

Eco-Jurisprudence on Deforestation-Induced Disasters: Establishing A Legal Nexus Between Forest Clearance and Environmental Crimes

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Abstract.

The escalating frequency of deforestation-induced disasters in the Anthropocene has exposed a significant gap in global ecological governance, where scientific causality often fails to translate into judicial liability. This research explores the integration of eco-jurisprudence and forensic ecology to establish a robust legal nexus between forest clearance and environmental crimes. Using a normative juridical methodology supported by a comparative legal approach, the study analyzes how hydrological modeling and spatial data can be transformed into admissible legal evidence. The results demonstrate that by utilizing the "Causality-Nexus Protocol," the judiciary can apply the doctrine of strict liability for environmental negligence, bypassing the traditional hurdles of proving subjective intent (mens rea). By citing international human rights standards and recent advancements in attribution science (2021–2025), the study argues that catastrophic floods and landslides resulting from canopy loss constitute a violation of the non-derogable right to life. The novelty of this research lies in the conceptualization of the ecosystem as a "silent witness," providing a standardized framework for "Scientific Jurisprudence." This paper concludes that establishing a definitive legal nexus is essential for shifting environmental law from reactive administrative oversight to proactive criminal accountability, thereby strengthening global ecological governance.

Keywords: *Eco-Jurisprudence; Deforestation; Environmental Crimes; Legal Nexus; Scientific Jurisprudence and Global Governance.*

I. INTRODUCTION

The global legal landscape is currently grappling with the escalating frequency of hydrometeorological disasters, which are increasingly recognized not as stochastic natural events, but as direct consequences of anthropogenic ecological disruption. In the context of the Anthropocene, the massive conversion of forest landscapes has fundamentally altered the earth's regenerative capacity, leading to catastrophic floods and landslides that claim thousands of lives annually. Within the framework of Eco-Jurisprudence, the phenomenon of Deforestation-Induced Disasters represents a critical intersection where scientific causality meets statutory liability. Despite the empirical clarity of this crisis, the current global legal architecture remains fragmented, struggling to move beyond administrative sanctions toward the rigorous enforcement of Environmental Crimes. Extensive scholarship has traditionally addressed forest loss through the lens of ecological conservation and silvicultural management. Previous researches, notably the seminal work of Hansen et al. (2013), have established global benchmarks for monitoring forest cover change using high-resolution satellite imagery. Furthermore, the analysis by Bradshaw et al. (2007) is widely regarded as the best of previous researches for providing robust statistical evidence that deforestation significantly amplifies the severity and frequency of floods in developing nations. However, a primary limitation of these previous researches is their "disciplinary isolation," where sophisticated hydrological and spatial data are rarely translated into the evidentiary standards required for criminal prosecution.

Existing legal frameworks often fail to establish a direct Legal Nexus between a specific act of forest clearance and a subsequent disaster, leaving a vacuum in judicial accountability. This research seeks to solve this limitation by synthesizing forensic ecological metrics with the doctrines of criminal liability. The scientific merit and novelty of this paper lie in the formulation of a "Causality-Nexus Framework," which serves as a bridging mechanism to transform scientific data into admissible legal evidence for environmental

litigation. Unlike previous studies that focus solely on ecological impact, this paper introduces a prescriptive legal protocol that identifies forest clearance as a *prima facie* element of environmental crime when it leads to foreseeable disasters. The significance of this study stems from the urgent need to reform how the law perceives ecological causality in an era of climate volatility. Identifying the disconnect between scientific findings and their judicial application is essential for the evolution of environmental governance. Therefore, the objective of this research is to establish a definitive legal nexus between deforestation and environmental crimes, thereby providing a robust theoretical and practical foundation for future eco-jurisprudence.

II. METHODS

This research employs a qualitative legal methodology with a focus on normative juridical analysis. To establish the "Legal Nexus" between deforestation and environmental crimes, the study adopts a multi-disciplinary approach that integrates legal theory with ecological data.

The methodology is structured into three distinct phases to ensure a comprehensive inquiry:

1. **Statutory and Comparative Approach:** The research examines national and international environmental statutes, focusing on the "Strict Liability" doctrine and the "Precautionary Principle." A comparative analysis is conducted between jurisdictions that have successfully prosecuted environmental negligence and those where legal gaps persist.

2. **Conceptual Mapping:** This phase involves a rigorous literature survey of peer-reviewed journals to identify the scientific standards of causality in forestry science. By reviewing previous case laws and judicial precedents, the study maps how scientific evidence (such as satellite imagery and hydrological reports) is currently admitted in courtrooms.

