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RECEIVED 05 May 2025

ACCEPTED 08 October 2025

PUBLISHED 28 October 2025

CITATION

Shetty AJ and Saxena M (2025) Harm principle in green criminology: environmental harm and human risk matrix.
Front. Clim. 7:1602227.
doi: 10.3389/fclim.2025.1602227

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Harm principle in green criminology: environmental harm and human risk matrix

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This paper proposes to bridge the gap between traditional criminal law and environmental jurisprudence by redefining the harm principle proposed by Mill through the Environmental Harm and Human Risk Matrix. The Matrix classifies environmental harm and human risk as low, medium, and high impact, creating nine intersectional approaches to assess environmental harm based on its severity and irreversibility, the risk to human and non-human wellbeing, its intergenerational impact, and the ability to mitigate the impact. Through the Matrix, the paper identifies activities that should be assessed as violations with no criminal liability, harms that should have criminal liability and harms that are subject to interpretation by the executive and the judiciary thereby helping to understand environmental harm within the socioeconomic realities of the situation. The approach not only challenges anthropocentric legal paradigms but also the interpretation of the harm principle while treating the environment as a resource. The challenge to the anthropocentric legal paradigms integrates the socioeconomic realities, environmental harm to human and non-human beings and offers guidelines to differentiate violations requiring restorative approaches from crimes necessitating punitive action. The paper further argues that if environmental harm is purely perceived from the lens of the harm principle apportioning blameworthiness based on liability, culpability and accountability, then the entire human population commits environmental harm since the environment is a resource which is used/misused by all. The paper integrates both approaches while contextualizing the use/misuse of the environment as a resource and examines liability and culpability from the profit motive, wherein environmental harm is intergenerational, pervasive, long-term, and irreversible. However, social manifestations (order, disorder and strain in the society), behavior, culture and socioeconomic vulnerabilities on the utilization of the environment as a resource are imperative to understand environmental harm before affixing accountability. The paper develops a theoretical framework examining the relevant legal and criminological theories (deterrence, rational choice, etc.) and proposes a differential approach to assess environmental harm committed for profits and those committed by the marginalized and least advantaged members of society who invariably utilize environmental resources for survival and/or out of necessity. The paper further argues that sweeping punitive actions risk creating a 'paradox of poverty'. The Matrix contributes to the current scholarship from the legal and sociological standpoint, arguing for a just, fair and equitable utilization of resources while ensuring an inclusive and sustainable policy to combat environmental violations and thus harm. The work contributes to global green criminology discourse urging transformative legal reforms to mitigate ecological violence and advance planetary justice.

KEYWORDS

environmental law, green criminology, environmental harm, human risk matrix, socioeconomic disparities, criminal liability

Introduction

Green criminology has been a subject of debate for the past few decades. However, it has been slow to engage with the victims of environmental crimes. This is primarily because many do not view environmental harm as intrinsically bad, and some harm to the environment is lawful and licensed (Lynch and Long, 2022).

Empirical evidence shows that profit motives fuel the rise of environmental crime (*Environmental Crime a Threat to our Future*, 2008). It is a part of an extractive environmental economy challenging legal discourses, international relations, collaboration, neo-colonial perspectives, and non-anthropocentric perspectives (Burrell et al., 2023) and the scale of environmental harms has evolved in the past two decades (Franzen and Bahr, 2024). It is rated as the third largest criminal enterprise after drugs and counterfeiting (Malakouti and Hazrati, 2025). According to UNEP (2016) and Interpol (2016), it has an estimated value of \$110–258 billion, surpassing illegal arms trafficking (Nellemann et al., 2016). Illegal wildlife trade has increased at its current value, estimated at \$23 billion USD (*World Wildlife Crime Report*, 2024). Similarly, pollution, illegal mining, and waste trafficking have also increased. As per the Global Force Watch (2023), deforestation has increased by 12% between 2019 and 22, and illegal logging by 15–30% (Albanbaeva et al., 2025).

While such crimes increase the risks of creating ‘severe, pervasive and irreversible’ damage to the earth system and biodiversity (Nguyen et al., 2023), it also establishes a complex relationship between human vulnerability and ecosystem vulnerability, its linkages between climate change and security, conflict variables, global heating, migration and human conflict and, securitization with significant growth and diversification of criminal activities (Scheffran, 2022). Table 1 gives a detailed account of the underlying motivations to commit environmental crimes, its socioeconomic impact and the lack of a robust regulatory framework.

Environmental harms also operate at a socioeconomic level wherein people with the fewest financial resources and lowest adaptive capacities are most affected while being least responsible (Levitas et al., 2007). Fragile societies with low human development have limited/negligible coping capacities and are highly vulnerable to climate change, contributing to their coping capacity. Inequalities will make them prone to downward spirals of violence and societal instability (Schippers et al., 2022).

From the sociological perspective, underrepresented populations, residents of minority and poor communities who experience social, racial, and economic inequalities equally experience disparate impacts with varying degrees of harm to the environment (Smith et al., 2022). These manifest as a criminal activity wherein groups and individuals, inferior and/or marginalized groups, experience the criminal manifestations of climate change in different ways (Abbott, 2008). At the same time, it is also about how society perceives environmental harm from a behavioral, cultural and socioeconomic perspective, wherein social stability (order/disorder and strain), reduced social control, weakened social support, and increased opportunities for crime mark the fundamental departure of environmental violations from a profit motive.

The complexity of addressing environmental harm is that it occurs at every strata of human society, committed by the poor and marginalized by businesses, through state acquiescence and as a criminal activity. If therefore, environmental harm is purely perceived

from the harm principle apportioning blameworthiness based on liability, culpability and accountability and is governed by the dynamics of power, justice and harm then the entire human population commits environmental harm since it is a resource which is used/misused by all (Francis, 2021). Contextualizing the use/misuse of the environment as a harm to a resource requires distinguishing harm from a profit motive and harm as a social manifestation (order, disorder and strain in society).

Treating the environment as a resource to establish culpability on the use/misuse equally begs a question whether green criminology can solely rest on the harm principle as envisaged in criminal law or whether there is a requirement for a more nuanced approach, weaving the socioeconomic realities to apportion blameworthiness.

The current approach, though not formally documented, treats all perpetrators as criminals for environmental violations often characterized without the normative understanding of why the act was committed and the circumstances thereof. Most people are either from the marginalized sections of society, illiterate, or living in poverty, who are either not aware of the supposed harm and/or commit for survival needs. Most critical is the tragic “paradox of poverty” (*Report of the World Commission on Environment and Development*, 1987), which forces people to use “free” fuels and inefficient energy systems, reducing environmental sustainability and accelerating environmental pressures.

Liability for environmental crimes also cannot be treated as a cause-and-effect principle wherein the perpetrator is liable for punishment for having caused harm to the environment. Instead, the harm principle, which is the essential component of punishment, has to weave into the socioeconomic realities of the situation to apportion blameworthiness.

Bridging criminal and environmental law requires redefining harm to encompass ecological and social dimensions. Strengthening penalties, recognizing harm, and adapting hybrid mechanisms (e.g., corporate liability reforms and community-based enforcement) could enhance deterrence. Addressing socioeconomic drivers through equitable policies will ensure that enforcement does not perpetuate inequality, fostering a holistic approach to bridging the justice gap.

The paper posits three arguments

First, preventing environmental harm is necessary to maintain climate balance. This is particularly important when we are over or nearing the ability to cope with the nine planetary boundaries (Rockström et al., 2009). Moreover, exposure to environmental harm risks creating a ‘severe, pervasive, and irreversible’ (Pachauri, 2016).

Second, the challenge is to assess environmental harm as a necessity, wherein the State acquiesces/legitimizes permissible environmental harms committed by the State, the rich and affluent, and businesses as a justification to enable progress, wellbeing, and prosperity of the population at large, while presenting significant risks to the environmental victims. This is defined by the broad socio-political ecology of the State (Ioris, 2014).

Third, environmental harm committed as a necessity for survival, lack of awareness, and as part of culture and/or behavior, attempting to define the nature of the society (disorder/strain/disorganization). These primarily refer to the most marginalized and poor, underrepresented populations, residents of minorities who

TABLE 1 Environmental justice and systemic harm.

