

Trans Boundary Environmental Harm and State Responsibility: A Study Through the Lens of International Law

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Abstract

Trans-boundary environmental harm remains a persistent and complex challenge in international law, testing the limits of state sovereignty and collective responsibility. Classic principles such as the “no-harm” rule – first articulated in the Trail Smelter arbitration and international frameworks like the 1972 Stockholm Declaration and 1992 Rio Declaration affirm that states must ensure activities within their jurisdiction do not damage the environment of other states. Yet despite a proliferation of multilateral environmental agreements and guiding norms, disputes endure over accountability, reparations and enforcement. This paper examines the doctrinal underpinnings of state responsibility for trans-boundary environmental damage under customary international law, treaty law and soft-law instruments, alongside key judicial decisions and emerging developments. The analysis highlights the urgent need for clearer liability standards, stronger enforcement mechanisms, and innovative approaches from corporate accountability, to the recognition of ecocide and to address environmental harms of cross borders. In an era of climate change and global ecological interdependence, international law must evolve a more coherent and enforceable architecture that reconciles state sovereignty with the shared duty to safeguard the global commons for present and future generations.

Keywords: trans-boundary environmental damage, state responsibility, international environmental law, due diligence, climate change etc.

1. INTRODUCTION

Environmental degradation has become an inherently transnational phenomenon. Pollution, deforestation, desertification, biodiversity loss and most critically climate change are no longer confined within state borders. Air and water currents transport toxic pollutants across continents; greenhouse gas emissions generate long-term climatic impacts affecting distant nations; and shared ecosystems (rivers, forests, marine corridors) are vulnerable to over-exploitation and contamination originating in one jurisdiction but felt far beyond. Such occurrences give rise to trans-boundary environmental harm—situations where activities within one state’s territory produce significant adverse effects on the environment or human health in another state (Handl, 1975; Laganière, 2022). This reality raises profound legal, political, and ethical questions. While no single supranational institution exists with universal jurisdiction to prosecute or sanction perpetrators of environmental harm, international law has attempted to fill this gap through principles, treaties, and dispute resolution mechanisms (Birnie et al., 2009; Sands & Peel, 2018).

The central legal issue is therefore: To what extent can a sovereign state be held accountable, and potentially liable, for environmental harm that transcends its borders? Addressing this involves reconciling state sovereignty with the “no-harm” rule and the emerging doctrine of environmental stewardship—concepts that have gained salience in an era marked by ecological crises of planetary scale (Birnie et al., 2009). The accelerating pace of environmental degradation in the twenty-first century has rendered ecological challenges not only a matter of national concern but an urgent issue of global governance. Contemporary environmental threats—ranging from industrial pollution and deforestation to biodiversity loss and climate change—transcend political boundaries and defy unilateral solutions. Such phenomena underscore the reality of trans-boundary environmental harm, where activities originating within the jurisdiction or control of one state cause significant adverse effects on the environment or human health beyond its territorial borders (Handl, 1975; Jamal, 2014).

International law has long grappled with the problem of attributing responsibility for such harm, balancing the principle of state sovereignty with the equally important obligation to ensure that one's territory is not used in a manner that causes injury to other states. Foundational legal principles such as the *sic utere tuo ut alienum non laedas maxim*, the "no-harm" rule articulated in the Trail Smelter arbitration, and the duties codified in the Stockholm Declaration (1972) and Rio Declaration (1992) provide a normative basis for addressing cross-border environmental damage. Yet, the absence of binding, universally enforceable mechanisms often undermines their practical effectiveness. The question of state responsibility in this context is particularly complex. Establishing liability requires demonstrating a breach of an international obligation attributable to the state, a task often complicated by the diffuse, cumulative, and temporally delayed nature of environmental harm. Scientific uncertainty, multiple contributing actors, and the political sensitivities of environmental diplomacy further weaken enforcement efforts under customary international law and treaty-based regimes (ILC, 2001a; Bodansky, 2010).

2. Theoretical Framework of Trans-boundary Environmental Harm

Trans-boundary environmental harm is defined as environmental damage originating within the jurisdiction or control of one state but producing significant adverse effects in another state's territory or in areas beyond national jurisdiction (Handl, 1975). Such harm may occur through airborne pathways (e.g. pollutants carried by wind currents), watercourses (pollution of rivers or oceans that flows to other states), or other vectors like migrating wildlife or drifting marine debris. Classic examples include the spread of acid rain across national boundaries, oil spills in international waters washing up on foreign shores, or nuclear fallout dispersing radiation over wide regions (Sands & Peel, 2018).