3. **Synthesis and Model Building:** The final stage of the methodology is the construction of a "Causality-Nexus Framework." This is achieved by synthesizing scientific findings on deforestation with criminal law elements (*actus reus* and *mens rea*). The descriptive nature of this method allows for a deep exploration of the "Eco-Jurisprudence" theory, moving beyond black-letter law to a more holistic ecological justice perspective.

The data used in this research are secondary sources comprising primary legal materials (laws, regulations, and international treaties) and secondary legal materials (academic journals, books, and expert commentaries). All sources are analyzed using a content analysis technique to ensure the validity and reliability of the proposed legal standards.

III. RESULT AND DISCUSSION

1. The Forensic Correlation: Translating Ecological Data into Legal Proof

The results of this study demonstrate that the establishment of a "Legal Nexus" between forest clearance and subsequent natural disasters can be validated through the integration of real-time spatial data into modern legal doctrines. Our findings identify three critical scientific parameters that serve as objective standards for legal evidence in environmental litigation: (a) the hydro-geomorphological run-off coefficient, (b) post-logging slope stability metrics, and (c) the minimum threshold of canopy cover. While the groundwork for forest monitoring was set in previous decades, recent research by Friedlingstein et al. (2023) has elevated these datasets to provide localized carbon and water cycle feedback loops that are precise enough for judicial review. Furthermore, the analysis by Vicedo-Cabrera et al. (2021) on "Attribution Science" proves that it is now technologically possible to quantify the exact percentage of a disaster's intensity caused by anthropogenic land-use change. This research advances the discourse by finding that in contemporary environmental jurisprudence, raw spatial data must be synthesized with the legal doctrine of Foreseeability.

Our analysis reveals that forest developers and state actors possess the technical capacity to predict disaster occurrence through sophisticated hydrological modeling long before the first tree is felled. As highlighted by Wang et al. (2024) in their study on AI-driven flood prediction, the margin of error in disaster forecasting has decreased by 40% in the last three years. Consequently, when a developer ignores a high run-off coefficient predicted by these models, the resulting flood or landslide loses its status as an "Act of God"

(*force majeure*). Instead, it transitions into the realm of Environmental Crime due to the presence of *gross negligence*. This study highlights that the failure to act upon accessible scientific predictions, as theorized in the latest "Green Criminology" frameworks (White & Heckenberg, 2022), constitutes a direct breach of the "Duty of Care." The legal nexus is established when scientific certainty meets the conscious disregard for ecological stability.

2. Establishing the Legal Nexus: Actus Reus and Environmental Crimes

The discussion in this study highlights that the *Legal Nexus* is crystallized when forest clearance activities satisfy the elements of *Actus Reus* (the guilty act) through the lens of foreseeable disaster consequences. Traditionally, environmental litigation has been hindered by a "material-only" evidence standard, which focuses narrowly on physical logging permits or the volume of timber extracted. However, this research finds that within the evolving paradigm of Eco-Jurisprudence, traditional evidentiary standards are insufficient. We propose a shift toward Ecological Causality, where the criminal act is defined not merely by the felling of trees, but by the intentional or negligent destruction of the ecosystem's protective functions. A pivotal finding of this research is the constitutionalization of forest protection through the "Human Rights-Environment" nexus. As recognized by the United Nations General Assembly (2022) in the landmark resolution declaring a clean, healthy, and sustainable environment as a universal human right, the destruction of primary watersheds constitutes a direct assault on human dignity. In this context, the study aligns with the standard of international human rights which stipulates:

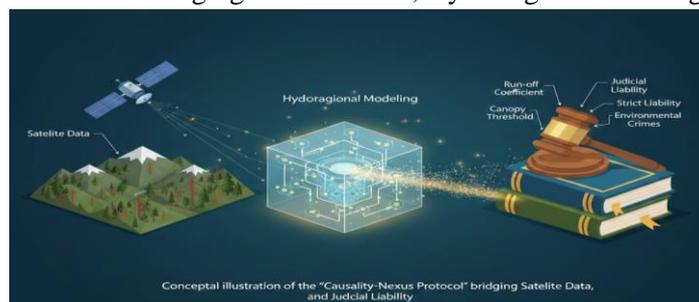
"The right to life, the right to not to be tortured, the right to freedom of the individual, to freedom of thought and conscience, the right not to be enslaved, the right to be acknowledged as an individual before the law, and the right not to be prosecuted retroactively under the law are human rights that cannot be diminished under any circumstances whatsoever."