Case incidents							
Hurricane Katrina (United states, 2005)	Systematic Inequalities	Racial and Economic Disparities	Environmental Injustice	Governmental Inadequacies	Levee Failures and Geoengineering	Cultural and Livelihood Threats	Vulnerable groups/ Marginalized Groups
The Ogoni Struggle in the Niger Delta (Nigeria)	Environmental degradation	Socioeconomic Disparities/	Political Neglect	Gender Disparities	Vulnerable groups/ Marginalized Groups	Cultural and Livelihood Threats	
Pacific Island Nations and Sea- Level Rise	Inadequate Climate Finance	Threat to s sovereignty	Human rights	Cultural and Indigenous perspective			
The Arctic and Indigenous Peoples	Inequalities and Discrimination	Governance and Indigenous rights	Human rights and Legal advocacy				
The Sundarbans and Sea- Level Rise (India and Bangladesh)	Socioeconomic Inequalities and Vulnerability	Gender Disparities	Inadequate governance	Human Displacement			
The Flint Water Crisis (United States)	Inadequate governance	Systematic racism	Socioeconomic Disparities				
The Coal Industry in Appalachia (United States)	Environmental degradation	Socioeconomic Inequalities	Inadequacies of Corporate responsibility	Procedural Inequities			
The Standing Rock Sioux Tribe and the Dakota Access Pipeline (United States)	Environmental and Procedural Injustice	Distributive Injustice	Climate Justice and Activism				
Typhoon Haiyan (Philippines, 2013)	Political neglect	Socioeconomic Vulnerabilities	Policy Inadequacy				
Climate Refugees in the Sahel Region (Africa)	Legal and Recognition Challenges	Displacement	Environmental and Social Injustice	International Collaboration and Policy Gaps	Socio-Ecological and Economic Impacts		
Wildfires in Australia (2019–2020)	Social and Economic Inequities	Policy Inadequacy					
The Maldives and Climate Change	Displacement	Legal and Human rights challenges	International justice and equity				
The Amazon Rainforest and Indigenous Land Rights (Brazil)	Deforestation	Indigenous land rights	Socio-political challenges	Lack of Governance			
Climate-Induced Migration in Bangladesh	Climate induced migration	legal and policy challenges	Socioeconomic Disparities	Gender disparities	Lack of community-based disaster management		
The Case of Aamjiwnaang First Nation (Canada)	Historical Injustices	Environmental degradation	Lack of adequate legal framework	Lack of adequate policy frameworks			
Drought and Conflict in Darfur (Sudan)	Gender Justice	Resources Scarcity	Socio-political and Economic conflicts	Procedural and distributive injustices	Lack of policies		

(Continued)

TABLE 1 (Continued)

Case incidents							
The Marshall Islands and Climate Change Advocacy	Cultural and perceptual challenges	Distributive Injustice	Lack of adequate legal framework				
The Water Crisis in Cape Town (South Africa)	Inadequate Governance and policy	Lack of procedural justice	Inequality and social Injustice	Environmental degradation	Vulnerable groups/ Marginalized Groups	Socio-political Inadequacies	
The Tuvalu Climate Lawsuit (International)	Lack of legal support	Socioeconomic Vulnerabilities	Lack of International Support				
The Case of Kivalina (United States)	Vulnerable groups/ Marginalized Groups	Legal and policy challenges	Inadequacies of Corporate responsibility	Displacement			
Cyclone Nargis (Myanmar, 2008)	Vulnerable groups/ Marginalized Groups	Distributive Injustice	Inadequate governance	Political neglect	Displacement		
The West African Sahel and Desertification	Desertification	Lack of policies	Socioeconomic Inequalities and vulnerability	Livelihood Threats			
Air Pollution and Climate Justice in Delhi (India)	Socioeconomic Inequalities and vulnerability	Lack of Adaptation planning	Recognition Justice	Lack of Governance	Lack of policies	Lack of procedural justice	
The East African Drought Crisis (2011)	Environmental degradation	Distributive Injustice	Vulnerable groups / Marginalized Groups	Governmental Inadequacies	Lack of Policy	Lack of Adaptation planning	
Climate-Induced Conflict in Lake Chad Basin (Africa)	Environmental degradation	Governmental Inadequacies	Socioeconomic Disparities	Lack of Governance	Lack of policies	Political Neglect	Human rights
The Yakama Nation and Climate Change (United States)	Cultural and perceptual challenges	Vulnerable/ marginalized Injustices	Lack of policy	Distributive Injustice	Lack of Adaptation planning		
The Syrian Civil War and Climate Change	Displacement	Environmental degradation	Socioeconomic Inequalities and vulnerability	Lack of adequate policy frameworks	Vulnerable groups / Marginalized Groups		
The Australian Great Barrier Reef and Coral Bleaching	Environmental degradation	Adaptation	Lack of policy	Socioeconomic vulnerabilities	Cultural and Livelihood Threats		
The Greenland Ice Sheet and Global Sea-Level Rise	Vulnerable groups/ Marginalized Groups	Lack of Policy	Environmental degradation	Socioeconomic Disparities			
The Colorado River Basin and Water Rights (United States)	Cultural and Livelihood Threats	Legal and Recognition Challenges	Environmental degradation	Lack of adequate policy frameworks	Vulnerable/ marginalized Injustices		
Climate Justice and Urban Heat Islands in Phoenix (United States)	Socioeconomic Disparities	Vulnerable groups / Marginalized Groups	Lack of policy	Lack of Adaptation planning	Climate Justice and Activism		

(Continued)

TABLE 1 (Continued)

Case incidents							
The Bhutan Climate Change Resilience Model	Distributive justice	Procedural Inequalities	Lack of policy	Socioeconomic Disparities	Intergenerational and systematic Justice	Recognition Justice	
The Jakarta Flooding Crisis (Indonesia)	Distributive Injustice	Vulnerable groups / Marginalized Groups	Procedural Inequalities	Lack of adequate policy frameworks	Transformative Justice	Governmental Inadequacies	
The Maasai People and Climate Change (Kenya and Tanzania)	Displacement	Environmental degradation	Gender Disparities	Lack of adequate policy frameworks	Legal and Recognition Challenges	Lack of Adaptation planning	
The Los Angeles Clean Truck Program (United States)	Vulnerable groups/ Marginalized Groups	Environmental degradation	Socioeconomic Disparities	Lack of adequate policy frameworks			
The Ganges River Basin and Climate Change (India and Bangladesh)	Displacement	Socioeconomic Disparities	Political Neglect	Lack of adequate policy frameworks			
The Yellow River (Huang He), China	Climate injustice among the people	Environmental Justice	Disparities in enforcement	Disparities in enforcement			

experience social, racial, and economic inequalities and possess the fewest financial resources and lowest adaptive capacities (Reckien, 2020).

The paper proposes a theoretical framework examining the relevant legal and criminological theories (deterrence, rational choice, etc.) and proposes a differential approach to assess environmental harm distinguishing those committed for profits and those committed by the marginalized and least advantaged members of society who invariably utilize environmental resources for survival and/or out of necessity wherein the nature of the society plays a crucial role.

In doing so, the paper proposes the Environmental Harm and Human Risk Matrix. The Matrix classifies environmental harm and human risk as low, medium, and high impact, creating nine intersectional approaches to assess environmental harm caused by the severity and irreversibility of harm, the risk to human and non-human wellbeing, its intergenerational impact, and the ability to mitigate the impact. Through the Matrix, the paper identifies activities that should be assessed as violations with no criminal liability, harms that should have criminal liability and harms that are subject to interpretation by the executive and the judiciary, thereby helping to understand environmental harm within the socioeconomic reality of the situation.

The proposed Matrix weaves the socioeconomic realities to mitigate the severity of harm assessment on the poor and marginalized, expands the definition to potential wrongful harm to future generations, harm caused by the mere probability of adverse climate events and the nature of the society (order/disorder/strain). It expands liability on the principle of equity, arguing that people’s differential abilities to get and stay out of harm’s way are due to their vulnerability to climate change, poverty, lack of education, and political or legal obstacles to mobility (Shahar, 2021).

Part I of the paper undertakes a comprehensive review of the literature examining the harm principle and the different sociological approaches that render insights into the perpetuation of such behavior.

Part II explains the Environmental harm and human risk matrix and how it can be applied from a policy perspective.

Part III highlights the scope for future research and, Part IV concludes the paper.

Methodology

The paper has used the doctrine study to understand the harm principle while assessing we harm caused to environment due to human actions (Table 1) and the lack of green criminological framework to fix accountability. The terms of assessment of environmental harm and its human impact is based on the severity, irreversibility, pervasiveness and its intergenerational impact.

Since environment is a resource used/misused by all, a linear definition of harm principle (Mill, 1859) can hold the entire human race accountable. Therefore, the assessment of harm has dovetailed the socio economic circumstances of harm principally governed by motive and necessity wherein environment harm is committed for profit and/or large scale illegal activities as compared to harms committed for survival and/or necessity.