The Trail Smelter arbitration (United States v. Canada, 1941) remains the foundational case articulating the international rule on transboundary pollution. In Trail Smelter, a tribunal convened under a Canada-U.S. agreement held that Canada was responsible for sulfur dioxide fumes from a smelter in British Columbia that caused damage in Washington State. The tribunal's 1941 decision declared that "no state has the right to use or permit the use of its territory in such a manner as to cause injury to the territory of another" (Trail Smelter Arbitration, 1941, p. 1965). This dictum essentially imposed on states an obligation to control activities within their jurisdiction so as to prevent significant transboundary harm. It crystallized the maxim *sic utere tuo ut alienum non laedas* in international law, transforming a principle derived from Roman law and common law into a cornerstone of environmental obligation (Brownlie, 2008). In modern terms, the Trail Smelter principle is understood as requiring due diligence: each state must act with a level of care appropriate to the risk to ensure that activities within its control do not harm other states (Takano, 2018). This creates a conceptual bridge between sovereignty and responsibility – sovereignty over one's territory is conditioned by a duty not to injure the rights of others (including other states and the global commons). Trail Smelter also demonstrated the remedial consequence of breaching this duty: Canada was required to pay compensation and cease the harmful activity unless it could be controlled to prevent future damage. Compensation and cessation remain the primary remedies in state responsibility law (ILC, 2001a, art. 30-31).

The no-harm principle recognized in Trail Smelter was later codified explicitly in global declarations. Principle 21 of the Stockholm Declaration (1972) provides that states have "the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or areas beyond the limits of national jurisdiction" (United Nations, 1972). Two decades later, Principle 2 of the Rio Declaration (1992) reaffirmed this identical formulation (United Nations, 1992a). Although these Declarations are non-binding "soft law," their near-universal acceptance signals that Principle 21/2 reflects customary international law (Bodansky, 2010). To give the no-harm rule more operative content, the International Law Commission (ILC) formulated the Draft Articles on the Prevention of Transboundary Harm from Hazardous Activities (2001). These draft articles (also non-binding) elaborate a preventive regime: states must use all appropriate measures to prevent significant transboundary harm, or minimize the risk if it cannot be totally prevented (ILC, 2001b). They include procedural duties such as prior notification and consultation with potentially affected states, and require states to conduct environmental impact assessments (EIAs) for risky activities. While not a treaty, the ILC Prevention Draft has influenced state practice and informed judgments like the ICJ's dictum in Pulp Mills (2010) that an EIA is required by general international law for major projects with potential cross-border impacts (Pulp Mills, 2010, p. 83, ¶204).

3. State Responsibility in International Law

Under general international law, the doctrine of state responsibility holds that whenever a state commits an internationally wrongful act, it incurs responsibility and must make reparation (ILC, 2001a, art. 1). An internationally wrongful act arises if two elements are satisfied: (a) the conduct is attributable to the state under international law, and (b) the conduct breaches an international obligation of the state (ILC, 2001a, art. 2). These principles, codified in the ILC's Articles on Responsibility of States for Internationally Wrongful Acts (ARSIWA, 2001), are of general application – they apply to all breaches of international law by states, including environmental obligations. ARSIWA makes clear that it covers acts or omissions of state organs, and certain acts of private persons or entities that are sufficiently attributable to the state (through effective control, direction, or public function) (ILC, 2001a, arts. 4–8). It does not define specific primary obligations (like environmental rules); rather, it provides the secondary rules that determine the consequences of a breach of any obligation (ILC, 2001a, commentary to art. 1). In an environmental context, this means if a state violates the no-harm rule or a treaty obligation (the primary norm) and the violation is attributable to the state (e.g. due to insufficient regulation of a state-owned facility or failure to prevent a private actor's harmful conduct when the state had the ability to do so), then state responsibility is engaged (Jamal, 2014; Nollkaemper & Jacobs, 2013).

Notably, recent developments suggest an expanding view of state responsibility for environmental harm that touches on community interests. In its 2025 advisory opinion on climate change, the ICJ framed environmental protection as an obligation *erga omnes*, owed to the international community as a whole (ICJ, 2025). This implies that any state (not just a directly injured state) could invoke the responsibility of a perpetrator state for breaching obligations that protect common interests like the climate system or the oceans. In theory, that means a country highly vulnerable to climate change (say, a Pacific island state) could hold a major emitting country accountable even if the harm (sea-level rise) is a diffuse global phenomenon – because the obligation to mitigate climate change is owed to all. Similarly, we see a trend in human rights litigation to characterize environmental harm as a violation of obligations owed to individuals and humanity at large, thereby allowing broader standing to challenge environmental wrongdoing (Knox, 2012; Human Rights Committee, 2018; Inter-American Court of Human Rights, 2025).

It is important to distinguish state responsibility for wrongful acts from the concept of state liability for harm caused by lawful acts. In classical terms, “responsibility” attaches to a breach of an international obligation (a wrongful act), whereas “liability” in some contexts refers to obligations to compensate for harm even if no rule was violated (sometimes termed responsibility for harm alone or no-fault liability). Under the normal rules (ARSIWA framework), state responsibility is fault-based or breach-based: the injured state must prove the existence of an obligation, a breach, and attribution to the source state. By contrast, certain regimes contemplate that a state may be required to pay compensation solely on the basis of harm caused, regardless of any wrongful conduct. This is essentially a form of strict liability in international law, designed for ultra-hazardous activities where even the best prevention efforts cannot eliminate risks (Barboza, 201; ILC, 2006).

