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ENVIRONMENTAL LIABILITY ALLOCATION - PRACTICES

Lakshmi Priya [1], George K. Varghese [2], Maria Pettersson [3] and Christian Zafiu [4]

[1] *SCMS School of Engineering and Technology, Kerala, INDIA*
[2] *National Institute of Technology Calicut, Kerala, INDIA*
[3] *Department of Social Sciences, Technology and Arts, Luleå University of Technology, SWEDEN*
[4] *Institute of Waste and Recycling Management, BOKU University, Vienna, AUSTRIA*

1. INTRODUCTION

Environmental liability allocation, although grounded in sound and progressive legal principles capable of responding to evolving environmental challenges, remains ineffective unless those principles are meaningfully translated into practice without losing their purpose and intent. While our last column examined the foundational doctrines governing environmental liability—such as the polluter pays principle, precautionary principle, strict and absolute liability, and various civil liability allocation models—the practical application of these principles is discussed in this column. Environmental harm frequently involves multiple actors, historical contamination, scientific uncertainty, cross-border impacts, and evolving regulatory frameworks, all of which add to the complexity of identifying responsible parties and apportioning liability. Against this backdrop, we try to explore the practical approaches, mechanisms, and challenges involved in implementing environmental liability allocation in real-world environmental disputes and remediation processes.

By liability allocation practices, we mean the practical methods and mechanisms used to determine who should bear responsibility for environmental damage, to what extent, and in what manner such responsibility should be enforced. It may involve identifying responsible actors, establishing causation, apportioning liability among multiple contributors, determining remediation obligations, and enforcing compensation and restoration measures. While liability allocation principles provide the legal foundation for environmental accountability, liability allocation practices concern their operational application in real-world situations. Consequently, liability allocation practices represent the interface between legal theory and practical enforceability, translating environmental liability principles into workable mechanisms capable of ensuring effective remediation, environmental justice, and long-term environmental protection. These practices become particularly important in cases involving multiple polluters, historical contamination, scientific uncertainty, and long-term ecological harm, where even identifying the responsible party itself may be a complex exercise. The process is often shaped not only by legal rules but also by scientific evidence, regulatory policies, economic considerations, contractual arrangements, and institutional capacity.

2. CHALLENGES IN LIABILITY ALLOCATION

While undertaking liability allocation, it is important to be mindful of the challenges involved in translating the principles of environmental liability allocation into practice. Recognizing these challenges in advance helps in anticipating potential issues and carrying out the allocation process in the most appropriate and equitable manner. The major challenges likely to be encountered during liability allocation include:

- *Difficulty in identifying responsible parties*: Environmental harm often results from the cumulative activities of multiple actors over long periods, making the identification of responsible parties a complex exercise (Petrisor, 2014). Determining who caused the damage, to what extent, and during which period becomes particularly difficult in cases of historical contamination or diffuse pollution, where environmental harm may arise gradually from multiple sources rather than from a single identifiable polluter.
- *Problems of causation and scientific uncertainty*: Establishing a clear causal link between a particular activity and environmental harm is often one of the most difficult aspects of environmental liability allocation. Scientific uncertainty, cumulative pollution from multiple sources, and the delayed manifestation of environmental damage frequently complicate efforts to identify the precise source and extent of harm. In many cases, environmental impacts become evident only years or decades after the polluting activity occurred, making causation difficult to prove with certainty (Kruge et al., 2020).
- *Apportionment of liability among multiple polluters*: Even where responsible parties are identified, allocating liability proportionately remains a significant challenge. Determining the appropriate basis for differentiating liability among multiple responsible parties—whether based on the degree of contribution, duration of in-

Managing editors:
George Varghese, Maria Pettersson and Christian Zafiu
email: gkv@nitc.ac.in, maria.pettersson@ltu.se, christian.zafiu@boku.ac.at

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volvement, nature of activity, level of fault, or extent of environmental harm caused—is often a complex exercise (Reddy, 2010). Once such individual responsibilities are assessed, courts and regulators may decide whether liability should be imposed through joint and several liability, proportionate liability, or equitable allocation methods.