The third term of assessment is understanding environmental harm from a sociological perspective wherein the nature of the society (order, disorder, strain) identifies harm as a behavior, habit or culture and the legal framework is inadequate.

While the above three terms of assessment help in locating environmental harm within the legal, social and sociological framework, the second approach to understand environmental harm is to assess green crimes mirrored on criminal conduct thereby limiting the discourse on green crimes as a resource and not as a harm to the society.

The paper has extensively reviewed the examination of the harm principle (Mill, 1859) from a pure criminal law perspective which serves as a 'jurisdictional trigger for society to consider the interference of any sort (Vibert, 2022), the understanding of environmental harm as a vulnerability and perpetration. In doing so, the paper has examined extensive literature, international IGOs, civil society groups and state response on the treatment of environmental harm.

The above criteria have helped in developing the environmental harm and human risk matrix which provides a comprehensive understanding of the nature of environmental crime and its impact. This will help judges, legal practitioners, policy makers and civil society groups to identify environmental harm and affix responsibility upon perpetrator while being inclusive and based on the just, fair and equitable utilization of resources.

The paper will readers understand the implementation of the matrix by taking the Yellow River (Huang He), China as a brief case study.

Review of literature

Debates continue whether green crimes are best addressed through criminal justice systems or via civil or administrative mechanisms and how to examine environmental harm in green criminology (Nurse, 2015). While there is rich literature examining environmental harms and risks, the key question remains as to whether such harms can be treated as crimes. Many argue that the fundamental contest is the nature of the criminality, whether environmental harm rather than environmental crime should be the focus and, whether green crimes should be seen within mainstream criminal justice and dealt with by core criminal justice agencies such as the police, or whether they should be considered as being beyond the mainstream (Nurse, 2017).

Although much of the discussion has focused on organized environmental crime with a considerations as to how varied judicial and regulatory approaches can more effectively address environmental harms from an administrative, regulatory and conservation management law rather than as 'pure' criminal law (Nurse, 2023), its enquiry is limited to corporates and non-state actors and transnational crimes. This defines the nature of environmental 'crimes', their location within government environmental policy departments rather than criminal justice ones and the fact that environmental harms are often dealt with by specialist environmental agencies (Nurse, 2015).

Key debates continue to center around the definitions of environmental harm versus crime, the role of justice systems in promoting ecological justice, advocating justice not only to protect human interests but also non-human entities and ecosystems (Nurse, 2017). While such crimes extend to the crimes of the economy, particularly in industries like oil, wildlife, deforestation, etc., it highlights the complexities of state and corporate

accountability in environmental degradation (Ruggiero and South, 2013).

Green criminology has socioeconomic (Tolbert et al., 2023; Prasad et al., 2022) and cultural (Feddemma et al., 2020; Donovan, 2004) manifestations, which can contribute to the systemic marginalization of local communities (Duffy, 2022) and further exacerbate these issues. Killean and Dempster (2025) examine the limitations of this field from the perspective of anthropocentric legalism, neocolonial practices, neoliberalism and the historical marginalization of nature in transitional justice discourse. It argues that ignoring environmental harm not only undermines the possibility of holistic justice but also perpetuates structural violence and inequality (Killean and Dempster, 2025). Anthropocentric legalism also expands to local contexts, the historical legacies of colonization in shaping environmental crime fuelled by an extractive economy, which particularly risks marginalization of the communities in the Global South (Gladkova et al., 2020).

When environmental harms are examined from the context of distributive justice with state acquiescence wherein emissions are attributed as rights and States legitimizes the corresponding amount of emissions as part of the neoliberal phenomena, the criminological understanding of power dynamics draws boundaries of legal harm and often blurs the divide between large scale harm and those committed as an act of survival by the marginalized and those living in poverty (Okereke, 2007). While in both instances, the environment is a resource, but its use/misuse has disproportionate impacts. The former manifests wherein political and class interests and, the ability of the 'powerful' to manipulate and use the environment to preserve the basis of their power which is often as a result of State delinquency for breach of obligations and/or State acquiescence through public private partnership (PPP) justifying development (Sajikumar et al., 2023). In the process, the poor and the marginalized become the objects of the unequal impact of environmental harm.

However, sometimes, such an engagement can manifest as paradoxical harm wherein a green product causes inevitable harm (White, 2021) which is intentional, driven by economic motives (White, 2018) and sustain the status quo in favor of hegemonic nation-states and leading transnational corporations maintaining the viability of 'dirty' industries and supersedes universal human interests (White, 2018). Environmental harm in such instances rests on a neoliberal philosophy promoting private profit and narrow self-interest (White, 2015) serving as a death knell of collective well-being as a "lynchpin of contemporary class struggles occurring around the globe (White, 2021)".

Even the claims of restorative justice fall short given the disparate impact on the vulnerable population. Scholars have explored various dimensions, including climate change, wildlife trafficking, and the gendered aspects of environmental crimes, revealing how systemic structures like colonialism and capitalism influence both offending and victimization (Sollund, 2023). This anthropocentric justice system's approach advocates for ecological and species justice and highlights the importance of addressing state and corporate failures in environmental protection (Nurse, 2017).

Efforts to mitigate environmental harm have evolved over the years and across regions as an interventionist strategy through legislative frameworks without examining the subjectivity of the understanding of the harm and the possibilities of accountability.

Hrdina and Romportl (2023) incorporates abiotic, biotic, and anthropogenic factors to create 169 unique systems that illustrate human-environment interactions, emphasizing the need for comprehensive monitoring in light of biodiversity loss and anthropogenic pressure (Hrdina and Romportl, 2023) while harm classification systems like Ecological Risk Assessments (ERAs) and Globally Harmonized System (GHS) (Dert, 2024) evaluate the potential adverse effects of physical and chemical stressors on ecosystems through scientific data management for environmental decision-making while integrating the complexities of pollution and its ecological consequences while remaining silent on the liability of the harm (Shomanova et al., 2025). Similarly, Dert's (2024) Impact Measurement and Application of Conservation System (IMACS) emphasizes the importance of standardized methods for assessing environmental impacts, which could facilitate funding for conservation and promote sustainable practices (Dert, 2024). However, these systems are context-specific and sometimes face challenges in implementation and integration with existing regional systems, such as the EU's CLP regulation (Morita et al., 2006).

Central to the question of understanding harm and risk is the precautionary principle, sustainable development, common but differentiated responsibilities and national environmental sovereignty which guide negotiations and judicial interpretations in environmental protection. The legal regimes encompass various areas, including pollution control, resource management, and environmental impact assessments reflecting the need for a comprehensive approach to environmental governance (Saxena, 2015). While the framework aims to promote sustainability and mitigate the transboundary effects of environmental degradation and the interconnectedness of ecological and human systems (Rybyanets and Moiseeva, 2024), it continues to remain persuasive to compliance and calls upon to foster collaboration among states, non-governmental organizations, and international bodies (Dupuy and Viñuales, 2018).

International environmental law equally provides a framework to facilitate global cooperation in addressing environmental challenges with States bearing rights and responsibilities to ensure compliance and integrate these commitments into national policies, and innovative legal mechanisms aimed at mitigation and adaptation. Key arrangements include the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol, and the Paris Agreement, which establish binding emission reduction targets and promote international cooperation, while also highlighting the need for equitable treatment of developing nations (Aloamaka, 2024).

While these frameworks face challenges, including enforcement issues and compliance, necessitating stronger legal innovations like climate litigation and enhanced funding mechanisms for effective implementation (Mustafa, 2024), the involvement of non-state actors is essential for advancing climate governance and achieving sustainable development goals (Aloamaka, 2024).

Examining the harm principle

John Stuart Mill introduced the "Harm Principle" in his work "On Liberty" (Mill, 1966). He noted, "The only purpose for which power can be rightfully exercised over any member of a civilized community, against his will, is to prevent harm to others" (Holtug, 2002). Mill

asserts, "Over himself, his own body and mind, the individual is sovereign" (Holtug, 2002).

Critics argue that the principle creates a 'jurisdictional trigger for society to consider the interference of any sort (Vibert, 2022) and poses an existential challenge to identify the exact boundary to invoke the harm principle, mainly when harm is assessed as a preventive tool and/or is an outcome of self-regulating conduct aiming to prevent self-harm, thereby creating an anomaly of punishment or prevention (Vibert, 2022).

