement Status |
|---|---|---|---|
| **PT Kalista Alam** | 2012 | Rp 366 billion | **Fully paid** into state treasury |
| **PT National Sago Prima** | 2016 | Rp 319 billion | **Partial enforcement** (asset seizures, unclear full collection) |
| **PT Bumi Mekar Hijau** | 2015 | ~Rp 8 trillion | **Unpaid**, despite final judgment |
| **PT Waringin Agro Jaya** | 2016 | Rp 466 billion | Enforcement status unclear |
| **PT Jatim Jaya Perkasa** | 2015 | ~Rp 491 billion | Enforcement status unclear |
| **PT Arjuna Utama Sawit** | 2018 | Rp 371 billion | Enforcement status unclear |
| **PT Rambang Agro Jaya** | 2015 | Rp 600 billion | Enforcement status unclear |
| **PT Merbau Pelelawan Lestari** | 2014 | Rp 16 trillion | Enforcement unclear |
| **PT Kalimantan Lestari Mandiri** | 2017 | ~Rp 1 trillion | Enforcement unclear |
| **PT Timah Tbk / Harvey Moeis** | 2024 | Rp 271 trillion | Only Rp 210b corruption substitute; ecological loss unpaid |

Source: Sabin Center for Climate Change Law, Columbia Law School (2024)

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

From the table, it is evident that Indonesian courts have begun to show legal recognition of ecological loss across several landmark cases. The scale of quantification ranges widely, from hundreds of billions of rupiah in cases such as Kalista Alam and National Sago Prima (NSP), to trillions in Bumi Mekar Hijau (BMH), PT Timah, and Merbau Pelelawan Lestari.

Judicial outcomes, however, vary significantly. Some cases were dismissed on procedural grounds, as in Palmina and Asia Palem Lestari, while others confirmed strict liability principles, including Kalista Alam and NSP. The 2024 PT Timah case stands out as historic, with ecological loss recognized at IDR 271 trillion. Yet, despite this unprecedented scale, the court only imposed a partial penalty, highlighting the gap between judicial recognition and effective sanctioning.

A clear pattern emerges: courts acknowledge and even quantify ecological loss with increasing detail, often breaking it down into ecological, economic, and restoration components. Yet, there remains a severe enforcement gap. Out of approximately IDR 279 trillion in quantified ecological losses, less than 0.2 percent has been collected.

To date, only one case has been fully enforced—Kalista Alam, with IDR 366 billion paid to the state treasury. In National Sago Prima, damages of IDR 319 billion were awarded, but enforcement remains partial, with reports of asset seizures but no confirmation of full collection. Meanwhile, some of the largest cases—Bumi Mekar Hijau (~IDR 8 trillion), PT Timah (IDR 271 trillion), and Merbau (~IDR 16 trillion)—remain entirely unpaid. For most other cases, enforcement status is unclear, suggesting systemic weaknesses in compliance mechanisms.

The key insight is that while legal recognition of ecological loss now exists on paper, payment and enforcement rarely follow. This disconnect undermines ecological justice, leaving restoration goals largely unfulfilled despite judicial victories.

### 3.2. Why Most Defendant Fail To Pay In Full?

One central reason is the massive scale of damage awards. Judgments often reach trillions of rupiah—well beyond the liquidity and solvency of corporate defendants. For example, in the *PT Bumi Mekar Hijau* case, the court awarded damages of approximately IDR 8 trillion, while the more recent *PT Timah* case quantified ecological losses at IDR 271 trillion, a figure historically unprecedented in Indonesia. A second factor is the weakness of enforcement mechanisms. Asset seizure and execution of court judgments in Indonesia are typically slow, bureaucratic, and vulnerable to political interference Even when courts declare ecological damages payable, actual collection often stalls during the execution phase. Third, companies frequently engage in corporate resistance and appeals, exploiting legal loopholes or prolonging litigation to delay or reduce payment obligations. This tactic often includes negotiating settlements or leveraging influence to diminish liabilities over time. The problem is especially acute with state-owned enterprises (SOEs) and politically connected firms. The government is often reluctant to pursue aggressive enforcement, as doing so could risk bankrupting

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

strategic companies or destabilizing sectors deemed critical to national interests. This creates a "too big to fail" dynamic that undermines deterrence. Another ESG structural issue is the absence of an earmarked ecological restoration fund. Payments, when collected, are channeled into the state treasury as non-tax state revenue (PNBP) rather than being directly allocated to ecological recovery. This disconnect weakens incentives for genuine remediation and reduces the perceived legitimacy of enforcement. Finally, market and ESG frameworks remain weak. Ecological liabilities are generally treated as off–balance-sheet risks, with little to no disclosure in corporate financial reports. International investors and domestic markets rarely exert pressure on companies to provision for such liabilities, leaving enforcement almost entirely dependent on the state

**a. The PT Timah Tbk/Harvey Moeis Verdict (2024)**

The Central Jakarta Corruption Court's decision in *Putusan No. 70/Pid.Sus-TPK/2024/PN.Jkt.Pst*—popularly associated with PT Timah Tbk and the defendant Harvey Moeis—has quickly become a touchstone for debates about how Indonesia's criminal courts register, narrate, and (only partially) operationalize the idea of *kerugian ekologis* (ecological loss). The verdict is notable for documenting a colossal environment-linked loss—Rp 271.069.688.018.700 (Central Jakarta Corruption Court (2024, Putusan No. 70/Pid.Sus-TPK/2024/PN Jkt.Pst)—but then cabining its concrete monetary consequence to a classic anti-corruption remedy: a money substitute (*uang pengganti*) of "only" Rp 210.000.000.000 borne by the convicted defendant (Central Jakarta Corruption Court, 2024, Putusan No. 70/Pid.Sus-TPK/2024/PN Jkt.Pst), with sentencing orders covering conviction, a fine, the uang pengganti of Rp 210,000,000,000, execution via confiscation or auction, and subsidiary imprisonment on default (see Amar Putusan / disposition and execution mechanics). This juxtaposition—environmental loss on the scale of a national budget line, paired with a conventional criminal-restitution figure—is precisely what makes the case a landmark for climate and environmental accountability. It simultaneously showcases the growing reach of environmental valuation in courtroom fact-finding and the structural limits of criminal adjudication in translating ecological harm into payable liabilities.

