

RESEARCH ARTICLE

Environmental Bioethics and Law: Duties of Care, Intergenerational Justice and the Legal Protection of Life Systems

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Abstract

Environmental bioethics provides a normative framework for examining the legal regulation of human intervention in ecological and biological systems. Its significance extends beyond the traditional boundaries of biomedical ethics, encompassing questions concerning ecological risk, scientific uncertainty, intergenerational justice, biodiversity, non-human life, technological intervention and the distribution of environmental burdens. This study examines the manner in which these ethical concerns are translated into legal principles, duties and institutional mechanisms within international, European and human rights law.

Particular emphasis is placed on the precautionary principle as a legal response to scientific uncertainty and potentially serious or irreversible environmental harm, as well as on the transformation of prevention, proportionality and environmental assessment into instruments of ecological responsibility. The study further analyses intergenerational justice as a temporal dimension of environmental law, requiring present decision-making to account for irreversible ecological costs imposed upon future generations. Biodiversity protection is examined in connection with the tension between anthropocentric and ecocentric approaches, while environmental human rights are considered through the concepts of vulnerability, environmental justice and effective protection against climate-related harm.

The analysis also addresses emerging forms of technological intervention, including biotechnology, synthetic biology and climate-related technologies, highlighting the legal importance of risk assessment, reversibility, transparency, accountability and continuing review. Animal sentience and welfare are examined alongside ecosystem protection in order to demonstrate the need for coordination between individual and systemic approaches to living beings. The study argues that environmental bioethics contributes to the development of a legal architecture in which ecological dependence, uncertainty, representation of future generations and non-human interests, distributive justice and justified technological intervention operate as interconnected elements. Environmental law may consequently be understood not merely as a regulatory system governing pollution, permits and conservation, but as a legal framework for organising human responsibility for the biological and ecological conditions of life.

Keywords: Environmental Bioethics, Environmental Law, Precautionary Principle, Intergenerational Justice, Biodiversity, Environmental Human Rights, Environmental Justice, Ecological Integrity, Biotechnology, Biosafety, Climate Change, Future Generations, Animal Sentience, Environmental Vulnerability, Sustainable Development, Environmental Impact Assessment.

1. Environmental Bioethics as a Legal Problem

Environmental bioethics is not a mere transplantation

of medical bioethics into ecological policy. It is a normative field concerned with the moral status of living systems, the distribution of ecological risks,

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the duties owed to future generations, the treatment of non-human life and the limits of technological power over the biological conditions of existence. Its legal relevance lies in the fact that environmental law regularly decides questions that scientific expertise cannot answer alone. Science may describe risk, causation, exposure pathways, ecological degradation or loss of resilience. It cannot, by itself, determine which risks may be imposed on others, which forms of harm are unacceptable, how uncertainty must be distributed, or whether nature has value only through human interests.

Environmental law therefore operates as an institutional form of environmental bioethics. It translates ethical claims into duties of prevention, precaution, conservation, assessment, participation, liability and restoration. The central point is not that environmental law becomes moral philosophy. The point is that its legal categories already contain ethical choices: what counts as harm, who is allowed to speak for the affected environment, whether irreversible loss may be compensated financially, and whether present economic advantage can justify long-term ecological impoverishment. This is why the Universal Declaration on Bioethics and Human Rights expressly connects bioethics with protection of the environment, the biosphere and biodiversity [1].

The legal order remains partly anthropocentric. Constitutions, statutes and treaties often justify environmental protection through health, property, welfare, cultural identity and sustainable development. Yet this anthropocentrism has expanded. Human dignity, life and private life cannot be separated from ecological conditions. Clean air, water, soil, climate stability, biodiversity and disease-regulating ecosystems are not external amenities. They are preconditions of human autonomy and social continuity.

2. From Biomedical Principles to Ecological Responsibility

Classical bioethics is usually organized around autonomy, beneficence, non-maleficence and justice. Environmental bioethics changes the structure of each principle. Autonomy, in ecological matters, cannot be reduced to individual consent. No present individual can consent on behalf of an aquifer, a species, an ecosystem or future generations. Environmental autonomy therefore becomes procedural and collective. It is expressed through access to environmental information, participation in decision-making and access to justice. This is the legal significance of

the Aarhus Convention, which requires these three guarantees in environmental matters and links them to the right of present and future generations to live in an environment adequate to health and well-being [2].

Beneficence also changes meaning. In medicine, it refers to the promotion of the patient's welfare. In environmental law, it concerns the preservation or restoration of ecological conditions capable of sustaining life. Climate mitigation, adaptation, habitat restoration, water protection, biodiversity conservation and the reduction of toxic exposure are juridical expressions of ecological beneficence. They do not merely avoid damage. They preserve the material conditions under which freedom, health and social life can continue.