- *Quantification of environmental damage*: Environmental harm frequently involves ecological degradation, biodiversity loss, and long-term public health impacts that are not easily quantifiable in monetary terms (Pfennigstorf, 1979). Unlike conventional property damage, environmental injury may affect ecosystems, natural resources, and future generations in ways that are difficult to measure precisely. Consequently, assessing the appropriate cost of remediation, restoration, and compensation often becomes contentious, particularly where scientific uncertainty and competing valuation methods are involved.
- *Insolvency or disappearance of polluters*: In many cases, the entities responsible for environmental harm may become insolvent, dissolved, defunct, or otherwise untraceable by the time contamination is discovered or remediation is required. This creates significant practical difficulties in enforcing environmental liability, particularly in cases involving historical pollution or long-term environmental damage. As a result, governments or affected communities are often compelled to bear the financial burden of cleanup and restoration, undermining the effectiveness of the polluter pays principle and shifting environmental costs to the public.
- *Regulatory and institutional limitations*: The effective implementation of environmental liability regimes is often constrained by institutional and administrative limitations. Weak enforcement mechanisms, lack of technical expertise, inadequate monitoring and data collection systems, and bureaucratic delays can significantly hinder timely investigation, assessment, and remediation of environmental harm. In many jurisdictions, regulatory authorities may also face shortages of financial resources and scientific capacity, reducing their ability to enforce liability effectively and consistently.
- *Balancing environmental protection with economic development*: Governments may sometimes hesitate to impose stringent environmental liability on industries due to concerns about economic growth, industrial development, employment generation, and investment inflows. Fear of discouraging business activity or affecting economic competitiveness can lead to diluted enforcement, regulatory leniency, or delays in imposing remediation obligations, thereby weakening the effectiveness of environmental liability regimes (Becker et al., 2013).
- *Cross-border and transboundary environmental harm*: Environmental pollution frequently extends beyond territorial and jurisdictional boundaries, particularly in cases involving air pollution, transboundary rivers, marine pollution, and climate change. Such situations raise complex questions relating to applicable law, jurisdiction, enforcement authority, and the responsibility of different States or actors. The absence of uniform international standards and the need for effective cross-border cooperation often make the allocation and enforcement of environmental liability particularly challenging.

These challenges present a persistent gap between legal theory and practical enforceability in environmental liability allocation. While environmental law has developed sophisticated principles to ensure accountability, prevention, and remediation, their effective implementation often encounters scientific uncertainty, evidentiary difficulties, institutional limitations, economic pressures, and complex factual situations involving multiple actors and long-term environmental harm. As a result, the true effectiveness of environmental liability regimes depends not merely on the existence of sound legal principles but on the capacity of legal and regulatory systems to apply them consistently, fairly, and effectively in practice.

Liability allocation practices adopted across different jurisdictions have attempted to address these challenges, although with varying degrees of success. Nevertheless, environmental liability allocation procedures continue to evolve, supported by ongoing legal, regulatory, and scientific research.

3. LIABILITY ALLOCATION—SELECTED EXAMPLES

One of the major areas in which environmental liability has been extensively applied is the remediation of contaminated sites. Consequently, remediation liability provides valuable examples for understanding the existing practices of environmental liability allocation.

3.1 Liability allocation under CERCLA

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of the United States is widely regarded as one of the earliest and most influential civil liability statutes specifically addressing environmental remediation liability. Enacted in 1980, the legislation is more commonly known as the Superfund Act. Under CERCLA, the liability allocation process for contaminated site remediation follows a systematic procedure involving site assessment, identification of responsible parties, remediation planning, and cost recovery. The process generally begins with the identification of a contaminated site by the United States Environmental Protection Agency (US EPA) or state environmental agencies. Preliminary assessments and detailed site investigations are then conducted to determine the nature and extent of contamination, identify hazardous substances present, evaluate environmental and human health risks, and assess the urgency of remedial action.