**b. What The Court Records About Environmental Loss—And How?**

The judgment canvasses the results of the state's environmental loss assessment across extensive mining-affected lands in Bangka Belitung. The court recites that the "total environmental loss" reached Rp 271.069.688.018.700 over an affected area of 170,363.064 hectares, and—crucially—specifies the decomposition of that figure into (i) Ecological Loss (Kerugian Ekologi) Rp 183.703.234.398.100; (ii) Environmental Economic Loss (Kerugian Ekonomi Lingkungan) Rp 74.479.370.880.000; and (iii) Restoration Costs (Biaya Pemulihan) Rp 11.887.082.740.600. The decision further clarifies that, as a matter of public law framing, "environmental economic loss" is conceptualized as a *state's right* (*hak negara*), whereas "restoration costs" are cast

as the *state's obligation* (*kewajiban negara*), underscoring the public finance logic that accompanies ecological accounting in the Indonesian legal system.

Basically, the court recognized a very huge ecological loss of about Rp 271 trillion, which included ecological damage, environmental economic loss, and restoration costs. However, the restitution ordered on Harvey Moeis, the convicted perpetrator, was only Rp 210 billion as a corruption substitute payment (uang pengganti). Later, this amount was increased to Rp 420 billion, and if not paid within one month after the decision, he would face an extra 10 years in prison, on top of the 20 years jail sentence given by the Jakarta High Court (Mahkamah Agung RI, 2025, Putusan No. 5009 K/Pid.Sus/2025).

This shows a clear disconnect that the court reduced ecological loss into a corruption framework and pushed aside environmental accountability. In other words, ecological loss was treated only as a side note in a corruption case. The judgment framed the loss as "state loss" under anti-corruption law, not as an independent environmental liability. By doing so, the court limited the remedy to anti-corruption sanctions and ignored the bigger duty of ecological restoration under environmental law. This is quite strange, because media and environmental activists have always described this case as one of Indonesia's biggest "sins" toward the environment (GoodStats, 2025). But in reality, the court handled it only as an anti-corruption issue, while neglecting environmental responsibility.

Moreover, Although the judgment cited figures for restoration costs, no clear order was given to restore damaged ecosystems (replanting, hydrological recovery, biodiversity protection) and its not clear whether what will the prepators or the state do to the ecosysment damaged, even tough the court already admitted the there were loss on each components. The Payment was directed into state coffers, not tied to actual ecological rehabilitation projects, which is disconnected the main purposes to rehabilitation of the damaged environment. There is no instruction for reforestation, water-table recovery, peatland rehabilitation, or biodiversity restoration. The damages are framed as "state loss" in corruption law, not as a civil liability under environmental law. The only concrete financial sanction imposed was uang pengganti (restitution) of around Rp 210 billion, which goes to the state treasury, not earmarked for ecological rehabilitation. And as a matter of fact is that the liability was imposed only on Harvey Moeis personally, not PT Timah as a corporate entity. This creates a risk that corporate-scale ecological harm goes unremedied, while enforcement focuses narrowly on an individual with limited assets compared to the massive scale of loss. This is a major gap because the ecological harm is monetized, but no pathway is set out for environmental repair.

**c. Why the Court Reduced Ecological Loss to Corruption Loss?**

The main reason is because the prosecution brought the case under Law No. 31/1999 on the Eradication of Corruption, not under the Environmental Protection and Management Law (UU No. 32/2009). This means the judges' authority was limited to

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

ruling on state financial losses (kerugian keuangan negara), not ecological damages per se. As a result, ecological loss (Rp 271 trillion) was reclassified into the broader "Rp 300 trillion state loss" calculation but operationalized only as restitution under Article 18 of the Anti-Corruption Law. This is not right. And also The court explicitly stated that the spirit of corruption law is asset recovery (asset recovery) Therefore, the remedy was designed to seize assets and impose substitute money (uang pengganti) rather than to mandate ecological rehabilitation. Judges also noted that although the total loss was Rp 300 trillion, the benefit enjoyed by Harvey Moeis personally was only Rp 210 billion. I mean ecological loss is material loss, im pretty sure the defendant benefits so much from it. However, Under corruption law, the restitution order must be proportional to the unlawful benefit obtained by the convicted person—not the full ecological damage. At the end of the day, The judgment did not invoke Permen LHK No. 7/2014 or Article 87–88 of the Environmental Law (UU 32/2009), which could have enabled ecological restoration orders. By staying within corruption law, the court effectively sidelined environmental obligations and treated ecological loss as a "background figure," not a binding liability.

**d. BPKP's Role in the Case**

The author is currently serving at BPKP, where auditing ecological loss in practice presents significant challenges. Unlike financial state losses, which are often measured using the total loss method to calculate the aggregate misuse of funds or assets (Afri, 2023), ecological loss cannot be assessed with the same straightforward approach. There is no specific audit standard dedicated to quantifying ecological loss, and its nature is fundamentally different from financial losses. Environmental harm involves complex, long-term impacts on ecosystems, biodiversity, and natural resources, many of which cannot be easily translated into monetary values. For this reason, auditors avoid making independent interpretations of what should be classified as ecological loss. Instead, in cases of environmental litigation or state loss assessment, BPKP relies primarily on the standardized methodology outlined in Ministerial Regulation of Environment and Forestry (Permen LHK) No. 7/2014. In practice, the most effective approach has been to seek technical support from ecological valuation experts to ensure that calculations reflect scientifically grounded and legally acceptable methods.