Generally, states have been unwilling to accept open-ended liability for environmental damage in the absence of misconduct. A telling example is the Chernobyl disaster (1986): the nuclear accident in the Soviet Union caused radioactive fallout over many countries, yet affected states did not pursue legal claims against the USSR. The episode revealed a gap: catastrophic harm can occur from activities that are not prohibited, and if the operator-state was not negligent *per se*, classical responsibility may not provide relief to victims. To address this gap, international law has taken a sectoral approach. In a few specific areas involving ultra-hazardous activities, treaties impose strict liability on states. A prominent example is the 1972 Convention on International Liability for Damage Caused by Space Objects, which makes a launching state absolutely liable to pay compensation for damage caused on the surface of the Earth or to aircraft in flight by its space objects (United Nations, 1972b). This reflects the understanding that space activities pose potentially severe transboundary risks (e.g., a falling satellite causing harm) and that victims should be compensated without needing to prove fault. Another example is the liability regime under the Convention on Supplementary Compensation for Nuclear Damage (1997) and earlier nuclear liability conventions, where operators of nuclear facilities are subject to strict liability (typically channeled to the operator, backed by state guarantees). Similarly, the Protocol on Environmental Protection to the Antarctic Treaty (1991) includes an annex (Annex VI, adopted 2005) establishing a form of strict liability for environmental emergencies in Antarctica, making operators (and secondarily states) liable for the costs of response actions (Sands & Peel, 2018).

Economically, strict liability could expose states (and their industries) to staggering financial burdens for transboundary damage, potentially deterring beneficial activities or inviting a flood of claims. Developed states, for their part, often fear being targeted for their industrial activities or accidental spills. Thus, consensus has gravitated toward fault-based responsibility, supplemented by insurance schemes and industry liability at the national level to handle the fallout of “accidents” (OECD, 1986). Recognizing the need to ensure compensation even when no wrongful act can be established, the International Law Commission put forth the Principles on the Allocation of Loss in the Case of Transboundary Harm Arising out of Hazardous Activities (2006). These principles, though non-binding, recommend approaches for states to internally implement. A central tenet is that states should require operators of hazardous activities to maintain financial security (like insurance or funds) and impose liability on those operators for any transboundary damage without requiring proof of fault (ILC, 2006, princ. 4). In essence, the ILC Principles champion the polluter pays principle – the idea that the party responsible for pollution should bear the costs of damage. They advise that if victims cannot obtain full compensation from the operator (e.g., the company is insolvent or damage exceeds insurance), the state of origin should provide additional compensation (ILC, 2006, princ. 4(f)). The Principles also include provisions on non-discrimination (foreign victims should have equal access to remedies in the source state’s courts) and broad definitions of recoverable damage (including environmental restoration costs) (ILC, 2006).

4. Treaty Law and Multilateral Environmental Agreements

Treaty law and multilateral environmental agreements (MEAs) form a cornerstone of international environmental governance, providing legally binding frameworks for collective action on trans-boundary and global ecological problems. Since the 1972 UN Conference on the Human Environment in Stockholm, the number and scope of MEAs have expanded significantly—over 1,400 agreements to date—though only a fraction contain explicit liability or compensation provisions (Bodansky et al., 2017). MEAs address diverse challenges, many with cross-border implications. For example, the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992) requires cooperation in the management of shared water resources, obliging parties to prevent and control transboundary water pollution and to inform and consult each other on projects with possible cross-border effects. The Espoo Convention (1991) mandates EIAs, notification, and consultation for proposed activities likely to cause significant adverse trans-boundary environmental effects, thereby codifying procedural duties among neighboring states. The Basel Convention (1989) regulates the trans-boundary movement and disposal of hazardous wastes through a system of prior informed consent and environmentally sound management, aiming to minimize the risks of incidents like toxic waste dumping across borders. More recent instruments extend into global commons: the new UNCLOS Agreement on Biodiversity Beyond National Jurisdiction (BBNJ), adopted in 2023, seeks to conserve marine biodiversity in areas beyond national jurisdiction and incorporates principles like the polluter pays and benefit-sharing for marine genetic resources (Rajamani & Peel, 2021).

Despite generally high levels of formal adherence to MEAs, compliance and enforcement remain persistent challenges. Many MEAs rely on reporting, monitoring, and peer pressure rather than coercive sanctions. For instance, the climate regime under the UN Framework Convention on Climate Change (UNFCCC, 1992) and the Paris Agreement (2015) is built on nationally determined contributions and transparency mechanisms, but lacks a binding enforcement arm (Bodansky et al., 2017). The Stockholm and Rio Declarations enshrined guiding principles (no-harm, good-neighborliness, common but differentiated responsibilities), yet those declarations are soft law without direct enforcement. Even where MEAs have compliance committees or protocols (e.g. the Montreal Protocol’s Implementation Committee, or the Basel Convention’s compliance mechanism), these bodies typically offer assistance and recommendations instead of penalties. The result is an “implementation gap” often noted by scholars: there can be a substantial divergence between treaty commitments and actual environmental outcomes on the ground. Contributing factors include limited national capacity, insufficient political will, and the complexity of translating international norms into domestic action. Strengthening MEA regimes thus remains an ongoing project, with proposals ranging from more robust verification and dispute settlement procedures to innovative approaches like non-compliance responses (e.g. suspension of privileges or trade measures for persistent violators) and greater involvement of non-state stakeholders in monitoring compliance (Banda, 2019; du Toit & Kotzé, 2022).