Following site characterization, the EPA identifies Potentially Responsible Parties (PRPs), which may include current and former owners or operators of the site, hazardous waste generators, and transporters involved in the disposal of hazardous substances. CERCLA imposes strict, joint, several, and retroactive liability, meaning that any

PRP may potentially be held responsible for the full cost of remediation regardless of fault or the timing of the activity. Once PRPs are identified, the EPA generally encourages negotiated settlements under which the responsible parties voluntarily undertake or finance cleanup activities in accordance with EPA-approved remediation plans.

In situations involving multiple PRPs, liability allocation becomes necessary to equitably distribute remediation costs among the parties. Such allocation may occur through negotiations, mediation, non-binding allocation procedures, or contribution litigation before courts. During this process, several equitable considerations are taken into account to determine the relative responsibility of each PRP. The widely applied Gore Factors and Torres Factors provide important guiding principles for such allocation and are discussed separately. If negotiated allocation is unsuccessful, courts may determine the proportionate liability of each party based on site-specific circumstances and equitable considerations.

Once liability allocation is completed, remediation activities are implemented either directly by the PRPs or by the EPA using Superfund resources. Where the EPA undertakes cleanup itself, it may subsequently recover remediation costs from responsible parties through administrative or judicial proceedings.

3.2 Liability allocation examples from European Union

The Environmental Liability Directive (Directive 2004/35/EC) provides the overarching framework for environmental liability across the member states of the European Union (EU). However, the Directive functions as a minimum harmonization framework and is implemented through national legislation in each member state. Consequently, while the broad principles and objectives established by the Directive are common across the EU, the specific procedures and approaches for liability allocation may vary among member states depending on their legal systems and implementing legislation. Nevertheless, these national frameworks are generally aligned with the overarching requirements and guiding principles of the EU Directive.

3.2.1 Sweden

In Sweden, the allocation of liability is carried out under the Swedish Environmental Code (SEC), which is founded on several core principles: the polluter pays principle, strict liability, and shared and retroactive responsibility for environmental damage. The fundamental premise is that the party responsible for pollution should also bear the costs of preventing and remedying any resulting harm.

Under the Code's general rules of consideration, anyone who pursues or intends to pursue an activity must take the protective measures, observe the restrictions, and adopt the precautions necessary to prevent, hinder, or counteract damage or nuisance to human health or the environment (Ch. 2, s. 3 SEC). Where damage nevertheless occurs, the party who, through an activity or measure, has caused such damage is required to restore the environment or compensate for the harm caused. This responsibility persists "until the damage or nuisance has ceased" (Ch. 2, s. 8 SEC). These general rules apply broadly to virtually all activities affecting land, water, air, and ecosystems.

More specific provisions governing liability for environmental damage are set out in Chapter 10 SEC. Since 2007, these rules have been aligned with the EU Environmental Liability Directive and focus on three categories of serious environmental damage: damage to protected species and natural habitats, damage to water, and land contamination (Ch. 10, s. 1 SEC). The primary liable party is the person or legal entity that conducts or has conducted the activity that caused the pollution (the "operator"). Liability is strict, meaning that it does not depend on negligence or fault, and it applies to both current and former operators. Swedish law thus recognises retroactive liability, allowing responsibility to be imposed even for activities that have ceased. In practice, however, liability is generally limited to activities conducted after 30 June 1969, when modern environmental regulation emerged with the Environmental Protection Act. Retroactivity is particularly significant in cases involving contaminated land, such as abandoned industrial sites. Liability is not confined to completed activities; it may also arise in relation to ongoing operations where pollution damage or serious environmental damage can be established.

Where several parties have contributed to the pollution, they may be held jointly and severally liable. This allows the supervisory authority to require any one of them to bear the full cost of remediation. That party may subsequently seek recourse against the others in proportion to their respective contributions. Regardless of who is identified as the operator, the scope of remedial obligations is subject to a case-by-case assessment of reasonableness. In remediation cases, the reasonableness assessment balances, on the one hand, the general duty to take necessary preventive measures and, on the other hand, factors such as the time elapsed since the pollution occurred, whether the activity was lawful at the time, and the extent to which the party contributed to the damage (Ch. 10, s. 4 SEC). Consequently, even where an operator is formally responsible for historical pollution, the reasonableness assessment may reduce liability in practice, potentially to zero.