In the PT Timah case, the court explicitly referred to BPKP's audit report when calculating the state loss (kerugian keuangan negara). BPKP calculated the loss by combining three elements: (1) ecological or environmental damages (kerugian ekologi), (2) environmental economic loss (kerugian ekonomi lingkungan), and (3) restoration costs (biaya pemulihan). According to the BPKP report, the total figure was about Rp 271 trillion in environmental damages, out of around Rp 300 trillion in overall state losses (Putusan No. 70/Pid.Sus-TPK/2024/PN Jkt.Pst, see ("Amar Putusan" / disposition and execution mechanics).

Even though the court acknowledged BPKP's valuation as evidence, it did not turn the figure into an enforceable ecological restoration order. Instead, the judges treated it only as part of a corruption state loss calculation. The court noted that Harvey Moeis personally benefited only about Rp 210 billion, far below the ecological loss figure. Under the corruption law framework, the restitution imposed was limited to Rp 210–420 billion. BPKP's audit was able to quantify ecological damage using an accepted method, but the legal framing downgraded the result into a corruption case and sidelined the environmental accountability. This shows the weak link between audit findings and environmental law enforcement.

In conclusion, BPKP's audit successfully documented ecological and financial damages, but the court did not translate this into ecological accountability. Instead, the audit numbers were absorbed into corruption proceedings and reduced to a narrow restitution order, far from the original highlight of the case, which was massive environmental damage. This shows a systemic problem: even with strong forensic audit evidence, without environmental law as the legal basis, it is not possible to force real ecological restoration.

**e. Challenges in Quantifying and Enforcing Ecological Loss**

While Indonesian courts have increasingly recognized ecological loss in climate and environmental litigation, significant challenges remain. These challenges limit the transformative impact of litigation on ecological restoration and climate accountability. The Indonesian experience demonstrates that legal recognition of ecological loss is advancing, but the practical realization of restoration and climate accountability remains elusive. Weak enforcement, simplistic valuation methods, procedural barriers, political influence, fragmented legal frameworks, limited access to justice, and the lack of a restoration mechanism all undermine the effectiveness of climate litigation. Addressing these challenges is essential if litigation is to move beyond symbolic recognition and provide real remedies for ecological harm (Wibisana, 2020, pp. 113–134).

There are several weaknesses and challenges in quantifying and enforcing ecological loss in climate-related litigation. Based on my research, I identified the following main issues:

1. Weak Enforcement and Compliance. Court-ordered damages are often not translated into actual payments. Companies resist compliance, and enforcement mechanisms—asset seizures and execution orders—are slow and politically sensitive. For example, the IDR 8 trillion judgment in MoEF v PT Bumi Mekar Hijau remains unpaid despite years of enforcement attempts (Ministry of Environment and Forestry v. PT Bumi Mekar Hijau, Palembang District Court, 2016; SC No. 3555 K/Pdt/2018).
2. Limitations of Valuation Methods. Most cases rely on a flat rate of IDR 90,000 per ton of carbon to calculate damages. While simple, this method undervalues broader ecological services such as biodiversity, water regulation, and cultural

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

values. It also fails to capture long-term climate impacts, resulting in damages figures that may be considered conservative compared to actual ecological loss.

3. Procedural Barriers. Litigation is frequently obstructed by technical procedural hurdles. In MoEF v Asia Palem Lestari, the claim was dismissed for lack of necessary parties or *plurium litis consortium* (Ministry of Environment and Forestry v. PT Asia Palem Lestari, North Jakarta District Court, 2019). Similarly, in Palmina Utama, the case failed at first instance due to insufficient soil evidence (Ministry of Environment and Forestry v. PT Palmina Utama, 2016, Decision No. 125/Pdt.G-LH/2016/PN.Bjm (Banjarmasin District Court), confirmed by High Court Decision No. 48/PDT/2018/PT.BJM). Preventive and rights-based claims, such as the Youth Petition or Greenpeace Bali coal plant case, often fail because courts require proof of direct, actual damage.
4. Corporate Influence and Political Economy. Several defendants are large conglomerates or state-linked enterprises, making judgments politically sensitive. The PT Timah case, where damages were estimated at IDR 271 trillion, illustrates how systemic corruption and political influence undermine both prevention and accountability (Pengadilan Negeri Jakarta Pusat, 2024, Putusan No. 70/Pid.Sus-TPK/2024/PN Jkt.Pst [PT Timah corruption–ecological loss case]).
5. Fragmented Legal Framework. Indonesia's environmental governance is regulated by overlapping statutes in forestry, environment, mining, and corruption law. This fragmentation produces inconsistent judicial reasoning, especially concerning strict liability versus negligence. Moreover, climate obligations under the Paris Agreement are not fully integrated into domestic adjudication, limiting coherence in climate-related claims (Nicholson,2021).
6. Limited Access to Justice and NGO Capacity. NGOs such as WALHI and Greenpeace play an active role, but resource constraints limit broader participation. High litigation costs, expert witness fees, and protracted proceedings deter civil society and affected communities from pursuing claims. Communities most directly impacted by peatland fires or coastal degradation often lack standing or financial means to litigate (WALHI, 2022).
7. Restoration versus Compensation Gap. Even when damages are collected, funds are transferred into the state treasury rather than earmarked for ecological restoration. As seen in Kalista Alam, where damages were paid, there is little transparency on whether funds were used for peatland rehabilitation or biodiversity recovery (Ministry of Environment and Forestry v. PT Kalista Alam, 2012), Decision No. 12/Pdt.G/2012/PN.MBO (Meulaboh District Court); confirmed by Supreme Court Decision No. 651 K/Pdt/2015). This gap weakens the environmental justice purpose of litigation.