Non-maleficence becomes the duty not to cause serious, irreversible or cumulative ecological harm. The principle is broader than the prohibition of direct injury. Environmental harm is frequently delayed, diffuse, transboundary and probabilistic. It may emerge through accumulation rather than through a single identifiable act. Environmental law therefore extends non-maleficence into prevention and precaution. Justice, finally, becomes environmental justice. It includes distributive justice, because environmental burdens are unequally distributed; procedural justice, because affected communities must be heard; corrective justice, because polluters must repair harm; and intergenerational justice, because present decisions may bind persons who cannot participate in them.

3. The Precautionary Principle as Environmental Bioethics in Legal Form

The precautionary principle is one of the most precise legal expressions of environmental bioethics. It is based on a simple but demanding proposition: lack of full scientific certainty must not be used as a reason for postponing protective action where there is a risk of serious or irreversible harm. Principle 15 of the Rio Declaration states this in global environmental terms, while Article 191(2) TFEU places precaution, prevention, rectification at source and the polluter pays principle among the foundations of European Union environmental policy. [3]

The ethical force of precaution lies in its treatment of ignorance. Traditional regulation often acts only after harm has been demonstrated with adequate certainty. Precaution gives legal significance to plausible danger before damage becomes irreversible. It does not reject science. It rejects the legal assumption that scientific

uncertainty should automatically benefit the activity creating the risk. The distribution of uncertainty becomes a question of justice. Where an activity is profitable for some but may impose severe ecological risks on others, law must examine who controls the evidence, who benefits from delay and who will bear the burden if the risk materializes.

Precaution is especially important in environmental biotechnology, synthetic biology, chemical regulation, climate intervention, marine pollution and biodiversity loss. These fields are marked by systemic uncertainty. Damage may be non-linear, cumulative and difficult to reverse. A precautionary legal order is therefore not hostile to innovation. It requires prior assessment, proportionality, transparency, monitoring, reversibility where possible and periodic review. The objective is not paralysis but disciplined permission: technology may proceed only under conditions that make ecological responsibility legally enforceable.

4. Intergenerational Justice and the Temporal Structure of Environmental Duties

Environmental bioethics places future generations at the centre of legal reasoning. Future persons do not vote, litigate, participate in administrative consultations or negotiate market exchanges. Yet they may inherit climate instability, biodiversity collapse, contaminated soils, depleted aquifers or genetic erosion. The UNESCO Declaration on the Responsibilities of the Present Generations Towards Future Generations formulates this temporal duty by requiring present generations to safeguard the needs and interests of future generations and to preserve life on Earth.[4]

Intergenerational justice changes proportionality. A project may be profitable, useful or politically attractive in the short term and still be legally defective if it transfers irreversible ecological costs to the future. Proportionality must therefore examine the duration of harm, the reversibility of damage, the substitutability of the affected resource, the feasibility of restoration and the burden imposed on persons who did not participate in the decision. Short-term balancing is inadequate where the affected interest is the ecological freedom of the future.

Climate law is the strongest contemporary example. Greenhouse gas emissions are cumulative, and delay narrows future options. The Paris Agreement gives legal expression to this temporal logic by setting the objective of holding the increase in global average temperature well below 2 degrees Celsius and pursuing

efforts to limit it to 1.5 degrees Celsius, while requiring parties to prepare and maintain nationally determined contributions. The ethical problem is not only that present generations may harm future generations. It is that they may consume the regulatory and ecological space within which future generations could choose their own policies. [5]

5. Biodiversity, Intrinsic Value and the Limits of Human Dominion

Biodiversity law reveals the tension between anthropocentric and ecocentric reasoning. The Convention on Biological Diversity combines conservation of biological diversity, sustainable use of its components and fair and equitable sharing of benefits arising from genetic resources. The structure is hybrid. Biodiversity is protected because it supports human societies, but it is not exhausted by utility. Species, habitats, genetic variability and ecological functions have a significance that cannot be reduced to immediate economic use. [6]

Environmental bioethics deepens this legal framework by questioning the assumption that nature exists only as material for human projects. Law need not resolve all philosophical debates about intrinsic value in order to protect biodiversity. It is sufficient to recognize that purely instrumental reasoning fails where destruction is irreversible and where the full ecological significance of loss is unknown. The disappearance of a species, the fragmentation of habitat or the narrowing of genetic diversity cannot always be priced, replaced or restored.

This has direct legal consequences. Environmental assessment should not treat biodiversity as a secondary parameter. It must examine cumulative effects, habitat fragmentation, genetic diversity, ecological connectivity, ecosystem services and restoration feasibility. The International Court of Justice has held that an environmental impact assessment may be required under general international law where there is a risk of significant transboundary harm, while the precise content of that assessment is determined by domestic law or by the authorization process. The bioethical point is that a decision affecting life systems is not legitimate merely because an authority has formal competence. It must be informed, reasoned and open to scrutiny.[7]

6. Environmental Bioethics, Human Rights and Vulnerability

Environmental harm is rarely distributed evenly. Poor communities, indigenous peoples, children, elderly persons, persons with disabilities, workers,

coastal populations and communities dependent on natural resources often bear a disproportionate burden. Environmental bioethics therefore intersects with human rights law. The United Nations General Assembly recognized the right to a clean, healthy and sustainable environment in Resolution 76/300 of 28 July 2022. Even where such recognition does not operate in the same way as a directly enforceable constitutional right, it influences interpretation, legislation and the understanding of state duties.[8]

