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ASSESSING AND COMPENSATING ENVIRONMENTAL DAMAGE: INTERNATIONAL LEGAL FOUNDATIONS AND CHALLENGES

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Abstract: This article analyzes the international legal foundations for assessing and compensating environmental damage and examines the principal problems in this area. The study reviews various forms of environmental damage, methodologies for their assessment, and the current state of compensation mechanisms. Based on an analysis of international case law, the paper identifies shortcomings in contemporary international environmental law and suggests potential ways to address them. The article emphasizes state responsibility in environmental matters, the polluter-pays principle, and the importance of compensation funds.

Keywords: environmental damage assessment, ecological compensation, transboundary damage, international environmental law, state responsibility, polluter-pays principle.

With the intensifying global character of environmental problems in the twenty-first century, the assessment of environmental damage and compensation for transboundary ecological harm have become among the most pressing fields of international law. Today humanity faces serious ecological challenges. Although individuals, states, and the international community are aware of environmental safety requirements, violations are increasingly frequent. As a result, the relationship between nature and humanity is being undermined. Industrial development, technological progress, and urbanization have increased both the scale and complexity of environmental harm.

Assessing and compensating environmental damage is not merely a technical-economic issue; it is a complex process encompassing deep legal, political, and ethical dimensions. In international law, this issue requires balancing state sovereignty with the obligation to protect the environment.

At present, there is no single internationally agreed methodology for assessing environmental damage. This absence creates significant theoretical and practical problems.

INTERNATIONAL LEGAL FOUNDATIONS FOR ASSESSING ENVIRONMENTAL DAMAGE

In international law, the concept of "environmental damage" is discussed, inter alia, in the International Law Commission's 2001 Draft Articles on the Responsibility of States for Transboundary Harm Arising out of Hazardous Activities, which interprets it as follows:

"Environmental damage" is any change to the physical, chemical, or biological condition of the natural environment that has an adverse effect, impairs its ecological functions, or harms human health.

German jurist Hans Jonas, in his work *The Imperative of Responsibility*, stressed that modern technological development imposes a moral responsibility on humanity toward future generations. This perspective highlights the temporal dimension in environmental damage assessment. While technology provides many conveniences, it also poses risks to the environment, leading to degradation and loss of natural assets.

STANDARDS AND METHODOLOGIES FOR ASSESSMENT

Currently there is no single international standard for assessing environmental damage. The main widely used methods include:

Restoration Cost Method — evaluates damage based on the cost required to restore degraded environmental objects. This method estimates the expenses necessary to return natural resources and ecosystems to their pre-damage condition. However, it cannot be universally applied to all environmental harms because ecosystems and natural resources differ significantly. For example, soil fertility and climate change cannot be assessed by the same approach. Some ecosystems are effectively irreversible or require a very long time to recover.

Restoration costs vary greatly depending on factors such as:

- passive (natural regeneration) versus active (e.g., tree planting) restoration methods;
- implementation techniques (e.g., mechanized versus manual work, use of herbicides);
- species used (e.g., fast-growing pioneer species versus costly seeds of conservation-important species);
- the degree of site preparation needed; and
- the duration of maintenance required during the project.

Despite these difficulties, accurate and reliable financial data on restoration costs are essential. Such data support planning and management of restoration programs and can attract private sector investment.

Economic Valuation Methods — monetize ecosystem services and other environmental benefits to express damage in monetary terms. Economic valuation is increasingly used across health, transport, and environmental sectors. The number of valuation methods has grown as stakeholders—including corporations, governments, and researchers—demand economic values for environmental goods. For example, the World Bank conducted multiple projects on environmental economic valuation between 2000 and 2003. Historic environmental disasters, such as the 1989 Exxon Valdez oil spill in Prince William Sound, Alaska, highlighted the need to assign economic values to environmental assets like birds and biodiversity when evaluating cleanup benefits—values that were often absent at the time.