### 3.3. Toward Legal-Financial Integration in the Green Transition

Indonesia already possesses a technical core for valuing environmental harm in Permen LHK No. 7/2014. Courts and regulators should codify this practice in a judicially endorsed standard (e.g., a Supreme Court Regulation/Perma) that: (a) specifies admissible methods (restoration/replacement cost, ecosystem-service valuation, stated preference where appropriate); (b) requires expert credentials and

report structure (baseline and counterfactual, parameter choices, uncertainty ranges, restoration–residual mapping); and (c) sets rules to avoid double counting (sequencing restoration costs before residual service losses). Doing so would reduce variance across courts and create audit-ready calculations that companies and investors can understand and use.

To enhance international comparability, Indonesia's template should be cross-walked to global measurement frameworks: the UN System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA) for stock-and-flow accounts of ecosystem assets and services, and sectoral disclosure standards such as ESRS E4 (Biodiversity & Ecosystems) in the EU's sustainability regime (United Nations, 2021).

**a. Bring Court-Validated Figures Into Audits And Assurance**

Disclosure without assurance risks becoming greenwashing. The International Auditing and Assurance Standards Board (IAASB) has issued the International Standard on Sustainability Assurance (ISSA) 5000, complemented by the IESBA ethics standard for sustainability assurance, to raise the rigour of ESG assurance engagements across many jurisdictions. These standards give auditors a framework to test the consistency between legal findings (final judgments, consent decrees, regulator-approved remediation plans) and reported figures (provisions, contingent liabilities, restoration KPIs) (International Auditing and Assurance Standards Board [IAASB] & International Ethics Standards Board for Accountants [IESBA], 2025).

Assurance workflow. Auditors should: (1) trace reported ecological liabilities to court or regulator documents and the valuation method used (e.g., Permen 7/2014, SEEA-EA-aligned accounts); (2) re-perform critical calculations or benchmark unit costs and emission factors; (3) check controls over data sources (remote-sensing inputs, field surveys, lab results) and challenge management's estimates and uncertainty ranges; and (4) report exceptions and, where necessary, require restatements or enhanced disclosures. Assurance that explicitly references the legal basis and method converts litigation outcomes into market signals and discourages strategic under-provisioning.

**b. Leverage Satellite And AI For Evidence, Monitoring, And Valuation**

Earth-observation and AI tools can close data gaps that historically undermined ecological valuation. Platforms such as Global Forest Watch provide near-real-time alerts and global datasets on tree-cover loss, enabling early detection and independent verification of company claims; the Global Forest Review synthesizes trends for policy audiences (Global Forest Watch, 2025). Google Earth Engine offers scalable geospatial processing widely used in peer-reviewed research for land-cover change, water quality, and air-pollution mapping; tools for continuous land-change monitoring now allow pixel-level, time-series detection of disturbances (Velastegui-Montoya et al., 2023, p. 7). At the methodology layer, the IPCC Wetlands Supplement (2013) provides emission factors and guidance for peatlands and

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

drained soils, enabling transparent carbon-loss estimates when peat is burned or drained (Intergovernmental Panel on Climate Change (IPCC), 2013).
Remote-sensing outputs can be linked to valuation models: area and severity of damage (e.g., peat fire scar) × unit restoration costs (canal blocking, rewetting, replanting) → restoration cost; carbon stock loss estimated with IPCC-consistent factors → carbon damages (shadow price or market proxies); hydrological disruption inferred from water-table or vegetation indices → service-loss proxies and replacement costs (e.g., alternative water supply). Governance: courts can require a "digital evidence pack" in environmental cases: geospatial layers (before/after), methods, code (e.g., GEE scripts), and third-party review. Regulators can integrate alert-to-inspection pipelines—when satellite alerts trip materiality thresholds, companies must disclose incidents, update provisions, or file corrective action plans.

#### c. Putting It Together: A Legal–Financial Operating Model

A practical integration pathway for Indonesia (exportable elsewhere): (1) a judicial standard (Perma) operationalises Permen 7/2014; adopts SEEA-EA mapping; sets expert and evidence requirements and rules against double counting; (2) disclosure guidance clarifies that court-recognised ecological loss is presumed material under IFRS S1/S2 and CSRD/ESRS, with explicit instructions on provisions/contingencies, scenario ranges, and restoration KPIs; (3) assurance protocols (ISSA 5000) require method tracing, re-performance, and control testing of ecological loss data; exceptions lead to restatement or qualified conclusions; (4) a tech backbone provides reference datasets (unit restoration costs, emission factors) and a national geospatial evidence hub (scripts, layers, QA/QC) to standardise inputs across courts, firms, and auditors; and (5) supervisors integrate nature-related litigation risk into prudential and market-conduct supervision, echoing central bank guidance (Network for Greening the Financial System (NGFS), 2023). Outcome: litigation no longer ends at judgment. It reconfigures incentives ex ante, because firms must recognise, disclose, assure, and finance ecological liabilities—and because investors can price the risk of non-compliance and poor restoration performance.

### 3.4. Qantifying Ecological Loss in Other Countries

#### a. United States: NRDA under CERCLA & OPA (HEA/REA)

The US uses Natural Resource Damage Assessment (NRDA) rules under CERCLA (hazardous substances) and the Oil Pollution Act (oil spills). Regulations at 43 CFR Part 11 (DOI) and 15 CFR Part 990 (NOAA) set out standardised assessment procedures whose results carry a rebuttable presumption in court if followed (U.S. Code of Federal Regulations, n.d.). Trustees commonly apply Habitat Equivalency Analysis (HEA) (or Resource Equivalency Analysis) to match discounted service-acre-years lost with equivalent restoration gains; NOAA provides canonical guidance and examples. Scholarly overviews detail how NRDA measures injuries, service reductions, causality, and baselines, and the practical issues of discounting and interim loss (Barnthouse, et al, 2002). Recent rulemakings continue to update NRDAR practice (Federal Register, 2024).