5. International Jurisprudence and Case Studies

International jurisprudence on trans-boundary environmental harm has gradually developed through decisions of the International Court of Justice (ICJ), arbitral tribunals, human rights bodies, and other forums. A notable characteristic of these cases is the emphasis on procedural obligations (like environmental impact assessment and notification) over findings of substantive liability. For example, in *Pulp Mills on the River Uruguay (Argentina v. Uruguay, ICJ 2010)*, the ICJ acknowledged that conducting an EIA is a requirement under general international law for activities with potential trans-boundary impact. The Court found that Uruguay breached its procedural duty by failing to notify and consult with Argentina about the planned pulp mills, but it did not impose damages for environmental harm due to insufficient evidence of actual pollution. This reflects a cautious judicial approach: courts have been reluctant to hold states internationally liable for environmental injury unless clear and convincing proof of causation and damage is present (Bruneau, 2007).

Similarly, in the *Nuclear Tests cases (Australia v. France and New Zealand v. France, ICJ 1974)*, the ICJ avoided ruling on whether France's atmospheric nuclear explosions in the Pacific had caused impermissible environmental harm. The cases were effectively mooted by France's unilateral declaration that it would cease atmospheric testing, which the Court treated as binding. The ICJ thus sidestepped a direct pronouncement on the environmental legality of nuclear fallout, illustrating the judiciary's general preference for resolving cases on procedural or jurisdictional grounds rather than substantively assessing ecological damage (Bruneau, 2007). This judicial reticence means that procedural compliance (following notice, consultation, and other process requirements) often overshadows substantive environmental protection in case outcomes.

Several landmark cases have elucidated key principles. The *Trail Smelter arbitration (1941)* remains a foundational precedent: it was one of the first instances of an international tribunal ordering a polluting state (Canada) to pay compensation for trans-boundary harm (to the United States) and articulating the no-harm rule as a binding norm (Wirth, 1996). The tribunal's clear statement that no state may use its territory in a manner that causes significant injury to another state has been repeatedly affirmed in later jurisprudence.

In *Pulp Mills (2010)*, as noted, the ICJ reinforced the importance of procedural duties such as prior notification and transboundary EIA, thereby operationalizing the due diligence obligation. Although the Court did not find Uruguay liable for damages, the judgment underscored that states must cooperate in good faith and take steps to assess and prevent potential harm in shared waterways (Takano, 2018).

In the realm of human rights, *Portillo Cáceres et al. v. Paraguay (UN Human Rights Committee, 2019)* marked a milestone linking trans-boundary environmental harm to human rights violations. In that case, the Human Rights Committee found that Paraguay violated the right to life and other rights of farmers by failing to prevent severe cross-border pesticide pollution from commercial farms, which poisoned neighboring communities in Argentina (Knox, 2012). This decision exemplifies how human rights law can be used to hold states accountable for environmental harm, treating environmental degradation as an affront to fundamental rights and thus triggering international responsibility even in the absence of a traditional state-to-state claim. Likewise, the Human Rights Committee's more recent decision in *Billy et al. v. Australia (2022)* found that Australia's insufficient action on climate change violated the rights of indigenous Torres Strait Islanders, illustrating that states may incur responsibility for climate inaction that harms human rights (Human Rights Committee, 2022).

In contexts of armed conflict, evolving jurisprudence and commentary suggest that belligerent states can incur responsibility for environmental damage that spreads beyond their own or occupied territory. For instance, commentators have pointed to Iraq's deliberate oil well fires in 1991, which caused trans-boundary air and marine pollution, as conduct breaching emerging norms against widespread environmental destruction. While there is yet no ICJ case directly on wartime transboundary environmental harm, the International Review of the Red Cross and other authorities have argued that existing principles (no-harm, due diligence) continue to apply during armed conflict, complementing specific environmental provisions of international humanitarian law (Mingashang & Tshiamala Banungana, 2024).