The principle is further blurred when an otherwise harmless conduct is subject to the authority's intervention on grounds of public opinion, as a tool of prevention, moral disapprobation, utilitarianism, as an instrument of control, measures of social cohesion to uphold moral norms by legislation and preserve social unity (Peršak, 2007). In recent years, the principle has been questioned on surrogacy, suicide, euthanasia, bioethics, and homosexual behavior between consenting adults (Grimley, 2009).

From a rights perspective, the principle insufficiently provides for individual liberty, legitimizes State coercion (Holtug, 2002), controls individual behavior (Holtug, 2002), harms the voluntariness of individuals and is inherently political (Peršak, 2007) and justifies social interventions.

Scholars argue that the harm principle derives from its apparent simplicity and objectiveness (Lin, 2006). While at the same time, it means different things to different people, often disguising inevitable choices about values (Lin, 2004).

Although the no-harm principle has been identified as the cornerstone of international environmental law, it is not generally recognized as a central feature of international climate change governance. Enduring disagreements regarding the relevant normative principles of international cooperation have long plagued international climate change negotiations. Developing academic literature has examined the harm principle as vulnerability of the environment due to human-induced actions, thus identifying vulnerability as harm (Hamilton, 2021). Herington (2017) has identified it as a vulnerability to climate-related harms due to its impact on security.

Herington (2017) also argues that vulnerability to climate-related harms is itself a harm due to its impact on security (Herington, 2017) and in terms of this, it is further complicated because the definition of harmful action in the context of climate change can be ambiguous (Godoy, 2017). Lowry (2011) focuses on the potential for wrongful harm to future generations and the harm caused by the mere probability of adverse climate events, wherein the probability of harm risks in the decreased sense of well-being, apart from the adverse consequences that are the subjects of that risk (Salim et al., 2022).

The approach perpetuates the State coercion as a preventive tool where the harm principle expands its reach toward a strong punitive approach while remaining oblivious to the socioeconomic realities in which the crimes occur. It is also unlikely that a straight-jacketed application of the harm principle can hold people, society, and businesses accountable and thus prevent harm, given the reality that environmental crimes are deeply rooted in "critical, radical, and political-economic perspectives" (Barrett and Marshall, 2023). However, viewing human development from a 'no harm principle' approach is equally challenging since harm prevention is a *sine qua non* to environmental sustainability. The principle of harm has to focus on the ethical aspect of avoiding harm rather than solely criminalizing it.

Since environment is a resource used/misused by all, climate change is expected to increase environmental crime which includes environmental harm and criminal behavior related to the environment (Agnew, 2012).

The matrix aims to address these foreseeable changes, and a problem-solving approach tailored to the specific type and source of harm is recommended (White, 2021). It is not limited to direct physical damage but includes broader ecological consequences, such as disrupting ecosystem functions and services, which can lead to severe socioeconomic and health impacts (Walz et al., 2021).

The integration of harm into criminological frameworks allows for a more nuanced understanding of crime to guide criminal policy and enforcement (Paoli and Greenfield, 2018). The ecological and social dimensions of environmental degradation are a complex interplay between legal and illegal activities that contribute to biodiversity crimes, the exploitation of flora and fauna (Walz et al., 2021), and other environmental challenges. Therefore, in defining harm, certain actions, although not explicitly illegal, can still result in substantial environmental damage, which should be considered naturally harmful (Environmental Crime a Threat to our Future, 2008).

Theoretical framework

The nexus between development-climate risks- state acquiescence/ failure to protect - harm as a necessity/for survival- the interpretive coinage of harm by the political elites and its tremendous potential to exacerbate inequality, marginalization and further perpetuate “paradox of poverty” define the complex contours of environmental harm which goes beyond the traditional understanding of the harm principle (Mill, 1859).

In criminal law, harm is traditionally direct and immediate, involving physical injury, property damage, or threats to individual rights (Schulhofer, 1974), while environmental law defines harm as ecological degradation, often diffuse, cumulative, and intergenerational, affecting ecosystems, biodiversity, and public health (White, 2013). The nexus lies in the shared objective of preventing detrimental outcomes, yet environmental harm challenges conventional legal frameworks due to their complexity and delayed manifestation.

The wealth of literature and recent scholarship has highlighted the need for a normative framework expanding green criminology beyond legal definitions to include actual ecological impacts, providing a theoretical foundation for assessing environmental harm based on real impacts (human and non-human) rather than legal technicalities. For example, Islam (2024) examines the various dimensions of climate justice (procedural, compensatory, and transformative) through environmental sociology and prioritizes social equity and inclusion as a response to climate change (Islam, 2024). Similarly, Nurse (2017) highlights the importance of addressing state and corporate failures in environmental protection through an anthropocentric approach advocating for ecological and species justice, and Brisman and South examine how to incorporate various criminological theories, including classical and consensus paradigms.

The complexity of understanding and thus defining environmental harm therefore cannot be attributed to a single criminological or sociological theory given the various stakeholders, their circumstances (development praxis), intentions (awareness),

motivations (business, profits or for survival) and its impact human (victims-perpetrators) and non-human (climate/species/ecology) impact.

Justice and harm prevention can serve as a deterrent if designed as a preventative tool (Kennedy, 2012) arguing that it is motivated by a rational choice, profits and/other motives or a manifested form of social disorder or strain in the society giving an insight into the motivation and nature of the society (order/disorder/strain) or the lack of a legal and regulatory framework within the society (Jenkins, 2020) and equally, the propensity to cause environmental harm at the cost of human risk.

Environmental justice: harm prevention as a deterrent

Environmental harm prevention can best be understood from a sociological perspective, how people view environmental harm as a rational choice in the absence of any regulatory framework.

Understanding one's rational choice to commit harm is best understood by their motivation to seek profits in the absence of any deterrence. Though environmental protection laws exist in some form and scale, they are largely administrative/civil with little impact on the criminality of the harm. The absence of deterrence also refers to the State's failure/acquiescence to define tolerated illegal harm, and non-tolerated illegal harm, creating hegemonic notions of harm and practices of legality (Mol, 2017).

The behavior of the actors (individual/community and the corporates) is part of their rational decision-making process where they weigh the costs and benefits of their actions, their self-interest, and their rationale toward utility maximization (Beaudry-Cyr, 2015). In Finland, for instance, applying rational choice theory to environmental crimes reveals that fines were significantly lower than the optimal level needed to deter such crimes, even when accounting for offenders' wealth and the complexities of environmental harm restoration (Lindqvist et al., 2024). For instance, when government measures increase the costs of perpetration, incidents of eco-crimes tend to decline, indicating that the eco-movement's decision-making is influenced by their actions' perceived costs and benefits (Carson et al., 2020).

The rational choice theory also explains how criminal opportunities arise when motivated offenders, suitable targets, and a lack of capable guardians converge. Community breakdown creates a lack of social cohesion and social control, which in turn creates a high propensity to commit crime (Lynch and Barrett, 2017).

Deterrence plays a critical role in preventing environmental harm. Cesare Beccaria (1738–1794) laid the foundations of the Deterrence theory in the criminal justice context, arguing that punishments are designed as a preventative tool to deter crime (Monachesi, 1955) through the appropriate use of penalties by increasing certainty, swiftness, and severity of legal punishments while Thomas Hobbes's (1588–1679) theory of deterrence is rooted in the fear of punishment in preserving peace, and Becker (1930/2014) examines deterrence through rational calculation of the cost of punishment in economics in criminology and serves as a cornerstone rational choice theory.

While deterrence establishes itself on the fear of punishment and its swiftness to of the state to act and a preventative tool for the commission of crime (Monachesi, 1955), it cannot be sweepingly

applied to all because such approach risks to trigger the “paradox of poverty” (Brundtland, 1987) by targeting the poor and marginalized.

Deterrence combined with rational choice is best understood when the harm is profit-motivated, leading to large-scale environmental harm, which can also be severe, irreversible and has intergenerational impact. Deterrence is also limited when there exists an inherent tension between legally defined crimes (e.g., violations of the Clean Water Act) and socially constructed harms (e.g., carbon emissions driving climate displacement). For instance, while states may prosecute illegal logging, they often subsidize industries responsible for deforestation, illustrating the paradox of “lawful but harmful” practices. (Brundtland, 1987).

Formal sanctions and strong enforcement through a regulatory framework can alter cost–benefit calculations for potential violators for harms which cause a high degree of harm and pose a high risk of environmental harm, making deterrence effective.