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

HEA is the closest analogue to Indonesia's Permen LHK 7/2014 "service-based" components (e.g., hydrological regulation, carbon, biodiversity). It gives naration a service-years × discount rate logic that be discuss alongside Indonesia's formulas.

**b. European Union: Environmental Liability Directive (ELD)**

The ELD (Directive 2004/35/EC) creates an EU-wide restoration regime anchored in the polluter-pays principle and defines "environmental damage" across protected species/habitats, water, and land (European Union, 2019). Annex II operationalises three remediation types:

a. Primary remediation (on-site to baseline);
b. Complementary remediation (elsewhere if primary can't fully restore);
c. Compensatory remediation (for interim losses until full recovery), as defined in European Commission and Organisation for Economic Co-operation and Development [OECD] (2022).

The Commission's 2021 guidelines on "environmental damage" address uneven national application and clarify key concepts; they emphasise restoration (not cash awards) and the use of resource/service equivalency methods in selecting remedial options (European Commission, 2021). Case law (e.g., Germany's Federal Administrative Court) underscores that cash substitution is not the default—remediation is. Why this matters? Because the ELD's interim-loss compensation mirrors Indonesia's time-horizon (TH) × price-indexing logic and can justify including time-discounted ecological loss in judicial reasoning.

**c. United Kingdom: Natural Capital In Appraisal & Accounts**

The UK embeds ecological valuation in policy appraisal via HM Treasury's Green Book and Defra's ENCA guidance (HM Treasury, 2020). The Office for National Statistics publishes natural capital accounts with methods to value/track ecosystem services and assets by habitat. While not a litigation tool, UK practice shows mainstreamed valuation—useful when arguing that ESG reporting and audits should reflect court-validated ecological liabilities.

**d. Australia: Offsets Policy And Calculators (EPBC + States)**

Federally, the EPBC Act Environmental Offsets Policy sets principles to achieve no net loss for matters of national environmental significance, with offset calculators to scale obligations by risk, time lags and likelihood of success (Australian Government, Department of Climate Change, Energy, the Environment and Water, 2012). States (e.g., Queensland) operate financial settlement calculators and guides specifying formulas (e.g., protected-area impact × land value × policy ratios + direct impact costs) and maintain Estimated Rehabilitation Cost (ERC) calculators for mining liabilities (Queensland Government, Department of Environment and Science, n.d.). Reviews and scholarship evaluate how calculators incorporate time-to-benefit and

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

risk in offset sizing (Parliament of Australia, n.d.). Offset calculators are transparent, index-updateable tools akin to Permen 7/2014 Annex formulas (e.g., for hydrology/carbon). They also show how to hard-wire likelihood-of-success and time-lag multipliers—two recurrent blind spots in court valuations.

**e. New Zealand: "No Net Loss" Offsetting Under Planning Law**

NZ relies on non-statutory Guidance on Good Practice Biodiversity Offsetting (Department of Conservation, 2014) and planning instruments under the Resource Management Act (and updates) to secure no-net-loss through offsets/compensation. National and regional guides specify offset accounting models, limits to offsetting, and marine offset/compensation methods where data are sparse; practice emphasises effects-management hierarchy (avoid/minimise before offset/compensate). NZ shows a practice-led, guidance-heavy regime that still yields quantified offset ledgers—useful where statute is silent on formulas but agencies/courts expect quantified trade-offs.

**f. Canada: Fisheries Act Offsetting & Conservation Allowances; EDF**

Canada uses offsets under the Fisheries Act (to achieve no net loss of fish habitat/productive capacity) with DFO policy guidance; authorisations stipulate offset measures, monitoring and completion criteria. Federally, Environment and Climate Change Canada issued an Operational Framework for Conservation Allowances (2012; draft Biodiversity Offsetting Policy updates) aligning with the mitigation hierarchy and consistency principles for offset design. Canada also channels court-ordered environmental payments to restoration via the Environmental Damages Fund (EDF). Canada complements offset valuation (ex ante) with a restoration funding instrument (ex post), offering a policy model for aligning criminal/civil outcomes with ecological repair.

**g. Cross-Cutting: SEEA-EA (UN Ecosystem Accounting Standard)**

In March 2021 the UN Statistical Commission adopted SEEA-EA as the international statistical standard for ecosystem accounting—covering ecosystem extent, condition, service supply-use, and monetary asset/service accounts. It supports value transfer methods and spatially explicit service accounting for policy and budgeting. SEEA-EA gives you an auditable macro-framework to situate case-by-case ecological loss figures within national balance sheets—exactly the bridge you seek between litigation and ESG/finance.

| Jurisdiction | Method Used | Key Feature | Why Courts Accept It |
|---|---|---|---|

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

| | | | |
|---|---|---|---|
| **Indonesia** | *Permen LHK No. 7/2014* – Restoration cost, price index (IHt/IHd), time horizon (TH) | Calculates cost of restoring lost ecosystem functions (carbon, biodiversity, hydrology, soil fertility) | Not always consistently applied; judges may see very large numbers as "unrealistic" |
| **United States** | *NRDA (CERCLA/OPA)* – Habitat Equivalency Analysis (HEA), Resource Equivalency Analysis (REA) | Matches **service-years lost** with **restoration projects** | Standardized by federal regulation (43 CFR Part 11, 15 CFR Part 990); results presumed valid in court |
| **European Union** | *Environmental Liability Directive (2004/35/EC)* – Annex II remediation rules | Primary, complementary, and compensatory remediation (restoration-first approach) | EU-wide harmonized method; courts rely on it for consistency |
| **Australia** | *EPBC Act Offsets Policy* – Offset calculators, rehabilitation cost formulas | Transparent tools for "no net loss" of biodiversity and mining ERC calculators | Regulators and courts use same calculator → less dispute |
| **Canada** | *Fisheries Act + Environmental Damages Fund (EDF)* | Offsetting + mandatory payment into EDF for ecological restoration | Ensures collected funds are tied directly to restoration projects |