In a 2023 advisory opinion, ITLOS stated that states have an obligation under UNCLOS to prevent significant pollution of the marine environment from climate change, effectively reading climate mitigation duties into the law of the sea (ITLOS, 2024). And in its 2025 advisory opinion, as noted, the ICJ recognized that inadequate action on climate change could breach international law. Although advisory opinions are non-binding, they carry authoritative weight. The ICJ emphasized in its opinion

that states owe a duty of due diligence to reduce greenhouse emissions and that breaches of this duty may entail legal consequences, such as obligations of cessation and reparation. Meanwhile, domestic courts are increasingly engaging with climate-related harm across borders. A prominent example is *Lliuya v. RWE* in Germany, where a Peruvian farmer sued a German energy company for a share of the costs of climate change-induced glacial melting. In 2022 the Higher Regional Court of Hamm allowed the case to move to evidentiary phase, signaling that large emitters could potentially be held proportionately liable for climate harm abroad, though the case has grappled with complex questions of scientific causation and attribution (Rajamani & Peel, 2021). Notably, in May 2025 that court dismissed *Lliuya's* claim due to insufficient proof of imminent danger, but it nevertheless affirmed in principle that a company's significant contributions to global emissions can establish liability for a proportional share of climate-related damages (Bönnemann & Tigre, 2025).

6. Challenges in Attribution and Enforcement

Environmental damage often involves complex causal chains and multiple contributing sources, making it hard to pin legal responsibility on any single state or actor. In many trans-boundary pollution scenarios—air pollution, marine plastic debris, climate change—harm arises cumulatively from the actions of numerous parties over time. Scientific uncertainty can cloud the links between a particular source and a specific environmental impact. For example, establishing which upstream country's industries caused a downstream fishery collapse, or which nation's carbon emissions led to a particular drought, involves high levels of uncertainty. Advances in environmental forensics and climate attribution science are beginning to apportion contributions (e.g., attributing a percentage of glacial melt to emissions traced to a company or country), but these methods carry margins of error and remain subject to debate (Rajamani & Peel, 2021). The *Lliuya v. RWE* case illustrates this well: the German court acknowledged the plausibility that RWE's emissions contributed to Andean glacier melt, yet translating that into a precise share of liability has proven challenging. Judges are wary of making sweeping causation findings without solid scientific consensus, which in turn slows the development of jurisprudence assigning responsibility for diffuse harms like climate change.

Even when legal responsibility can be established, enforcing remedies across borders is fraught with difficulty. International courts such as the ICJ lack compulsory jurisdiction unless states consent, and even when states participate, compliance with judgments relies on their good faith and diplomatic pressure rather than any supranational enforcement arm (Grušić, 2023). There is no international "sheriff" to compel a sovereign state to pay compensation or cease an activity, especially if that state rejects the decision. Most MEAs similarly lack strong enforcement teeth: for instance, if a country breaches the Kyoto Protocol emission targets or Basel Convention rules, the consequences are mainly reputational or political, not financial or criminal. The ILC's Draft Articles on State Responsibility recognize that an injured state can seek cessation and reparations, or that other states can invoke responsibility for obligations *erga omnes*, but these are legal principles that still depend on voluntary compliance or collective pressure (ILC, 2001a).

Where treaty-based compliance mechanisms exist, they are generally facilitative rather than punitive. The Basel Convention's compliance committee, for example, offers assistance to improve implementation; it cannot impose trade sanctions or fines. Similarly, the Paris Agreement relies on transparency and "naming and shaming" rather than binding penalties for climate inaction. Sovereignty concerns loom large: many governments resist external scrutiny of their environmental management, viewing it as a matter of national prerogative. This can lead states to ignore or withdraw from processes that might hold them accountable. A notable case is the US refusal to participate in the ICJ proceedings on climate obligations or its withdrawal from certain international environmental commitments, illustrating that major powers can opt out of adjudication or agreements that they fear will constrain them (Bodansky, 2010).

Jurisdictional fragmentation in international law means environmental disputes can fall into gaps or overlaps between forums. An issue might be addressed in part by a trade agreement panel (if trade restrictions are imposed for environmental reasons), a human rights court (if claimants frame it as a rights violation), or an arbitral tribunal (if investors sue over environmental regulations). This fragmentation can result in inconsistent outcomes or forum shopping, further complicating enforcement. For example, companies affected by environmental measures might seek relief in investment arbitration (arguing expropriation or unfair treatment), potentially undermining enforcement of those measures (Nollkaemper & Jacobs, 2013).

The net effect of these challenges is that even landmark rulings often have limited deterrent effect beyond the parties involved. The Trail Smelter award was pioneering, yet it remained an isolated instance with few direct follow-ups for decades. The Pulp Mills case clarified procedural duties but did not fundamentally prevent future disputes over river pollution. Robust enforcement of environmental responsibilities likely requires both strengthening international mechanisms (e.g., empowering compliance committees or granting jurisdiction to a specialized environmental court) and enhancing domestic avenues for accountability (so that victims can sue foreign polluters in the polluter's home country courts). Without such advances, the gap between legal principles and real-world environmental protection will persist (Sands & Peel, 2018).

7. The Climate Change Conundrum

From an attribution standpoint, climate change is the cumulative result of emissions over many decades by a multitude of actors. Pinpointing direct, quantifiable harm caused by any single state's emissions is scientifically complex. While climate models can estimate contributions to global temperature or sea-level rise, linking, for example, one country's emissions in a given year to a specific flood or to the loss of a particular glacier involves layers of uncertainty (Rajamani & Peel, 2021). Consequently, the core no-harm principle—don't use your territory in a way that harms others—becomes difficult to apply, because virtually all states both contribute to and suffer from climate change. The harm cannot be neatly traced across one or two borders; it is everywhere and nowhere in particular.