While deterrence needs to identify high human risk and environmental harm, a regulatory framework is also required to identify harms which either have high environmental impact while posing medium human risk and those which have medium environmental impact but high human risks. These include harms where human wellbeing is affected but not severely endangered and refer to legally defined crimes and socially constructed harms like air quality, wide-scale water contamination, illegal deforestation, pollution impacting human health and well-being. Both these categories have a profit motive, intentionally severely impact human well-being and are large-scale, but actions can be reversed through preventive measures and strong regulatory frameworks. They also exist because of the inadequacy of existing frameworks, weak law enforcement, corruption, and administrative failures (Center for Spatial Justice, 2022). The role of environmental regulation is crucial, as robust and flexible regulations can reduce the adverse effects of environmental damage and promote compliance (Rynaldi, 2024).

From an environmental crime perspective, deterrence and the rational choice theory examine that the cost of perpetration will lead to a decline in environmental crimes (Rynaldi, 2024). However, both rely on the utilitarian idea of justice and proportionality (Pickett et al., 2019) with an emphasis on rational hedonism and the prevention of criminal activity but remain silent on factoring socioeconomic imperatives that motivate the perpetrated crimes. Mitigating factors, such as economic deprivation and lack of alternatives, are essential in assessing culpability and determining appropriate responses, but remain punitive even through restorative justice.

On the other hand, social disorganization theory posits that factor such as poverty, mobility, racial heterogeneity, family disruption, and structural density influence neighborhood crime rates (Warner and Pierce, 2006). It remains popular for understanding spatial (geographical) crime distribution.

Propensity to cause environmental harm at the cost of human risk

The nature of the society gives an insight into people's/communities' causing environmental harm at the cost of human risk. This happens in two situations. First, harm is large-scale and motivated

by profits. Second, environmental harm committed but out of necessity/survival, which do not cause grave risks.

It could be culturally embodied or psychologically motivated either because of lack of regulatory framework, social disorder or strain. In both instances, the social structure is crucial. Kelling and Wilson (1982) introduced the Broken window theory (Wilson and Kelling, 2011) based on the psychological principle arguing if a window is left unrepaired, it leads to visible signs of disorder in society, such as broken windows, graffiti, or litter, and can lead to an increase in more serious crimes. While community maintenance is the key and policing minor offenses helps prevent significant crimes, people naturalize environmental harms. While the regulatory framework establishes the risk of zero tolerance, it has the potential to disproportionately target marginalized communities, risk community alienation, and unjust targeting of specific groups (Jenkins, 2020).

Inequality, marginalization, and poverty create strains within the society due to lack of access to legitimate means (Strain Theory, Merton, 1938) and thus environmental harm over a period of time becomes culturally embedded as a means of survival wherein people may reject goals but follow all rules. Agnew (1992) argues that strain may come from failing to achieve valued goals, resulting in anger or frustration and an increased likelihood of crimes.

From the social policy perspective, the theory helps to understand how environmental stressors contribute to behaviors which can also help undermine societies facing climate-induced strains. While social control theory (Gottfredson and Hirschi, 1990) examines crimes sociologically, it also gives insights into individuals' bonds to societal institutions such as family, education, and employment which deter deviant behaviors. These bonds are characterized by attachment, commitment, involvement, and belief, which collectively inhibit engagement in activities that violate societal norms. Individuals or institutions lacking strong bonds to societal norms due to inadequate environmental regulations or insufficient community engagement may be more inclined to commit environmental offenses.

Such deviant behaviors enable us to understand activities causing minimal environmental harm and may be viewed as regulatory infractions rather than criminal acts, mainly because they stem from socioeconomic pressures as a proportionate response to harm as a necessity, survival and/or poverty. What is required is the assessment of culpability in terms of the severity of the harm and intent of the actions. Since strain theory and social control theory are behavior-laden, critical criminology can best explain environmental crimes through the lens of social inequality, power dynamics, and systemic structures, including people from disadvantaged backgrounds who may engage in environmentally harmful activities out of economic necessity, emphasizing how societal factors influence criminal behaviors and the definition of crime itself. The approach best combines broken windows, social strain, and the social control theory to approach criminal behavior and environmental harm as a subfield of green criminology. The theories also help examine the harm principle through socioeconomic factors. Labeling these acts strictly as ‘crimes’ without considering the underlying socioeconomic pressures may overlook the root causes.

Therefore, while environmental harm and human risk may be categorized as high and medium as discussed above, green criminology must examine the environment as a resource wherein

environmental harm and human risk will be low/medium. Some of these include Environment harm (low)-human risk (low), Environment harm (low) -human risk (medium) and Environment harm (medium) human risk (low).

If we examine the above contingencies, criminal law will tend to hold people culpable of harm without examining the socioeconomic conditions of the resource being utilized. For example, low human risk could entail minimal impact to human health and well-being and be indirect. Some examples of low environment impact could include (a) small-scale or isolated events that lead to temporary and non-severe pollution, which can be cleaned up or naturally remediated without causing significant long-term environmental or health issues (b) minor infractions of environmental regulations that do not result in significant damage, such as a business failing to file the correct paperwork for waste disposal but at the same time the waste is not hazardous or is disposed of correctly regardless (c) small-scale or occasional instances of over-harvesting or use of resource use that do not lead to substantial depletion or long-term scarcity (d) trespassing in Protected Areas causing significant disturbance to wildlife or habitats. Minor environmental regulation violations that may have a negligible impact, such as using wood or destroying trees for survival, basic needs like cooking.

Figure 1 provides the framework to assess environmental harm. The dotted line represents the swivel with ends defined by legal frameworks and the nature of the society (order/disorder/strain). While above half of the swivel focuses on deterrence primarily governed by rational choice and social control, it shapes the dominant idea of criminology (profit motive). The lower part of the swivel represents the nature of the society experiencing strain/disorder, which leads to social disorganization, routine activity and broken window behavior. The combination of the two balances the swivel while ensuring environmental justice is just, fair, and equitable, and the lower half represents the nature of the society, which creates increased risks to commit crimes, either because of the strain/disorder/or disorganization within the society marked by wealth inequality, power, and exclusion. Addressing the latter ensures a sustainable and inclusive approach.

The above framework broadly qualifies legal challenges to deter and the society's circumstances. However, each of these theoretical frameworks is specific to the situation and may dynamically shift in the upper/lower half, giving insights into the necessity of a legal framework and the functioning of the society. For example, society may be so disorganized that it requires being placed in the upper half, qualifying for stringent law enforcement to balance the scales. Similarly, the regulatory framework may be weak and

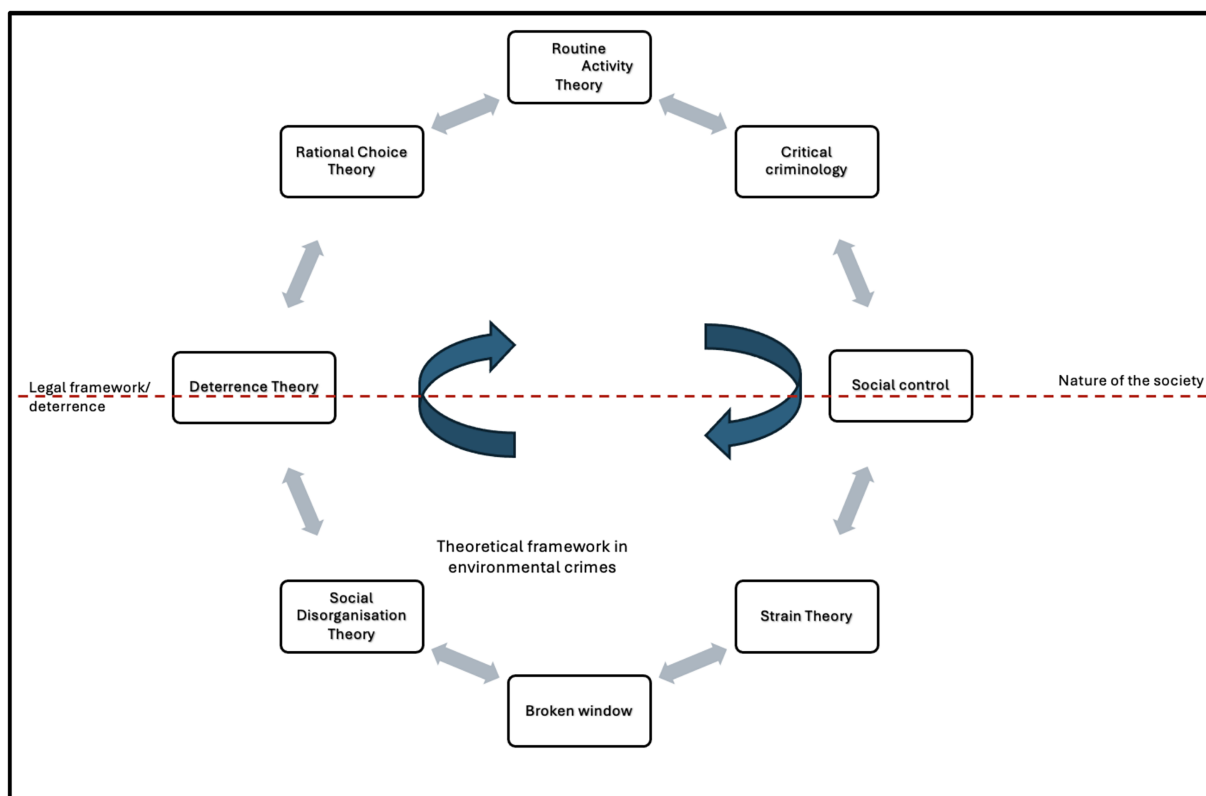


FIGURE 1
Theoretical framework: environmental crimes.