Under certain conditions, liability may also extend to landowners. This liability is subsidiary and arises only where no responsible operator can be identified or held accountable. It further requires that the property was acquired after the contamination occurred and that the acquirer knew, or ought to have known, of the pollution at the time of acquisition. The purpose of the landowner liability is to push for thorough investigations in land acquisitions, thereby enforcing the precautionary part of the regulatory framework.

3.2.2 Austria

In Austria, liability allocation for environmental damage was introduced in 2009 and amended in 2018 through the Federal Environmental Liability Act (BGBl. I Nr. 55/2009), which transposed the European Environmental Liability Directive into national law. Consistent with the EU Directive, the Austrian framework is based on the polluter pays principle and relies on a combination of strict public law enforcement and civil liability mechanisms.

Similar to Swedish legislation, operators engaged in specified hazardous activities are subject to strict liability, irrespective of fault, for the prevention and remediation of environmental damage affecting soil, water bodies, and biodiversity. The Act defines operators as persons or entities carrying out professional activities and excludes private individuals from its scope.

Unlike the Swedish framework, however, liability under the Austrian Environmental Liability Act is limited to environmental damage occurring after the Act entered into force on 20 June 2009 and therefore does not have retroactive effect. For contamination predating the Act, or in situations where the polluter cannot be identified, other legislative instruments may apply, most notably the Contaminated Sites Remediation Act, which has been in force since 1989. This Act is intended to address legacy pollution and orphan contaminated sites. Remediation activities under the Contaminated Sites Remediation Act are financed through a dedicated environmental levy imposed on landfilling, long-term waste storage, waste incineration, and certain waste transport activities. In addition to remediation measures, the fund also supports site investigations, monitoring programmes, and research on innovative remediation technologies. In certain circumstances, the provisions of the Federal Environmental Liability Act may be superseded by more specific legislation, such as the Water Rights Act or the Waste Management Act.

The costs of preventive and remedial measures must be borne by the operator responsible for the environmental damage, including costs incurred by third parties acting on the operator's behalf. Where such costs cannot be recovered from the liable operator, the owner or co-owner of the property from which the damage originates may be required to bear the costs, provided that the owner consented to or knowingly tolerated the installations or activities that caused the damage and failed to take reasonable preventive measures.

The allocation of costs under the Austrian framework is intended to incentivize operators to adopt preventive measures and sound environmental management practices while also recognizing the responsibilities of property owners in preventing environmental harm.

3.3 Liability allocation in India

India does not yet have a dedicated and comprehensive environmental liability allocation framework comparable to the detailed allocation mechanisms established under CERCLA or the Environmental Liability Directive. However, liability allocation principles are increasingly reflected through a combination of statutory provisions, judicial decisions, and regulatory guidelines. One notable guideline is the 'Guidelines on Implementing Liabilities for Environmental Damages due to Handling and Disposal of Hazardous Waste and Penalty' prepared by the Central Pollution Control Board (CPCB). It is based on the principles of strict liability and joint and several liability, under which the responsible party—whether occupier, transporter, operator, or importer of hazardous waste—is held liable irrespective of negligence. In the event of spills, leakages, fires, illegal dumping, or other hazardous waste incidents, the responsible party must immediately undertake emergency response measures to contain and control the release, protect human health and the environment, and report the incident to the concerned authorities. The responsible party is further required to carry out an environmental site assessment, including Phase I and Phase II Environmental Site Assessments (ESA I and ESA II), to determine the extent of contamination, identify contaminants of concern, assess exposure pathways and receptors, and evaluate risks to human health and the environment. Based on these assessments, remediation plans with site-specific target levels must be prepared and implemented following approval by the State Pollution Control Boards (SPCB) or Pollution Control Committees (PCC). The framework also imposes compensation liability for damages such as loss of property, crop damage, reduced agricultural productivity, health impacts, hospitalization costs, ecological damage, and loss of life.