Legally, the main global framework for climate change is cooperative rather than liability-oriented. The UN Framework Convention on Climate Change (1992) and its instruments (Kyoto Protocol 1997, Paris Agreement 2015) establish collective obligations to mitigate emissions and adapt to impacts. However, these agreements deliberately avoid imposing strict, enforceable emissions targets on individual states in a way that would resemble liability. The Kyoto Protocol had binding targets but only for developed countries and with limited enforcement (and some major emitters never joined or later withdrew). The Paris Agreement relies on nationally determined contributions (NDCs) that are self-chosen and not directly enforceable; there are no financial penalties or formal sanctions for failing to meet an NDC (Bodansky et al., 2017). This reflects the political reality of climate negotiations—states were willing to commit to aspirational goals and transparency, but not to any regime of punitive enforcement or adjudication for non-compliance. As a result, accountability for inadequate climate action is largely a matter of political and moral pressure, not legal obligation, in the current treaty regime.

The concept of common but differentiated responsibilities (CBDR), enshrined in the Climate Convention and Rio Declaration (Principle 7), adds another layer of complexity. It acknowledges that developed countries should lead in combating climate change due to their historical emissions and greater capacities. While ethically and politically important, CBDR can complicate legal accountability by providing an argument that certain states (developing countries) have lesser obligations and thus perhaps a partial defense if accused of climate inaction. Major emerging economies often invoke CBDR to resist binding emission cuts, while developed nations use it to justify why they should not bear sole responsibility. This dynamic has stalled efforts to create any international regime of climate liability (Bodansky et al., 2017).

Despite these hurdles, there is movement towards recognizing responsibility for climate harm. Increasingly, vulnerable states and communities are invoking legal principles to seek redress. At the diplomatic level, the establishment of a Loss and Damage Fund at the 2022 UNFCCC COP27 reflects a nascent acceptance that wealthy nations should provide compensation for climate-induced losses in poorer countries. (Notably, the COP27 decision explicitly avoids any admission of liability or legal compensation, focusing instead on solidarity funding (Tietjen & Gopalakrishnan, 2023). However, this fund's operational details and scale remain uncertain, and contributions are voluntary for now. Moreover, there were no specific funding commitments or any link to legal responsibility in the founding documents of the fund (United States agreed only to "funding arrangements" without prejudice to liability (cambridge.org). Nevertheless, the very creation of the Loss and Damage Fund sets a precedent for financial responsibility for climate harms on a multilateral stage.

In litigation, claimants are testing new strategies: Small Island States have turned to international courts for advisory opinions (as seen with the ICJ and ITLOS requests) to bolster the normative case that emitting states owe duties to others (ITLOS, 2024; ICJ, 2025). The U.N. General Assembly's resolution requesting the ICJ opinion, spearheaded by Vanuatu and adopted by consensus in 2023, demonstrated global support for clarifying states' legal obligations on climate (United Nations General Assembly, 2023).

Domestically, cases like the Netherlands' Urgenda decision (2019) have even ordered governments to enhance climate action based on human rights law—though those are within one country's legal system. The European Court of Human Rights recently joined this trend: in *Verein KlimaSeniorinnen Schweiz v. Switzerland* (2024), the ECHR found that Switzerland's inadequate climate policies violated the rights of elderly women to life and health, effectively holding the state accountable for climate inaction under human rights obligations (ECtHR, 2024). And as noted, the Inter-American Court of Human Rights in 2025 declared the existence of an autonomous right to a healthy climate, recognizing environmental harm as a human rights issue and even characterizing the duty to avoid irreversible climate damage as *jus cogens* – a groundbreaking development (Inter-American Court of Human Rights, 2025). The growing number of climate lawsuits worldwide (over 2,600 filed by the end of 2022) attests to this “rights turn” and the search for accountability through courts (Nature, 2024; Setzer & Higham, 2023). Enforcement of any climate-related legal rulings, however, remains politically sensitive. Major powers may resist stringent emissions obligations for fear of economic constraints, and some are outside the jurisdiction of certain courts or would ignore adverse judgments. Developing countries, on the other hand, argue that without significant financial and technological support, demanding strong climate action from them is unfair given their minimal historical contribution—a tension that plays out in negotiations over climate finance and technology transfer (Bodansky et al., 2017).

Ultimately, the climate change conundrum exposes a gap between moral responsibility and legal liability in international law. There is broad scientific consensus and moral force behind the idea that those who contribute most to climate change should bear the costs of its impacts. Translating that into legal terms is challenging under current law but is gradually happening through creative litigation and evolving norms (Nature, 2024). Closing this gap may require bold innovations: perhaps a new international agreement imposing liability for excessive emissions, or an amendment to the International Court of Justice's jurisdiction to allow climate damage claims, or broader acceptance of principles like a global carbon price or tax (Rajamani & Peel, 2021; ICJ, 2025).