The human rights dimension does not reduce environmental protection to individual subjectivity. It shows that ecological degradation affects the conditions of rights. Life, health, private and family life, home, water, food, housing, culture and property may all be impaired by environmental degradation. The European Court of Human Rights has now incorporated climate-related harm into the protective scope of Article 8 ECHR, holding in *Verein KlimaSeniorinnen Schweiz and Others v Switzerland* that Article 8 encompasses a right to effective protection by state authorities from serious adverse effects of climate change on life, health, well-being and quality of life. [9]

Vulnerability is central. Formal equality may conceal unequal exposure and unequal capacity to adapt. A neutral industrial permit, waste facility, transport project or extraction plan may be ethically and legally defective if it concentrates burdens on already disadvantaged communities or excludes affected persons from decision-making. Environmental bioethics therefore supports environmental justice, anti-discrimination analysis, access to justice, participatory guarantees and the integration of vulnerability into impact assessment.

7. Biotechnology, Ecological Intervention and Legal Restraint

The most difficult problems of environmental bioethics arise where technology promises ecological benefit while creating new forms of environmental risk. Biotechnology, synthetic biology, gene drives, assisted migration of species, carbon removal and climate engineering all illustrate this tension. The law must avoid two errors. The first is technological optimism, which assumes that any environmental problem can be solved by further intervention. The second is technological paralysis, which rejects intervention even where ecological degradation is already severe and inaction itself causes harm.

The Cartagena Protocol on Biosafety is important because it places living modified organisms within a legal structure of advance informed agreement, risk

assessment, risk management and precaution. Its logic is not that biotechnology is unlawful. Its logic is that the transboundary movement and environmental release of living modified organisms require a framework capable of addressing uncertainty, ecological interaction and long-term effects. In this sense, biosafety law is a concrete branch of environmental bioethics. [10]

The same reasoning applies to emerging climate and biodiversity technologies. A legal system committed to environmental bioethics must ask not only whether a technology works, but who decides, who benefits, who bears the risk, whether alternatives exist, whether the intervention can be reversed, and whether it creates permanent dependence on technological management of nature. Ecological intervention is not illegitimate as such. It becomes legitimate only when embedded in legality, transparency, proportionality, democratic accountability and continuing review.

8. Animal Life, Sentience and Ecological Protection

Environmental bioethics also requires attention to animal life. Environmental law has traditionally protected animals through species conservation, habitat protection and biodiversity instruments. Bioethics adds another dimension: animals are not only ecological units or components of biodiversity, but living beings capable of suffering. European Union primary law expressly requires the Union and the Member States, when formulating and implementing specified policies, to pay full regard to animal welfare requirements because animals are sentient beings. [11]

This does not collapse animal welfare law into environmental law. The two fields have different objects and techniques. Yet their separation is incomplete. Habitat destruction, intensive farming, wildlife trade, pollution, climate change and ecosystem degradation affect both biodiversity and animal welfare. A coherent legal order cannot protect species while ignoring systematic suffering, nor can it protect individual animals while disregarding the ecological systems on which their lives depend.

The legal difficulty is institutional. Environmental law often operates at the level of populations, habitats and ecosystems. Animal welfare law often operates at the level of individual treatment. Environmental bioethics requires mediation between these levels. It resists both an abstract ecocentrism that disregards suffering and a narrow individualism that ignores ecological relations.

9. The Legal Architecture of Environmental Bioethics

An environmental bioethical legal order rests on five elements. First, it recognizes ecological dependence. Human dignity, health, autonomy and private life presuppose functioning ecosystems. Environmental protection is therefore not external to rights protection but part of its material foundation. Secondly, it integrates uncertainty. Law must be able to act before ecological damage becomes certain, especially where harm may be serious, irreversible or cumulative.

Thirdly, it protects the voiceless. Future generations, non-human life and ecosystems cannot defend themselves through ordinary political channels. Legal institutions must therefore create representation through public interest litigation, duties of trusteeship, participatory rights, independent assessment, ombud institutions and judicial review. Fourthly, it distributes burdens fairly. Environmental law must examine not only aggregate welfare but also who suffers, who profits and who is excluded.

Fifthly, it subjects power over life systems to justification. Scientific capacity does not automatically create legal permission. A state, corporation or research body may possess the technical ability to transform ecological conditions without possessing the normative authority to do so unilaterally. Environmental bioethics therefore demands a law of justified intervention: necessity, suitability, proportionality, transparency, accountability and restoration must structure the exercise of power over living systems.

The result is a more demanding understanding of environmental law. It is not only a set of administrative permits, emission limits and conservation rules. It is the legal organization of human responsibility for the conditions of life. Environmental bioethics supplies the grammar of that responsibility by connecting

ecological integrity, human rights, intergenerational justice, scientific uncertainty, animal life and democratic legitimacy within a single normative field.

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