### 3.5. Why Enforcement Works Abroad – The "Secret"?

One reason enforcement tends to be more effective abroad is that many jurisdictions place restoration at the center of liability regimes, rather than treating damages as mere cash penalties. In the United States, for example, the Natural Resource Damage Assessment (NRDA) process under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Oil Pollution Act requires polluters to fund ecological restoration directly (U.S. Department of the Interior, 2022). Similarly, the European Union's Environmental Liability Directive (ELD) and Australia's offset calculators embed ecological repair into the valuation of damages.

Another strength is the existence of dedicated restoration funds. In Canada, the Environmental Damages Fund (EDF) ensures that penalties collected are applied directly to environmental projects. In the United States, the "Superfund" mechanism provides a financial pool for remediation, reducing the risk that compensation will be absorbed into general government revenues (Environment and Climate Change Canada, 2025).

Enforcement abroad is also supported by insurance and financial guarantees. In the EU and the US, polluters are often required to maintain liability insurance, bonds, or other financial guarantees, ensuring that funds for restoration are available even if the polluter becomes insolvent (European Commission, n.d.). Further, the use of standardized valuation tools reduces disputes and strengthens credibility. Instruments such as the Habitat Equivalency Analysis (HEA) in the US (U.S. Code of Federal Regulations, n.d.), Annex II of the EU ELD (European Commission, 2004), and Australia's biodiversity offset calculators provide transparent methodologies for quantifying ecological loss.

Some countries also embed ecological loss into national accounting systems. The United Kingdom and the United Nations' System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA) integrate ecological loss and ecosystem services into official statistics, making such damages harder for policymakers and corporations to ignore.

Finally, effective enforcement relies on independent oversight. In jurisdictions with strong rule-of-law safeguards, regulators and courts operate with greater autonomy, limiting political interference and ensuring that judgments are executed with consistency.

## 4. CONCLUSION AND RECOMMENDATIONS

This paper finds a clear picture that legal recognition of ecological loss in Indonesia is strong, but implementation is weak. The courts can put numbers on damage (for example, using Permen LHK No. 7/2014) and have issued large awards (e.g., Kalista Alam, Bumi Mekar Hijau, PT Timah). Yet collection is rare and field restoration is uncertain. The PT Timah case situation shows how remedies can shift toward restitution to the state rather than ecological repair, leaving nature unrecovered. In short, Indonesia can count the damage, but struggles to make nature recovered again. To close this gap, the paper offers practical and realistic steps which is a short Supreme Court regulation (Perma) to standardize valuation (clear baselines, expert rules, no double counting); restoration-first orders that pair every sum with a plan, targets, milestones, and monitoring; a ring-fenced restoration fund so payments are used only for repair; fast-track enforcement with firm deadlines and sanctions; and MoEF–AGO coordination with targeted training and public tracking of progress.

It is recommended that Indonesia strengthen its legal architecture by issuing a Supreme Court Regulation (Perma) to standardize the application of Permen LHK No. 7/2014, ensure corruption cases are paired with civil environmental suits, and create fast-track enforcement protocols. Payments from ecological-loss judgments should be directed into a ring-fenced restoration fund, supported by mandatory financial assurances (bonds or insurance) and restoration-first remedies with verifiable milestones. On the corporate side, companies should be required to disclose ecological liabilities in ESG reports, subject to independent assurance, while compliance should be tied to licensing and incentives. To improve valuation and monitoring, a national handbook of unit costs, service-equivalency tools, and digital evidence packs using satellite and AI data should be

adopted. Institutional reforms should include joint MoEF–AGO enforcement units, targeted training for judges and auditors, and public dashboards tracking case outcomes and restoration progress. Finally, pilot projects and longitudinal studies should be undertaken to measure enforcement effectiveness, while integrating court-quantified ecological losses into SEEA-EA ecosystem accounts to inform fiscal and policy planning.

For the academic contribution, this paper develops a practical "*valuation → judgment → enforcement*" framework tailored to Indonesian environmental cases. It explains what to measure (ecological loss, not remedial costs), how to measure it (clear baselines, parameters, and expert standards), and how courts should write the order (restoration-first plan with targets, milestones, and monitoring). The framework then shows how enforcement should work (ring-fenced funds, deadlines, and simple public tracking) so money from judgments becomes verifiable restoration on the ground. Unlike policy checklists, this is a doctrinal, courtroom-focused tool that researchers and judges can apply case by case to test whether legal reasoning, numbers, and remedies truly lead to measurable ecological recovery.

## Acknowledgements

This article was presented as an oral presentation at the 17th OISAA (Overseas Indonesian Students' Association Alliance) International Symposium 2025 in Bursa, Turkiye.
No conflict of interest is declared in relation to this work.
This research was privately undertaken and received no external funding support.

## REFERENCES

Arévalo, P., Bullock, E. L., Woodcock, C. E., Olofsson, P., & Fahnestock, M. (2020). A suite of tools for continuous land change monitoring in Google Earth Engine. Frontiers in Climate, 2, 576740. https://doi.org/10.3389/fclim.2020.576740Australian Government, Department of Climate Change, Energy, the Environment and Water. (2022). EPBC Act environmental offsets policy (update and resources). https://www.dcceew.gov.au

Boyle, A. (2021). Climate change, principles of international law, and the problem of ecological loss. Cambridge University Press.