The guidelines prescribe indicative financial liabilities for different stages of environmental response and remediation. Upon identification of an incident, an immediate response liability is imposed to cover emergency response actions and Phase I assessment. If the SPCB/PCC itself undertakes the emergency response due to non-compliance by the responsible party, the liable amount may increase to twice the immediate response liability along with applicable interest. In addition, a minimum site assessment liability is also imposed, which can increase depending on the extent and nature of contamination. Remediation liabilities vary depending on factors such as contaminant type, impacted environmental media, groundwater contamination, and ecological sensitivity. The responsible party may also be required to furnish bank guarantees equivalent to the estimated assessment and remediation liabilities.

The guidelines further state that when the responsible party is not traceable, the SPCBs/PCCs may themselves undertake emergency response, environmental assessment, and remediation activities directly or through third-party agencies, and may seek financial assistance from the State/UT Government if necessary. In such situations, the SPCBs/PCCs are empowered to file an FIR under the Code of Criminal Procedure (CrPC) for investigation and identification of the responsible party, and subsequently recover liabilities equivalent to three times the actual costs incurred, along with applicable interest.

4. GENERALIZED PROCEDURE OF LIABILITY ALLOCATION

A closer examination of the examples discussed above reveals that, although the specific details may vary across jurisdictions and cases, the underlying liability allocation procedure remains broadly similar. This general framework may be summarized as illustrated in Figure 1. Table 1 briefly explain these stages.

5. DETERMINANTS OF LIABILITY

A frequent challenge in environmental liability allocation is determining the relative contribution of individual polluters in situations involving multiple responsible par-

TABLE 1: Liability allocation procedure.

Step	Stage	Key Activities	Key Output
1	Identification of Damage or Contamination	Detection through inspection, monitoring, self-reporting, or complaints; preliminary inquiry by competent authority	Damage or environmental threat identified
2	Emergency Response and Immediate Measures	Contain, control, and mitigate immediate risks; protect human health and environment; authority intervention if responsible party fails to act	Immediate risks reduced or controlled
3	Site Assessment and Damage Characterization	Assess extent and nature of contamination; identify pollutants, affected media, receptors, and pathways; conduct risk assessment and causal analysis	Site assessment and risk characterization completed
4	Identification of Responsible Parties	Identify owners, operators, generators, transporters, importers, and other contributors using records, permits, manifests, and forensic analysis	List of potentially responsible parties prepared
5	Determination of Applicable Liability Standard	Determine applicable legal regime such as strict liability, fault-based liability, absolute liability, joint and several liability, or proportional liability	Applicable liability principles established
6	Development of Remediation/Restoration Plan	Prepare remediation and restoration strategy; include primary, complementary, and compensatory measures where necessary; obtain regulatory approval	Approved remediation or restoration plan
7	Allocation of Liability Among Multiple Parties	Allocate liability through negotiation, mediation, administrative process, or court proceedings; consider contribution, toxicity, duration, compliance, causation, and benefit derived	Allocation decision and share of liability for each party
8	Imposition of Financial Liability and Cost Recovery	Impose liabilities for response, assessment, remediation, compensation, monitoring, and administrative costs; require financial assurance mechanisms	Financial liabilities imposed and secured
9	Implementation of Remediation Measures	Responsible parties implement approved remediation plan under authority supervision and compliance monitoring	Remediation measures implemented and compliance achieved
10	Government Intervention (if Non-Compliance or Unidentified Parties)	Authority undertakes remediation where parties fail, are insolvent, or unidentified; recover costs, penalties, and interest through legal action	Government action and cost recovery initiated