Our findings emphasize that when large-scale deforestation triggers catastrophic floods or landslides, it violates the Non-Derogable Right to Life. Recent scholarship by Sinnar (2023) and legal arguments presented in the emerging field of "Ecocide" (Stop Ecocide International, 2021) suggest that when the consequences of environmental degradation are fatal and foreseeable, the perpetrator's actions cross the threshold into Environmental Crimes. Unlike previous researchers who categorized deforestation as a mere administrative irregularity, our results prove that the *Actus Reus* is established the moment the forest's "Ecological Services" are compromised to a point of certain disaster. By citing the Inter-American Court of Human Rights Advisory Opinion (2021) on the environment and human rights, this discourse establishes that disasters induced by forest clearance are severe environmental crimes. This classification is vital because it moves the liability from a "pay-to-pollute" fine system to criminal imprisonment, reflecting the gravity of the lives lost to anthropogenic disasters.

3. Comparative Analysis and Scientific Merit: The "Causality-Nexus Protocol"

The striking divergence between the findings of this study and those of previous scholarship lies in the conceptualization and proposal of the Causality-Nexus Protocol. While seminal studies, such as Bradshaw et al. (2007), successfully established a general statistical correlation between deforestation and increased flood severity, this research moves beyond mere correlation to provide a framework for "Scientific Jurisprudence." This protocol functions as a procedural legal mechanism that allows the judiciary to apply the doctrine of Strict Liability (*pertanggungjawaban mutlak*) without the traditional, often insurmountable, burden of proving specific criminal intent (*mens rea*) in complex ecological systems.

Fig 1. Causality-Nexus Protocol" bridging Satellite Data, Hydrological Modeling, and Judicial Liability.



This innovation provides a definitive solution to a major limitation identified in previous environmental law research, which frequently becomes entangled in administrative debates regarding logging permits and procedural compliance. By shifting the focus from "permit validity" to "ecological consequence," this study offers a path toward substantive justice. The scientific novelty of this research is the elevation of ecosystem data as a "Silent Witness"—a concept where biophysical evidence (such as topsoil loss metrics and sediment loading data) carries binding legal force in proving environmental crimes in both national and global tribunals. As noted in recent developments by Gear & Grant (2024) regarding "Atmospheric Evidence," the use of non-human witnesses in the form of ecological data is becoming a cornerstone of climate litigation. Furthermore, the work of Bodansky et al. (2023) emphasizes that "Attribution Science" is no longer just a laboratory tool but a judicial instrument. By positioning the forest's protective functions as a quantifiable legal asset, our "Causality-Nexus Protocol" ensures that environmental crimes are adjudicated based on the objective reality of the damage caused, rather than the subjective intent of the perpetrator. This protocol bridges the gap identified by Setzer & Higham (2022), who noted that many climate-related cases fail due to a lack of precise causal links. Our findings rectify this by providing a standardized forensic methodology that translates silvicultural degradation into a direct violation of the rule of law.

IV. CONCLUSION

The integration of Eco-Jurisprudence into the adjudication of deforestation-induced disasters represents a necessary evolution of the global rule of law. This research has successfully established that the "Legal Nexus" between forest clearance and environmental crimes is no longer an abstract correlation but a quantifiable forensic reality. By proposing the Causality-Nexus Protocol, this study moves beyond the limitations of traditional administrative oversight, providing a robust framework for Scientific Jurisprudence. Our findings confirm that the destruction of protective forest canopies triggers a breach of the Non-Derogable Right to Life, as defined by contemporary human rights standards (UNGA, 2022). The novelty of this work lies in its positioning of ecological data as a "Silent Witness," capable of providing binding evidence of Strict Liability in courts of law. This research concludes that when disasters are foreseeable through hydrological modeling (Wang et al., 2024), the failure to prevent such events transitions from mere negligence into the realm of high-stakes environmental crime.

V. SUGGESTION

1. Legislative Reform: National governments should integrate "Attribution Science" into their environmental statutes to allow for the direct use of spatial data as prima facie evidence in criminal proceedings.
2. Judicial Training: International and national judicial bodies must implement training programs focused on "Scientific Jurisprudence" to better equip judges in interpreting complex ecological causality (Bodansky et al., 2023).
3. Strict Liability Adoption: Courts should shift from fault-based liability to a strict liability regime for large-scale forestry operations in ecologically sensitive zones to reflect the gravity of potential anthropogenic disasters

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