Central Pollution Control Board (CPCB). (2019). Methodology for assessing environmental compensation and related sectoral guidelines. https://cpcb.nic.in

Chynoweth, P. (2008). Legal research. In A. Knight & L. Ruddock (Eds.), Advanced research methods in the built environment (pp. xx–xx). Wiley-Blackwell.

Council of Australian Law Deans (CALD). (2009, November 17). The CALD standards for Australian law schools. http://www.cald.asn.au/education

Department for Environment, Food & Rural Affairs (Defra). (2025). Enabling a natural capital approach (ENCA): Guidance. https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca

Department of Conservation (New Zealand). (2014). Guidance on good practice biodiversity offsetting in New Zealand. https://www.doc.govt.nz

Environment and Climate Change Canada (ECCC). (2023). Draft biodiversity offsetting policy (consultation document). https://www.canada.ca

Environment and Climate Change Canada (ECCC). (2025). Environmental damages fund: Applicant guide and program overview. https://www.canada.ca

Environment and Climate Change Canada. (2025, July 24). Environmental damages fund. Government of Canada. https://www.canada.ca/en/environment-climate-change/services/environmental-funding/programs/environmental-damages-fund.html

European Commission. (2004, April 1). Questions and answers: Environmental Liability Directive (MEMO/04/78). https://ec.europa.eu/commission/presscorner/detail/en/memo_04_78

European Commission. (2016). REFIT evaluation of the Environmental Liability Directive (ELD) (SWD(2016) 121 final). https://environment.ec.europa.eu

European Commission. (2021). Guidelines providing a common understanding of "environmental damage" as defined in the ELD (2021/C 118/01). https://eur-lex.europa.eu

European Commission. (n.d.). How the Commission implements the Environmental Liability Directive. Environment — Environmental liability implementation. European Commission. Retrieved from https://environment.ec.europa.eu/law-and-governance/environmental-compliance-assurance/environmental-liability/implementation-commission_en

European Financial Reporting Advisory Group (EFRAG). (2023). ESRS E4: Biodiversity and ecosystems (Delegated Act Annex). https://www.efrag.org

European Parliament. (2021). Report on the liability of companies for environmental damage (A9-0112/2021). https://www.europarl.europa.eu

European Union. (2019). Directive 2004/35/EC on environmental liability (consolidated text). https://eur-lex.europa.eu

European Union. (2022). Directive (EU) 2022/2464 on corporate sustainability reporting (CSRD). https://eur-lex.europa.eu

Federal Register. (2024). Natural resource damages for hazardous substances—Proposed rule and updates to NRDAR procedures.

Federal Register, 89(3), 637–680. https://www.federalregister.govFisheries and Oceans Canada (DFO). (2019). Policy for applying measures to offset adverse effects on fish and fish habitat. https://www.dfo-mpo.gc.ca

Genn, H., Partington, M., & Wheeler, S. (2006). Law in the real world: Improving our understanding of how law works: The Nuffield inquiry on empirical legal research. The Nuffield Foundation. http://www.ucl.ac.uk/laws/socio-legal/empirical/docs/inquiry_report.pdf

Global Forest Watch (GFW). (2025). About Global Forest Watch & data access. https://www.globalforestwatch.org

Global Reporting Initiative (GRI). (2016–2023). GRI 304: Biodiversity (standard and revision updates). https://www.globalreporting.org

Gultom Law Consultants. (2023, July 14). Analisa kritis penerapan metode total loss dalam audit penghitungan kerugian keuangan negara.

https://www.gultomlawconsultants.com/analisa-kritis-penerapan-metode-total-loss-dalam-audit-penghitungan-kerugian-keuangan-negara/

HM Treasury. (2022). The Green Book: Central government guidance on appraisal and evaluation. https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

Hutchinson, T. (2010). Researching and writing in law (3rd ed.). Thomson Reuters.

Hutchinson, T., & Duncan, N. (2012). Defining and describing what we do: Doctrinal legal research. Deakin Law Review, 17(1), 83–119.

International Auditing and Assurance Standards Board (IAASB). (2024). International Standard on Sustainability Assurance (ISSA 5000). https://www.iaasb.org

International Ethics Standards Board for Accountants (IESBA). (2024). International ethics standards for sustainability assurance (including international independence standards). https://www.ethicsboard.org

International Financial Reporting Standards (IFRS) Foundation. (2023a). IFRS S1: General requirements for disclosure of sustainability-related financial information. https://www.ifrs.org

International Financial Reporting Standards (IFRS) Foundation. (2023b). IFRS S2: Climate-related disclosures. https://www.ifrs.org

Intergovernmental Panel on Climate Change (IPCC). (2013). 2013 supplement to the 2006 IPCC guidelines for national greenhouse gas inventories: Wetlands. https://www.ipcc.ch

Kementerian Lingkungan Hidup dan Kehutanan (KLHK). (2014). Peraturan Menteri Lingkungan Hidup dan Kehutanan No. 7/2014 tentang kerugian lingkungan hidup. KLHK.

Kusumawijaya, I., & Setyowati, A. (2021). Valuation of environmental losses in peatland fire litigation. Indonesian Journal of Environmental Law, 18(2), 145–168.

Larasati, C. R. (2025). Perbandingan sanksi pidana dan pemulihan kerugian negara dalam kasus tindak pidana korupsi: Studi kasus Harvey Moeis. HARISA: Jurnal Hukum, Syariah, dan Sosial, 2(1), 206–208.

Law No. 32 of 2009 on the Management and Protection of the Environment (Indonesia). (2009). https://greenaccess.law.osaka-u.ac.jp/wp-content/uploads/2019/03/Law-No.32-of-2009-on-The-Management-and-Protection-of-the-Environment.pdf

Mahkamah Agung Republik Indonesia. (2015). Putusan No. 651 K/Pdt/2015, MoEF v. PT Kalista Alam (confirming Meulaboh District Court Decision [2014]).