Human Risk/ Environment Harm	Human Risk (HR) (LOW)	Human Risk (HR) (MEDIUM)	Human Risk (HR) (HIGH)
Environment Harm (EH) (LOW Impact)	EH (Low Impact)/ HR (Low)	EH (Low Impact)/ HR (Medium)	EH (Low Impact)/ HR (High)
Environment Harm (EH) (MEDIUM Impact)	EH (Medium Impact) / HR (Low)	EH (Medium Impact) / HR (Medium)	EH (Medium Impact) / HR (High)
Environment Harm (EH) (HIGH Impact)	EH (High Impact) / HR (Low)	EH (High Impact) / HR (Medium)	EH (High Impact) / HR (High)

FIGURE 2

Human risk and environmental crimes matrix.

environmental harm may manifest as a routine activity requiring a balance.

Part III: environmental harm and human risk matrix

Figure 2 gives a tabular representation of the Human Risk and Environmental Crimes Matrix.¹ The Explanation of each of these categories is amplified in Table 2.

The Matrix classifies environmental harm and human risk as low, medium, and high impact, creating nine approaches to assessing environmental harm which help in the identification of environmental harm, its utilization as a resource, its impact, motivation and intention. These nine assessments are defined by the severity of harm and risk to human and non-human well-being, assessed not just from the legal perspective but also from the sociological perspective, viewing the environment as a resource to be judiciously utilized. The justifiable benchmark of assessment is the just, fair and equitable utilization of resources and its consequential harm to the environment and human risk, which forms the founding basis of culpability of harm.

The Matrix defines human risk and environmental harm as follows:

Human risk

Human risk (high)

refers to the significant threat posed to human health, safety, and livelihoods through human-induced environmental hazards. These harms are severe and irreversible and can cause immediate and long-term harm to future generations and their well-being. They contribute

to global morbidity, mortality, economic inequality, displacement, and insecurity.

Contaminated water, air pollution, and damaged ecosystems result from massive industrial pollution, large-scale dumping of chemical waste without precaution, and large-scale illegal logging or deforestation.

Human risk (medium)

It refers to situations where human well-being is affected but not severely endangered while recognizing the interconnectedness of ecosystems and human societies (Mirkamali and Hajivand, 2017). Even if the consequences are not immediately catastrophic, medium risks justify preventive actions when individual or corporate behavior causes harm to others and environmental harm negatively affects others' health or living conditions.

Such risks include impacts like reduced air quality, water contamination, or habitat loss, which can be a moderate risk. However, medium risk can lead to health issues over time, but does not pose immediate life-threatening danger while not reaching the threshold of severe or catastrophic harm. For example, moderate pollution levels may not cause immediate fatalities but can still result in respiratory problems, justifying regulations to prevent further harm.

Human risk (low)

Environmental harm that minimally impacts human health and well-being is indirect and slow, but does not have the potential to harm. Low human risk in terms of environmental crime refers to situations where the harm caused to humans is minimal, indirect, or slow-developing.

This principle is crucial in defining environmental crime, where the focus is on preventing harm rather than merely criminalizing actions. The idea is to prevent behavioral instinctive things rather than treating the victim as a criminal.

Even though the harm may be less direct or immediate, the harm principle still justifies preventive actions, which can elevate a seemingly insignificant environmental crime to a higher severity.

Examples include minor Pollution, such as slight air quality reduction or limited habitat disturbances, that do not immediately

¹ Application for copyright submitted to the government of India vide application number 29346/2024-CO/L.

TABLE 2 Detailed explanation of each of the categories.

	Environment harm (Low)	Environment harm (Moderate)	Environment harm (High)
Human Risk (Low)	(Environmental harm as a violation) (a) The likelihood of the crime occurring and the potential environmental damage is minimal. (b) The probability and the impact of the environmental offense are low. (c) Do not threaten public health, safety, and the environment. (d) Manage and monitor through a preventive function. (e) Does not lead to any noticeable environmental degradation. (f) There is a high prevalence of such crimes among the poor and marginalization for survival needs and/or ignorance of its impact on the environment.	(a) Scenarios are less likely to occur, but when they do, they result in a moderate level of harm to the environment and/or public health. (b) It can potentially have a noticeable impact on wildlife, ecosystems, or human communities, but it does not cause widespread or catastrophic damage. (c) While there is a low risk to human and non-human well-being, the systemic and long-term exploitation of resources will impact the environment. (d) If not checked, the long-term consequences would be extensive and potentially irreversible. These could include widespread Pollution, substantial loss of wildlife or biodiversity, significant health hazards to populations, or long-term degradation of critical ecosystems. (e) The probability of harm is low due to legal frameworks, effective enforcement and compliance mechanisms, lower economic incentives for committing the crime, and/or the rare opportunity for committing such crimes. (f) Measures to prevent this include targeted environmental protection policies, regular inspections of susceptible areas, and contingency plans for addressing environmental harm if it happens. (g) Some examples include (a) contamination of a local waterway due to a small-scale chemical spill, (b) limited habitat destruction due to unauthorized development, and (c) moderate overfishing that affects fish populations but not to the brink of collapse.	(Subjective Assessment of Environmental Harm) (a) Due to the existing regulatory mechanism, the likelihood of an environmental incident occurring is relatively low. However, if it does occur, the potential damage is severe. (b) Severe health and environmental consequences (c) Requires continuous vigilance and maintenance of safety measures to prevent such high-harm events. (d) Some of these include major industrial accidents such as a chemical spill from a plant or a nuclear reactor meltdown, large-scale oil spills from tankers or offshore drilling rigs, which can have disastrous effects on marine ecosystems, dam failures that could lead to catastrophic flooding and environmental destruction, introduction of invasive species, uncontrolled wildfires leading to significant habitat destruction and releases of carbon dioxide, illegal dumping of hazardous waste, rare natural disasters such as a volcanic eruption in an area with a dormant volcano, may be infrequent or have a low probability of occurring within a given time frame, accidental release of genetically modified organisms into the wild, nuclear waste contamination from a well-managed nuclear waste storage facility, etc.
Human Risk (Moderate)	(Environmental Harm as a Violation) (a) Scenarios typically involve less frequent but more controlled violations with moderate environmental impact, but are not severe enough to cause immediate or large-scale environmental damage. (b) Effective regulation and compliance measures minimize the likelihood of occurrence, yet the potential for moderate environmental harm necessitates ongoing monitoring and management. By identifying and mitigating these low risk yet moderately harmful activities, policymakers can ensure that environmental impacts are kept in check while allowing for sustainable development and industrial activities.	(Subjective Assessment of Environmental Harm) (a) Environmental offenses are likely to occur, and when they do, they have a considerable but not catastrophic impact on the environment, ecology, or public health. (b) There is a reasonable chance the crime will be committed due to the lack or absence of enforcement, compliance, or economic pressures. (c) While the consequences of these crimes are not negligible, they are also not the most severe possible. This harm could manifest as regional rather than global environmental damage, reversible ecological impacts, temporary disruptions to ecosystems, or substantial but containable health effects.	(Environmental Harm as a Crime) (a) Situations where individual environmental offenses pose a moderate level of harm but carry a high risk due to their potential cumulative or systemic impacts. (b) These are instances where each offense has a discernible environmental impact that is more than minimal but may not immediately lead to catastrophic consequences. (c) Over time, the collective effect or the potential for escalation presents significant risks to ecosystems and human health.