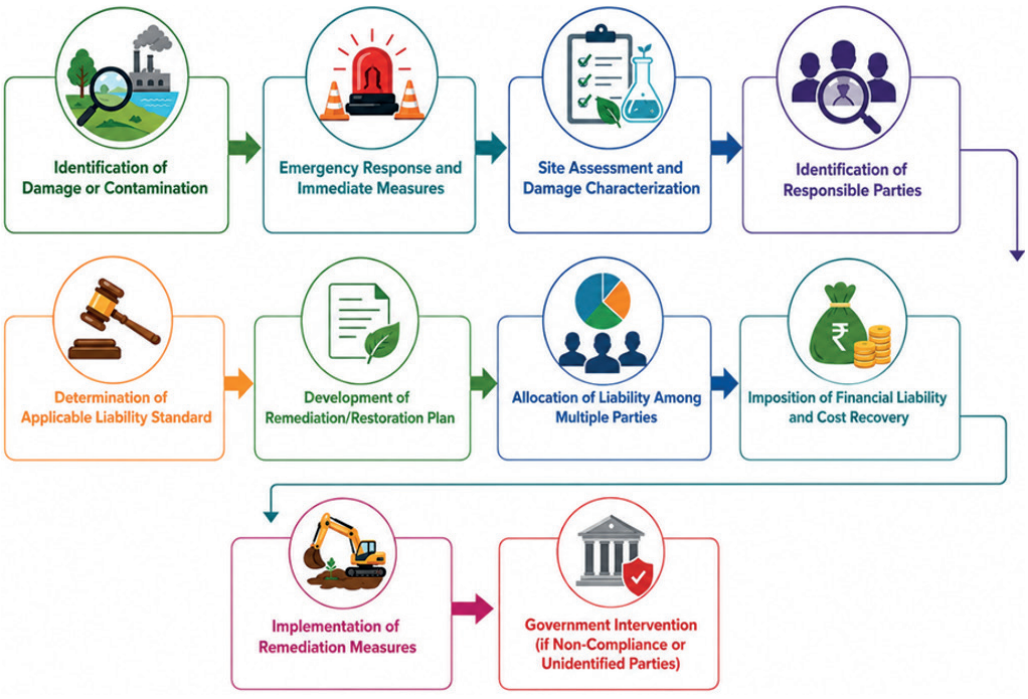

FIGURE 1: Stages of environmental liability allocation.

ties. To address this issue, courts in the United States have often relied on equitable allocation approaches such as the Gore Factors and Torres Factors. In addition, recent research has increasingly focused on developing methodologies for differential responsibility allocation, incorporating scientific, legal, and risk-based approaches to achieve more equitable distribution of environmental liabilities.

5.1 Gore factors

The Gore Factors originated from legislative discussions led by former U.S. Congressman Albert Gore Jr. during the development of CERCLA. Although they were never formally incorporated into the statute, over time, the Gore Factors (H.R. 7020, 96th Cong., 2d Sess. (1980)) have become widely accepted in contribution actions, settlement negotiations, and non-binding allocation procedures as practical tools for equitable apportionment of cleanup costs among responsible parties.

The Gore Factors generally consider six major aspects while allocating liability: (i) the ability to distinguish the contribution of each party to the contamination; (ii) the quantity of hazardous waste contributed by each party; (iii) the degree of toxicity of the hazardous substances involved; (iv) the degree of involvement of each party in the generation, transportation, treatment, storage, or disposal of hazardous waste; (v) the degree of care exercised by the parties with respect to the hazardous substances; and (vi) the degree of cooperation demonstrated by the parties with regulatory authorities during investigation and remediation.

Although the Gore Factors are non-binding and do not override CERCLA's strict, joint, and several liability framework, they play an important role in promoting fairness and facilitating negotiated settlements among PRPs. Courts, allocators, and regulatory agencies frequently rely on these factors, along with site-specific considerations, to distribute remediation costs in a more equitable manner. The Gore Factors have also influenced environmental liability allocation practices in several other jurisdictions and continue to serve as one of the most recognized frameworks for equitable allocation of environmental remediation liabilities.

5.2 Torres factors

The Torres Factors are additional equitable considerations used in the United States to assist in the allocation of environmental remediation liability among multiple PRPs under CERCLA. Unlike the more widely recognized Gore Factors, the Torres Factors (United States v. Davis, 31F. Supp.2d 45 (D.R.I.1998)), emerged primarily through judicial interpretations and case-specific allocation exercises in complex contamination disputes. They are generally applied as supplementary criteria to achieve a more equitable and practical distribution of remediation costs, particularly in situations where strict application of statutory liability may produce disproportionate outcomes.