8. Emerging Paradigm of Environmental Governance

In response to the shortcomings of the traditional framework, a new paradigm of environmental governance is emerging—one that expands accountability beyond state-to-state responsibility and integrates human rights, corporate duties, and even criminal law into the protection of the global environment. Whereas classic international law dealt almost exclusively with states, there is growing momentum to hold corporations and other non-state actors directly accountable for environmental harm. This is evident in domestic courts and international forums alike. For example, the Hague District Court's 2021 *Milieudefensie v. Shell* decision ordered a multinational oil company to cut its global emissions, signaling that corporations can have an independent obligation (grounded in human rights norms) to mitigate climate change (Gailhofer, 2023). At the international level, the Inter-American Court of Human Rights' 2025 advisory opinion went so far as to urge states to regulate corporate behavior as part of their climate obligations. This reflects a wider trend of “corporate due diligence” laws (such as the EU's proposed directive on corporate sustainability due diligence) which require companies to identify and prevent environmental and human rights harm throughout their supply chains.

The principle of climate justice – addressing the disproportionate burden of climate change on those least responsible – is increasingly influencing international discourse. This has led to initiatives for climate reparations, wherein high-emitting states (and possibly companies) would compensate vulnerable nations and communities for loss and damage caused by climate change. The establishment of the Loss and Damage Fund, as noted, is one institutional manifestation of this idea. While modest in current form, it sets a precedent for financial responsibility for climate harms (ICJ, 2025; Tietjen & Gopalakrishnan, 2023). Moreover, there are calls for expanding legal avenues for affected populations (for instance, residents of sinking island states or disaster-struck areas) to claim compensation from major emitters. In 2023, Vanuatu spearheaded a United Nations resolution seeking an ICJ opinion on states' obligations towards small island states suffering climate injuries – aiming to clarify legal bases for reparations. These efforts align with a broader shift toward viewing a stable climate and healthy environment as inherent rights, owed to present and future generations, which the international community has a duty to uphold. The recognition of a universal human right to a clean, healthy, and sustainable environment by the UN General Assembly in 2022 (Resolution 76/300) further reinforces the expectation that governments must proactively safeguard environmental quality as a matter of legal obligation.

As illustrated by the Portillo Cáceres case, the KlimaSeniorinnen decision of the European Convention on Human Rights (ECHR), and the Inter-American Court's Advisory Opinion OC-32/21, human rights law is increasingly being used to enforce environmental protection. This integration means that individuals (and not just states) can raise claims about environmental harm on the international stage, reframing issues like pollution and climate change as violations of rights to life, health, culture, or property. It also imposes on states a duty to protect those rights against environmental threats, including those originating from private actors or transboundary sources (as per the Human Rights Committee's General Comment No. 36 on the right to life). The emerging paradigm thus sees environmental governance not only as a matter of inter-state relations, but as part of the relationship between a state and its citizens (and residents of other states, in some cases) (Knox, 2012; Voigt, 2022a).

One of the most striking developments in recent years is the proposal to recognize ecocide – defined by an independent expert panel in 2021 as severe and either widespread or long-term environmental destruction – as an international crime. Advocates aim to amend the Rome Statute of the International Criminal Court (ICC) to include ecocide, which would empower the ICC to prosecute individuals (e.g., business leaders or officials) for egregious environmental harm. This represents a shift of environmental governance into the realm of criminal law and individual accountability. The concept, once fringe, has gained support from several states (e.g., small island nations like Vanuatu and the Maldives have voiced backing) and the European Parliament has discussed it in the context of EU law (European Parliament, 2022). Treating ecocide as a crime would integrate environmental protection with existing international criminal law frameworks, forcing a more eco-centric perspective within a traditionally anthropocentric legal system (Gillett, 2025). The challenge will be defining the crime precisely and ensuring it complements, rather than conflicts with, environmental treaties. Nonetheless, the mere advancement of ecocide to serious consideration signifies a paradigm where grievous environmental destruction – rainforests bulldozed, rivers poisoned, major oil spills – would be on par with war crimes or crimes against humanity in terms of international condemnation. The normative adjustments required for such an “ecocentric shift” are substantial, but the conversation itself is altering expectations of accountability.

Global Governance and Multi-Level Cooperation paradigm also emphasizes governance at all levels: global, regional, national, and local. It promotes multi-level cooperation mechanisms—for example, regional courts (like the African Court on Human and Peoples' Rights, which has been asked to weigh in on climate obligations in 2025), transnational networks of environmental agencies, and city-level climate leadership initiatives. There is a growing understanding that effective solutions often require coordination among states, international organizations, civil society, indigenous peoples, and the private sector. Environmental governance is thus becoming more inclusive and networked. Initiatives such as the Paris Agreement's “Global Stocktake” or the Escazú Agreement (a Latin American treaty on environmental democracy) illustrate how transparency, public participation, and access to justice are increasingly built into environmental regimes, aligning with governance ideals of accountability and inclusivity (Banda, 2019; United Nations, 2018).