(Continued)

TABLE 2 (Continued)

	Environment harm (Low)	Environment harm (Moderate)	Environment harm (High)
Human Risk (High)	(Subjective Assessment of Environmental Harm) (a) There is a substantial probability of an environmental offense occurring, yet the actual impact or level of damage is relatively minor or localized. (b) The occurrence of an environmental offense is relatively unlikely (low risk), but if it were to occur, the resulting damage would be severe (high harm). (c) Potential for harm exists, but factors such as swift mitigation, limited scope of the incident, or the resilience of the affected environment result in lesser harm being realized. (d) The likelihood of risk is elevated due to factors like inadequate regulation, lack of enforcement, the opportunity for illegal profit, or other incentives that could lead to environmental offenses being committed. (e) Despite the high occurrence risk, the actual consequences of the harm are not severe, and the damage can be relatively minor, manageable, or reversible with timely and appropriate interventions. (f) Requirement to allocate resources to maximize the effectiveness of those efforts. (g) Since the harm is low, the response may be less urgent or intense, but the high risk indicates that proactive and preventive measures are necessary to ensure that potential harm does not escalate. (h) The consequences of the harm would be extensive and potentially irreversible, such as widespread Pollution, substantial loss of wildlife or biodiversity, significant health hazards to populations, or long-term degradation of critical ecosystems. (i) The probability of the crime occurring is low due to various factors, such as strong legal frameworks, effective enforcement and compliance mechanisms, lower economic incentives for committing the crime, or simply the rare opportunity for committing such crimes. (j) If they do happen, they have the potential to cause extensive and severe environmental damage.	(Environmental Harm as a Crime) (a) There is a significant likelihood that an environmental offense will occur (high risk), and each occurrence is expected to have a moderate impact on the environment or public health. (b) Moderate harm reflects the scale of environmental impact. The high risk indicates that such offenses are occurring frequently or are very likely to occur. (c) In these cases, effective preventive measures and mitigating actions are important to reduce risk and eventual harm. (d) Moderate Pollution Incidents: Frequent occurrences of Pollution that, on their own, do not cause catastrophic damage but can contribute to environmental degradation and health issues if they are part of a recurring pattern. (e) Widespread Pesticide Usage: Regular application of legal but potentially harmful pesticides could negatively impact non-target species and ecosystems, yet extensive use across vast agricultural areas elevates the overall risk. (f) Small-scale Resource Exploitation: Activities like overfishing or small-scale illegal logging might not immediately devastate an ecosystem, but if widely practiced, they can steadily reduce biodiversity and impair ecological function. (g) Urban Sprawl and Habitat Fragmentation: While the damage from a single new development may be moderate, the combined effect of continued expansion poses a high risk of disrupting wildlife corridors and reducing ecosystem resilience. Frequent Traffic Violations in Protected Areas: An example could be off-road driving in sensitive habitats. Although each event may only moderately damage the environment, the high occurrence rate could lead to significant cumulative effects.	(Environmental Harm as a Crime) (a) There is a substantial likelihood of causing extensive damage to ecosystems, human health, or property. (b) Combining two distinct aspects of severe risk probability will harm human well-being. (c) There are immediate and long-term impacts, leading to public order situations, social unrest, and social tensions. The potential for damage is supported by evidence or patterns. (d) Harm is dictated by the extent and severity of the considerable damage expected or realized from these activities. (e) The cons (f) sequences are likely to be widespread, long-lasting, and potentially irreversible, affecting large numbers of people, broad expanses of ecosystems, and substantive economic value. (g) Immediate and concerted action is necessary to prevent, mitigate, or address the anticipated or actual damage. (h) Massive Industrial Pollution: Large-scale dumping of toxic waste into rivers, air, or land that poses a serious threat to human health, wildlife, and ecosystems. (i) Large-scale Illegal Logging or Deforestation: An extensive removal of forest cover that threatens entire ecosystems, contributes to significant biodiversity loss and exacerbates climate change. (j) Illegal Fishing Practices: Overfishing or destructive fishing techniques can deplete fish stocks, causing them to collapse and destroy marine habitats. Wildlife Poaching is the targeting of endangered species for trade, which can push those species toward extinction and upset ecological balances.

endanger human health but can have long-term effects if unaddressed. From an eco-centric perspective, it refers to low human risk and minimal disruption to ecological systems and non-human entities, such as rivers and trees, which are often considered in legal proceedings dealing with environmental crimes.

Environmental harm (low impact)

These harms are less severe and/ or localized. It refers to environmental offenses that, while still illegal and carrying negative consequences, will result in less severe or localized impacts on

ecosystems, human health, or natural resources than high-harm crimes. These could also be caused through sporadic or isolated inventions and can be easily mitigated or have the potential to be reversible over a shorter period without causing long-lasting or widespread damage. They do not have significant or medium-term consequences, are reversible, and do not severely impact the ecosystem or human well-being.

Accumulation of low-harm incidents can still lead to significant environmental degradation, and thus, these crimes also require appropriate attention and enforcement.

Environmental harm (medium impact)

It refers to a level of environmental damage that significantly affects ecological integrity and human well-being but does not reach the threshold of severe or irreversible harm. While the harm affects individuals, communities, and ecosystems, it can be severe but is not catastrophic and is reversible over a longer time.

Moderate harm can include, but is not limited to, (a) illegal deforestation, Pollution, or improper waste disposal that degrade the environment and lead to negative impacts on public health, biodiversity, or natural resources; and (b) localized pollution or habitat degradation that affects community norms and interests without causing catastrophic outcomes.

The harm needs a balanced approach in legal proceedings, where the ecological dimensions of harm are assessed to ensure proper sanctions and preventive measures are applied.

Environmental harm (high impact)

These include environmental harms that result in immediate and direct damage and long-term and potentially irreversible changes to the environment, biodiversity, ecosystems, species, natural resources, human health, and safety. The consequences have scale, have severe immediate and future harm capable of destroying total or in part of the environment ecosystem, including human and non-humans, illegal and capable of inviting non-bailable warrants and which have an immediate impact on the health and well-being of people, which can manifest as a public order concern or a public health emergency.

They have direct and indirect adverse consequences for individuals and communities, including health risks, economic losses, and substantially diminished quality of life, thus justifying the need for laws and regulations to deter such harmful activities and protect the environment and public health.

High harm is a critical offense with significant and often broad-reaching consequences

Some of these examples include: (a) Environmental destruction of habitats and ecosystems, leading to extensive biodiversity loss and ecosystem collapse; (b) pollution from hazardous waste with a wide range of health issues, from respiratory problems to chronic diseases and genetic mutations in humans and wildlife, (c) damage to natural resources which can undermine local and national economies, especially in communities that rely on those resources for livelihoods, such as through tourism or fishing industries, (d) social and Cultural

impact to include Indigenous and local communities have cultural ties to the environment and can lead to social destabilization, (e) contribute to global issues like climate change and ocean acidification, which have widespread effects beyond the immediate location of the crime, This concept helps to prioritize enforcement and policy-making efforts to address the most damaging and severe environmental illegal activities.

An explanation of the environmental harm and human risk model

The Matrix identifies three categories of harm: (a) environmental harm as a violation not inviting punitive actions and can be addressed through a behavioral change intervention (light gray boxes mentioned in the figure), (b) environmental harm, which is subject to the assessment by the State and regulatory bodies which be either treated as a violation or a crime (light gray boxes with a diagonal line across the boxes) (c) environmental harm as crime crimes (dark gray boxes). The basis of classification includes: (a) harms that cause immediate and long-term impacts threatening current and future generations, (b) is reversible/irreversible, (c) can be mitigated without causing consequential harm, (d) is a resource.

These are harms of low-intensity scale and impact, and are often committed because of survival and/or lack of awareness by the poor and marginalized communities who lack the means of adopting sustainable practices. Such harms require a more nuanced approach to understanding the 'why, what, and how' of omission/commission. Punitive actions against these environmental harms risk further aggravating environmental damage, forcing people to further plunge into the cycle of poverty, thereby establishing an inverse relationship between poverty and sustainability (Brundtland, 1987).

Preventing such environmental harm requires a multidisciplinary approach that is not limited to harm assessment. It refers to the disparate impact on the poor and marginalized.

The Matrix identifies:

- (a) Environmental harm (low impact) and human risk (low).
- (b) Environmental harm (low impact) and human risk (medium).
- (c) Environmental harm (medium impact) and human risk (low).

The above categorization of environmental harm and human risk is minimal or limited, preventable, relatively minor, or localized. Swift intervention with minimum legal resources can mitigate the harm. Table 1 provides a detailed explanation of each category.