Overall, valuing environmental assets presents one of the most urgent and complex challenges in environmental economics. Why express natural resources in monetary terms? Four main reasons can be cited:

- to carry out cost-benefit analyses;
- to prepare environmental accounts;
- to quantify damage to natural resources; and

- to set appropriate prices.

Mitigation (Avoidance / Damage Alleviation) Approach — estimates the costs of measures directed toward preventing and reducing damage. This method focuses on actions for restoration or mitigation and the expenses associated with them.

U.S. legal scholar Richard B. Stewart has emphasized that each method has specific advantages and disadvantages and that local conditions must be taken into account. I concur: each ecosystem and natural asset performs distinct functions, and some are non-renewable, making both assessment and compensation difficult or impossible in practical terms.

INTERNATIONAL PRACTICE OF COMPENSATION MECHANISMS

One major contemporary example of environmental damage on a mass scale is the ecological harm resulting from the Russia-Ukraine war, which threatens ecological security not only for the two countries but for the wider world. Since the large-scale hostilities began in February 2022, many actors have undertaken or are undertaking assessments of environmental impacts. The United Nations Development Programme (UNDP), with support from the Government of Sweden, launched a project to establish a coordinating center for environmental damage assessment in Ukraine, aiming to monitor and document the nature, scale, and significance of conflict-related environmental impacts and to mitigate long-term ecological disaster risks.

The project's overall goal is to assist relevant state bodies, including the State Environmental Inspectorate and the Ministry of Environmental Protection, in developing the normative and institutional infrastructure and technical capacity to document and collect evidence of environmental harm— including gender-responsive assessments. One objective is to help develop the necessary legislation and practical mechanisms for collecting evidence across Ukraine in the aftermath of Russian aggression.

The war in Ukraine has devastated cities, caused mass casualties, destroyed infrastructure, and produced severe environmental consequences. According to the Ukrainian Ministry of Environmental Protection and Natural Resources, over 30 percent of more than 1.2 million hectares of protected areas have been affected by military activities. Widespread forest fires, attacks on fuel and industrial facilities leading to chemical contamination of rivers and groundwater, and the creation of toxic legacies that endanger future generations have been reported.

Project experts contribute to developing effective methodologies, legislative frameworks, and technical capacities to document environmental damage caused by the invasion. Gender-based assessments are carried out, and gender-disaggregated data are collected. Awareness-raising campaigns inform the public and stakeholders about project activities and environmental issues. Certified mobile stations for measuring environmental parameters have been procured.

In international environmental law, customary rules and treaty obligations establish certain environmental duties, but there is no comprehensive international legal instrument that strictly prescribes methods for damage assessment, compensation, and restoration. One of the most widely recognized principles is the **polluter-pays principle**.

APPLICATION OF THE POLLUTER-PAYS PRINCIPLE

The **Polluter-Pays Principle** was first formally articulated by the Organisation for Economic Co-operation and Development (OECD) in 1972. Under this principle, the person or state responsible for pollution bears the costs of remedying the environmental harm and compensating damages.

French jurist Michel Prieur described this principle as "one of the fundamental rules of modern environmental law." However, its practical application faces several problems:

- difficulty in identifying pollution sources;
- cumulative impacts that produce harm; and
- disparities in states' economic capacities.

Identifying the polluter is challenging because it requires scientific substantiation and can be time-consuming and resource-intensive. Furthermore, differences in states' economic capabilities—between developed and developing countries—affect the implementation of obligations and material liability; developing states may lack resources to undertake extensive restoration or to pay compensation.

Bilateral agreements on transboundary environmental harm are common in practice and are often more effective than multilateral instruments. Bilateral agreements enable neighbor states to tailor responses to local conditions. A notable example is the 1991 Canada–United States Air Quality Agreement on transboundary air pollution, often cited as a successful model.

Canadian lawyer John Swaigen highlighted the advantages of such agreements:

- mechanisms for prompt resolution;
- ability to account for local conditions; and
- preservation of diplomatic relations.

Multilateral compensation funds are another effective approach. Examples include:

- the International Oil Pollution Compensation Funds (IOPC Funds), established in 1971 to compensate for damage from oil pollution of the marine environment; and
- various international funds established for the aftermath of the 1986 Chernobyl nuclear disaster.