9. Recommendations

- **Strengthen International Legal Frameworks:** Transform key environmental principles—such as the no-harm rule, due diligence, and the precautionary principle—into enforceable treaty obligations with clear liability standards. This could involve negotiating a framework convention on trans-boundary harm or strengthening existing MEAs with protocols that impose liability for environmental damage. Additionally, support the establishment of specialized judicial or arbitral bodies (e.g. an environmental chamber of the ICJ or a new International Environmental Court) to adjudicate transboundary environmental disputes and ensure consistent application of these principles (Sands & Peel, 2018; Latif & Khan, 2025, Robinson, 2025).
- **Enhance Scientific Attribution:** Invest in and institutionalize environmental forensics and attribution science to improve causal analysis in environmental litigation. For instance, develop internationally recognized methodologies for attributing portions of climate change impacts to particular emitters (e.g., through organizations like the IPCC), and create an independent scientific panel that can provide expert findings in legal cases (similar to how the IPCC informs climate policy). Strengthening pollutant monitoring networks, data sharing agreements, and cooperative research will help meet the high evidentiary thresholds needed to hold actors accountable for diffuse harms (Rajamani & Peel, 2021; IPCC, 2023).

- **Leverage Regional Mechanisms:** Empower regional frameworks and agreements to handle trans-boundary environmental issues at the appropriate scale. For example, expand the mandate of river-basin organizations (like the Mekong or Nile Commissions) to include dispute resolution authority and emergency response for pollution incidents. Encourage the development of regional environmental courts or tribunals (as has been done in some regions for human rights) that can swiftly address cross-border environmental grievances. Regional arrangements can often foster greater trust and peer pressure among neighboring states, complementing global efforts (Banda, 2019).
- **Domesticate International Norms:** Encourage and assist states to incorporate their international environmental commitments into domestic law, enabling individuals and communities to seek remedies in national courts for trans-boundary environmental harm. This might include passing legislation that allows foreign plaintiffs to sue for certain environmental damages (thus internalizing the external harm) or recognizing foreign judgments in environmental cases. Supporting legal capacity-building, judicial training, and public interest litigation in domestic systems will close the enforcement gap by giving victims a more direct avenue for redress. National courts, if accessible, can enforce environmental norms by, for example, issuing injunctions against harmful activities or awarding damages, which in turn pressures states and corporations to adhere to international standards (Grušić, 2023; Laganière, 2022).
- **Expand Stakeholder Participation:** Promote greater involvement of non-state stakeholders—NGOs, indigenous communities, and scientific experts—in international environmental decision-making and compliance processes. For instance, expand the role of civil society in MEA conferences and compliance review mechanisms, and implement the Escazú Agreement’s principles globally to ensure access to information, public participation, and justice in environmental matters. By democratizing environmental governance, states can be held to account not just externally by other states, but internally and regionally by informed citizens and organizations, creating a multi-layered accountability web (Banda, 2019; United Nations, 2018).

10. Conclusion

Trans-boundary environmental harm disrupts conventional legal paradigms of sovereignty and territorial jurisdiction. While, foundational principles such as the no-harm rule, due diligence and environmental impact assessment are well established but the prevailing international framework remains fragmented, heavily reliant on soft-law and biased toward procedural rather than substantive obligations. Scientific uncertainty and political resistance further limit the enforceability of existing rules. Global ecological threats—from acid rain to ozone depletion to climate change—demand a legally robust, scientifically informed and universally applicable framework that balances state sovereignty with the collective duty to protect the global commons. Strengthening judicial forums, codifying clear liability standards, and fostering cooperative diplomacy will be central to achieving this balance. Only through a re-calibrated regime that genuinely binds states and incentivizes compliance can international law effectively prevent, redress, and deter trans-boundary environmental harm, thereby ensuring environmental justice and intergenerational equity.

Despite significant legal developments over the past century – from the Trail Smelter Arbitration’s seminal dictum in 1941 to the ICJ’s climate advisory opinion in 2025 – a gap persists between principle and practice. This gap is manifested in continued environmental degradation that outpaces our legal responses, due in part to challenges in attributing responsibility, the diffuse nature of global harms like climate change, and the reluctance of states to submit to binding constraints. Bridging this gap demands nothing short of a paradigm shift towards a more proactive, cooperative, and enforcement-minded model of environmental governance. The emerging trends give reason for optimism: the integration of human rights and environmental law, the push for corporate accountability and possibly a crime of ecocide, and the rise of climate litigation all indicate that the international community is moving towards holding actors accountable at multiple levels. If these trends consolidate into enduring legal mechanisms, environmental stewardship could evolve from an aspirational ethical goal into a tangible, enforceable reality. The world’s ecological integrity, and the rights of present and future generations, hinge on our ability to solidify this transformation. International law must continue to adapt – drawing on science, embracing new norms, and reinforcing its institutions – to meet the immense challenge of trans-boundary environmental harm in the 21st century.

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