Subjective assessment of environmental harm and human risks

The assessment of such harms is critical since it is subjective to the interpretation of the examiner and the judiciary. The assessment of such harm can be mapped on tangible parameters, establishing a clear link with the consequential human risks. However, it will not necessarily always necessitate the invocation of the harm principle. The assessment of such environmental harms will be subject to greater

scrutiny in terms of impact (immediate and long term), scale (limited to a particular community or across the entire population), the alleged perpetrator (State, corporate, or community), and the extent of damage (irreversible or can be mitigated) most notably the cause of harm to the penalty is unequivocally related to the socioeconomic wellbeing of the alleged perpetrator.

The Matrix identifies:

- (a) Environmental harm (high impact) and human risk (low).
- (b) Environmental harm (medium impact) and human risk (medium).
- (c) Environmental harm (low impact) and human risk (high).

Some of the impacts in this classification include noticeable impacts on wildlife, ecosystems, or human communities while falling short of causing widespread or catastrophic damage. Situations, when environmental harm is high and human risk is low, refer to situations when the potential for harm exists. However, swift mitigation can limit the scope of the harm, or the system is resilient enough to mitigate the harm while it poses a high risk to human well-being.

The likelihood of the risk is also elevated by factors like inadequate regulation, lack of enforcement, the possibility of illegal profit, and other incentives that could lead to environmental offenses being committed. The assessment is most critical when environmental harm is moderate and human risk is medium. The consequential harm may be reversible but can cause substantial loss to wildlife and biodiversity, significant health hazards to the population, and/or degradation of critical ecosystems.

Moderate risk indicates a reasonable chance of the commission of a crime due to moderate levels of enforcement, occasional lapses in compliance, economic pressures that push individuals or companies toward non-compliant behavior, or vulnerabilities in environmental protection systems. Moderate harm means the consequences of these crimes, though not negligible, are also not the most severe. This harm could manifest as regional rather than global environmental damage, reversible ecological impacts, temporary disruptions to ecosystems, or health effects that are substantial but containable.

Environmental harm as a crime

This term refers to illegal environmental activities that are likely to cause extensive damage to ecosystems, human health, and/or biodiversity. It combines two distinct aspects: significant risk probability and the likelihood of the activity having a severe and irreversible impact on human well-being with immediate and long-term consequences leading to public order situations, social unrest, and social tensions.

This implies that the potential for damage is not just theoretical but supported by evidence or patterns. Harm is dictated by the extent and severity of the damage expected or realized from these activities, which are considerable.

The consequences are likely to be widespread, long-lasting, and potentially irreversible, affecting large numbers of people, broad expanses of ecosystems, or substantive economic value. Immediate and concerted action is necessary to prevent, mitigate, or address the anticipated or actual damage.

The Matrix identifies:

- (a) Environmental harm (high impact) and human risk (moderate).
- (b) Environmental harm (medium impact) and human risk (high).
- (c) Environmental harm (high impact) and human risk (high).

Some scenarios include moderate pollution incidents that do not result in catastrophic damage. However, they can contribute to environmental degradation and health issues if they are part of a recurring pattern of widespread use of pesticides that have the potential to moderately negatively impact non-target species and ecosystems. However, the extensive use across vast agricultural areas elevates the overall risk.

The combination of urban sprawl and habitat fragmentation poses a high risk of disrupting wildlife corridors and reducing the resilience of ecosystems. Small-scale resource exploitation, like overfishing or small-scale illegal logging, might not immediately devastate an ecosystem, but can steadily reduce biodiversity and impair ecological function if widely practiced.

Implementing human harm and environment risk: Huang He (or Huang He) (the yellow river)

The case of the yellow river pollution is the classic example to understand the significant environment degradation which took place over decades. There were multiple actors or sectors involved who were direct polluters like heavy industries which spilled off industrial runoff like toxic chemical spills and heavy metal contamination (Wei et al., 2023). The major industry included steel, chemical textile and paper industries who were responsible for the discharge of untreated/ partially treated industrial wastewater (Zhao et al., 2020). In addition to industrial discharge municipal sewage was also dumped into the river (Chen et al., 2020).

The consequential impact was severe, intergenerational, but had a potential of being reversed. The extent of pervasive harm contributed to nutrients runoff leading to eutrophication and poor water quality (Quan et al., 2022). This impacted people livestock and resulted in sediment erosion which entered rivers from farms and pastures.

Given the severity of the harm, the people residing astride and along the river were most impacted. This led to severe health impact causing cancer and many villagers are referred as cancer villagers (BBC News, 2013). Heavy metal poisoning led to lesions and nerve damage due to arsenic poisoning, kidney damage and bone fracture due to cardamom poisoning (Wang et al., 2025). Similarly high concentration of lead and mercury lead to brain defect in children, brain damage, memory loss and bone weakness (Dey et al., 2023). Untreated sewage and pathogenic contamination led to hepatitis A and E, Cholera, Typhoid and other water borne diseases (Dey et al., 2023). The long-term exposure led to congenital abnormalities, low birth weight, miscarriage, still birth, infertility, etc. (Dey et al., 2023).

While the contamination resulted in several significant and legal actions from prison sentences to hefty fines to shut down but only the few industries were penalized and punished, sentences were largely handed over to the local population (ASIA, 2025).

If we examine the case from the environmental harm principle as proposed by John Stuart Mill, then the industrial polluters and the locals were responsible for the sewage disposal in the yellow river were equally responsible.

However, if we examine the same environmental harm from the matrix, the harm attributability will be apportioned on pervasiveness, irreversibility, long term consequences and inter-generational harm. While at the same time, the matrix will enable to distinguish harm commit for profit motive and harm committed by people because of vulnerability or lack of awareness.

If the above criteria are to measure the extent of harm, then industrial polluters would fall in the categorization of “high harm and high impact” (refer matrix). As mentioned above the human impact was irreversible human harm as mentioned above is irreversible (still birth), pervasive (water borne, reproductive abnormalities, muscle weak), intergenerational (reproductive effect due to lead and arsenic food poisoning) and long term (water borne diseases).

However, if we examine the punishment accorded, the industrial polluters were only issued with administrative fines and minor punishment (in certain cases), while the majority punishment was awarded for the local people/ small vendors who in affect were victims rather than perpetrators like example in the case of Yellow river sand mining (2021) the responsible actor was Individual sand miner and he was penalized with 1 year 4 months jail and ¥20,000 fine (Zhu, 2020).

Part III: scope for future research

The Environmental Harm and Human Risk Matrix is the first attempt to categorize environmental harm accountability based on the differential capabilities of the alleged perpetrators. While the Matrix serves as a policy approach to understanding an inclusive and sustainable climate-balanced system, it can also be applied. More research needs to be conducted to map national prevention, which may be on the geographies and the availability of natural resources; the approach serves as a robust policy guide toward understanding environmental harm. The Matrix requires more research and validation from an empirical standpoint to validate the robustness of the model.

Part IV: conclusion

This paper critically examined the evolving field of green criminology, emphasizing its significance in understanding and addressing environmental crimes that threaten ecological integrity and human well-being. Key discussions revolved around the definition of environmental crime, the systemic vulnerabilities within global governance frameworks, and the socioeconomic drivers that exacerbate ecological harm. The analysis presented evidence of the alarming increase in environmental offenses, underpinned by profit motives and institutional deficiencies pervasive in conventional legal systems.

Integrating diverse theoretical perspectives is imperative for advancing the discourse on environmental criminology. The synthesis of harm principles, socio-legal frameworks, and ecological justice

theories provides a comprehensive lens through which to assess the multifaceted nature of environmental degradation and its societal repercussions. Such an integrative approach facilitates a deeper understanding of the interplay between human activities and ecosystem health, highlighting the urgency of addressing the symptoms of environmental crime and its root causes within the context of systemic inequalities.

Moreover, the paper underscored the pivotal role of robust policies, effective enforcement mechanisms, and active societal engagement in pursuing climate justice. Legal frameworks must evolve to embrace principles of restorative justice and equitable enforcement to safeguard vulnerable communities disproportionately affected by environmental harms. This necessitates a collective commitment from governments, non-governmental organizations, and citizens alike to foster proactive measures that protect the environment and promote social equity. Ultimately, only through a multidisciplinary and participatory approach can we hope to achieve sustainable solutions that uphold the principles of environmental justice and ecological resilience.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

AS: Writing – original draft. MS: Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research and/or publication of this article. Alliance University have funded for Publication (APC Charges).

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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