English scholar P. Sand emphasized the importance of these funds, noting that as collective liability mechanisms they can be more effective than relying solely on individual states' capacities.

Insurance systems play an increasing role in compensating environmental damage. The German Environmental Liability Act of 1990 was a pioneering statute in this field. German jurist Klaus Lange analyzed its features and noted its significance in facilitating causation proof and broadening liability regimes.

Arbitral Practice: Trail Smelter (United States/Canada, 1938–1941)

The Trail Smelter dispute arose from sulfur dioxide emissions from a smelter in Trail, British Columbia, affecting agricultural lands and forests in the State of Washington, USA. U.S. farmers and residents lodged complaints, and the United States brought the matter to Canada. The arbitration was one of the earliest international decisions addressing transboundary environmental harm and state responsibility.

The tribunal recognized Canada's responsibility for the pollution originating from its territory and ordered compensation. It specified amounts for damages occurring up to certain dates and required measures to prevent future harm. The Trail Smelter decision is widely regarded as a classical precedent in transboundary environmental law. U.S. scholar Edith Brown Weiss characterized it as a paradigmatic case.

CONTEMPORARY CHALLENGES AND SOLUTIONS

Key problems in assessing environmental damage include scientific uncertainty—given the complex dynamics of ecosystems—and difficulties in assigning monetary value to natural resources and ecosystem services. As ecologist Eugene Odum noted, an ecosystem is a dynamic system where a change in one component affects the whole system.

Legal scholar X.M. Yunusov has observed that the absence of a universally accepted definition of environmental damage complicates determining its nature and the criteria for compensation. Indeed, differences among ecosystems and the non-renewable nature of some resources make precise economic valuation and compensation impracticable in many cases.

Deficiencies in international environmental law

- **Jurisdictional issues:** Unclear which courts or tribunals have competence over transboundary damage disputes.
- **Weak enforcement mechanisms:** International court decisions often lack robust enforcement structures.
- **Insufficient preventive measures:** Existing legal frameworks focus largely on compensation rather than effective prevention.

Italian jurist Tullio Treves links these problems to the "institutional weakness" of international environmental law.

Proposed solutions

- **Establishment of a specialized International Environmental Court:** Many scholars support creating an institution specialized in transboundary ecological disputes. Dutch jurist Philippe Sands argues that such a court would be justified by the complexity and international nature of modern environmental challenges.
- **Creation of a global compensation fund:** A fund with universal state participation could finance environmental damage remediation. Potential revenue sources include mandatory state contributions, payments from international corporations, and environmental taxes.
- **Implementation of preventive liability mechanisms:** Require entities engaged in potentially hazardous activities to provide financial guarantees (e.g., security deposits or insurance) prior to commencing operations.

CONCLUSION

Assessing and compensating environmental damage is among the most complex and urgent fields of international law. The study's conclusions are as follows:

1. **Theoretical foundations:** No single internationally accepted methodology for assessing environmental damage exists. Although the polluter-pays principle is widely recognized, its practical application faces significant obstacles.
2. **Practical mechanisms:** Bilateral agreements and multilateral funds have demonstrated some effectiveness, but they are insufficient to resolve global problems comprehensively. Specialized funds such as the IOPC Fund have produced positive results within their mandates.
3. **Judicial practice:** Decisions by the International Court of Justice, arbitral tribunals, and regional courts have significantly contributed to the development of legal norms on environmental assessment and compensation; however, enforcement of such decisions remains problematic.
4. **Contemporary problems:** Scientific uncertainty, methodological shortcomings, and legal gaps hinder the creation of effective compensation mechanisms.

The priorities for the future development of international environmental law include:

- developing a unified international methodology for damage assessment;
- creating a specialized international judicial system;
- establishing global compensation mechanisms;
- strengthening preventive measures; and
- enhancing interstate cooperation.

Given the global nature of environmental challenges, solutions require coordinated efforts by states.

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