The Torres Factors expand the scope of liability allocation beyond direct contaminant contribution by incorporating broader equitable and socioeconomic considerations. These factors may include the economic benefit derived from the polluting activity, the degree of knowledge regarding the hazardous nature of the waste, the financial capability of the responsible party, the extent of negligence or misconduct, efforts taken to prevent environmental harm, and the willingness of parties to participate in remediation and cooperate with regulatory authorities. In some cases, courts may also consider the relative fairness of imposing liability, including whether excessive financial burden on a party would undermine equitable cost distribution. Consequently, the Torres Factors provide flexibility in liability allocation and allow courts and allocators to account for site-specific circumstances that may not be fully addressed through traditional contaminant-based allocation approaches alone.

6. RECENT DEVELOPMENTS

The Gore and Torres factors provide a strong foundation for liability allocation in situations involving multiple parties contributing to environmental pollution. In addition, the Environmental Liability Directive and guidelines adopted in several other countries have proposed various factors relevant to different contamination scenarios and regulatory contexts. Numerous court decisions across jurisdictions have also relied on case-specific considerations for proportionate liability allocation. Building upon these developments, Priya et al. (2022) conducted a comprehensive analysis of the various determinants used in environmental liability allocation and proposed a structured framework that integrates scientific assessment with legal and equitable considerations in cases involving multiple polluters contributing to a common environmental damage. Recognizing the limitations of the current approaches to liability apportionment, the authors proposed a two-stage allocation procedure consisting of technical liability allocation followed by legal liability allocation. The framework is intended to improve transparency, consistency, and scientific defensibility in assigning remediation responsibilities among polluters.

The first stage, termed technical liability allocation, focuses on scientifically quantifiable characteristics of pollution and pollutants. According to the authors, technical liability represents the proportion of responsibility attributable to each polluter based on measurable environmental attributes determined through environmental forensic investigations. The proposed technical factors include pollutant quantity, toxicity, mobility, persistence, spread within environmental media, duration of pollutant release, and remediability of the contaminant within the affected environmental matrix. To operationalize these factors, the framework proposes the use of indices such as an "Impact Index" and a "Remediation Index," which collectively reflect the extent of environmental harm and the complexity of remediation attributable to each polluter. This stage therefore attempts to establish a scientifically derived proportional contribution of each responsible party.

The second stage involves legal liability allocation, wherein the technically derived shares are further adjusted using legal, regulatory, and equitable considerations. These may include negligence, regulatory non-compliance,

economic benefit derived from the polluting activity, cooperation with authorities, and other jurisdiction-specific legal principles. In this manner, the framework combines objective scientific assessment with broader legal and policy considerations to arrive at a more balanced and equitable liability allocation. The proposal by Priya et al. is particularly significant because it allows technical experts to undertake the scientific component of liability determination while enabling the judiciary and regulatory authorities to focus primarily on legal and equitable considerations within their domain of expertise (Priya et al., 2025).

7. CONCLUDING REMARKS

Environmental liability allocation is an inherently complex and challenging task, particularly in situations involving multiple polluters, long-term contamination, and uncertainties in causation and environmental damage assessment. The principles underlying liability allocation reflect broader societal priorities regarding environmental protection, ecological restoration, public health, fairness, and accountability. Consequently, liability allocation practices must not only ensure effective recovery of remediation costs but also uphold the fundamental spirit of environmental justice and the polluter-pays principle.

The effectiveness of environmental liability systems depends significantly on the robustness, transparency, and scientific defensibility of the allocation procedures adopted. Well-defined allocation methodologies are essential for translating broad legal principles into practical, equitable, and implementable outcomes. In this context, liability allocation should not remain purely a legal exercise, as environmental contamination often involves highly technical issues related to pollutant behaviour, contaminant transport, ecological risk, environmental fate, and remediation complexity. Therefore, the involvement of technical experts, particularly environmental forensic experts, is essential for establishing scientifically sound and defensible allocation decisions. Integrating technical expertise with legal and regulatory considerations can substantially improve the accuracy, transparency, consistency, and acceptability of liability allocation outcomes, thereby contributing to more effective environmental remediation, environmental justice, and overall environmental governance.

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