Mahkamah Agung Republik Indonesia. (2018). Putusan No. 3555 K/Pdt/2018, MoEF v. PT Bumi Mekar Hijau (confirming Palembang District Court Decision [2016]).

Mahkamah Agung Republik Indonesia. (2025, June 25). Putusan No. 5009 K/Pid.Sus/2025.

Ministry for the Ecological Transition and the Demographic Challenge (MITECO). (2019). Modelo de oferta de responsabilidad ambiental (MORA): Documento metodológico (updated methodological documentation). https://www.miteco.gob.es

Ministry of Environment and Forestry v. PT Asia Palem Lestari. (2019). Decision No. 607/Pdt.G-LH/2019/PN.Jkt.Utr.

Ministry of Environment and Forestry v. PT Bumi Mekar Hijau. (2015). Decision No. 24/Pdt.G/2015/PN.Plg. Climate Case Chart. https://climatecasechart.com/non-us-case/ministry-of-environment-and-forestry-v-pt-bumi-mekar-hijau/

Ministry of Environment and Forestry v. PT Palmina Utama. (2016). Decision No. 125/Pdt.G-LH/2016/PN.Bjm; Appeal Decision No. 48/PDT/2018/PT.BJM.

Minow, M. (2012). Doctrinal restatement and recasting projects. Deakin Law Review, 17(1), 1–30.

Muliawati, A. (2024, December 18). Harvey Moeis bingung dari mana negara rugi Rp 300 T di kasus timah. Detik.com. https://news.detik.com/berita/d-7692817/harvey-moeis-bingung-dari-mana-negara-rugi-rp-300-t-di-kasus-timah

National Green Tribunal (India). (2019–2021). Selected orders in OA No. 593/2017 and related matters (environmental compensation methodology and utilisation). https://greentribunal.gov.in

National Oceanic and Atmospheric Administration (NOAA). (n.d.). Habitat equivalency analysis (HEA): An overview (DARRP guidance). https://darrp.noaa.gov

National Oceanic and Atmospheric Administration (NOAA). (n.d.). 15 C.F.R. Part 990: Natural resource damage assessments under the Oil Pollution Act (eCFR). https://www.ecfr.gov

Network for Greening the Financial System (NGFS). (2023). Guide on nature-related financial risks. NGFS.

Network for Greening the Financial System (NGFS). (2023). Nature-related litigation: Emerging trends and lessons for climate risk management. https://www.ngfs.net

Network for Greening the Financial System (NGFS). (2024). Annual report 2024. NGFS.

Network for Greening the Financial System (NGFS). (2024). NGFS publishes two complementary reports on nature-related risks (Press release). https://www.ngfs.net

Nicholson, S. (2021). Fragmented environmental governance in Indonesia. Environmental Policy and Law, 51(3), 179–191.

Peel, J., & Lin, J. (2019). Transnational climate litigation: The contribution of the Global South. American Journal of International Law, 113(4), 679–726.

Pengadilan Negeri Jakarta Pusat. (2024). Putusan No. 70/Pid.Sus-TPK/2024 (Kasus korupsi PT Timah).

Pengadilan Negeri Meulaboh. (2014). Putusan No. 651 K/Pdt/2015, MoEF v. PT Kalista Alam.

Pengadilan Negeri Palembang. (2016). Putusan No. 24/Pdt.G/2015/PN.Plg, MoEF v. PT Bumi Mekar Hijau.

Sabin Center for Climate Change Law. (2025). Climate change litigation database. https://climatecasechart.com

Sulistiawati, L. Y. (2023). Climate change related litigation in Indonesia: The dawn of a new beginning? NUS Law Working Paper No. 2023/009; NUS Asia-Pacific Centre for Environment Law Working Paper 03/2023.

Tempo.co. (2024, March 29). PT Timah tin mining corruption case causes Rp271.06 trillion of state loss: Environmental expert. Tempo.co. https://en.tempo.co/read/1835566/pt-timah-tin-mining-corruption-case-causes-rp271-06-trillion-of-state-loss-environmental-expert-says

U.S. Code of Federal Regulations. (n.d.). 43 C.F.R. Part 11: Natural resource damage assessments. Title 43 – Public lands: Interior. Retrieved from https://www.ecfr.gov/current/title-43/subtitle-A/part-11

ISSN: 2774-6585
Website: https://conferences.uinsgd.ac.id/

U.S. Department of the Interior (DOI). (n.d.). Natural resource damage assessment and restoration (NRDAR) program. U.S. Department of the Interior. https://www.doi.gov/restoration

U.S. Environmental Protection Agency (EPA). (n.d.). Natural resource damages: A primer. U.S. Environmental Protection Agency. https://www.epa.gov

Van Hoecke, M. (Ed.). (2011). Methodologies of legal research: Which kind of method for what kind of discipline? Hart Publishing.

Velastegui-Montoya, A., Bullock, E. L., Woodcock, C. E., Olofsson, P., & Fahnestock, M. (2023). Monitoring deforestation using remote sensing. Remote Sensing of Environment, 293, 113617.

WALHI. (2022). Civil society and climate litigation in Indonesia. WALHI.

Wibisana, A. G. (2020). Ecological loss and environmental liability in Indonesia. Indonesia Law Review, 10(2), 113–134.

Wijaya, B. M. (n.d.). Reportase kasus korupsi timah 271 triliun dari kacamata hukum: Suatu analisis. LK2 FHUI. https://lk2fhui.law.ui.ac.id/portfolio/reportase-kasus-korupsi-timah-271-triliun-dari-kacamata-hukum-suatu-analisis

Yuliati, D. (2020). Challenges in enforcing environmental judgments in Indonesia. Journal of Environmental Law and Policy, 22(3), 201–225.

.