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Methodological Approaches and Instruments for Assessment of Environmental Harm to The Natural Environment in Conditions of Armed Conflicts: International Legal Dimension

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Abstract

This article examines methodological and legal approaches to assessing environmental damage caused during armed conflicts. It argues that wartime environmental assessment differs fundamentally from peacetime monitoring because of the dynamic nature of hostilities, fragmented information, destroyed monitoring infrastructure, and security risks for specialists. The study substantiates the need to apply systems-based and ecosystem-oriented approaches that view the environment as an interconnected whole rather than as a set of isolated natural components. Particular attention is given to component-specific and ecosystem indicators, including air, water, soil, biodiversity, ecosystem resilience, and public health parameters. The article also analyzes the complementary use of field and laboratory methods, satellite imagery, geographic information systems, and unmanned aerial vehicles. It concludes that international law is moving toward a scientifically grounded and interdisciplinary model for environmental damage assessment, although its implementation remains constrained by limited access to affected territories, insufficient methodological standardization, and the absence of a specialized international post-conflict assessment mechanism.

Keywords: Environmental damage; armed conflict; international environmental law; ecosystem approach; environmental assessment; remote sensing.

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1. Introduction

The assessment of environmental damage caused to the natural environment in the context of armed conflicts constitutes a distinct field of scientific and practical inquiry at the intersection of environmental science, engineering diagnostics, and international law. Unlike routine environmental monitoring in peacetime, where the object of observation is relatively stable and state control systems remain operational, wartime assessment is associated with fundamentally different challenges: the rapidly changing nature of the situation, the fragmented character of available information, the destruction or degradation of monitoring infrastructure, and direct risks to the lives and safety of specialists. At the same time, the results of such assessments subsequently provide an evidentiary basis for legal responses, including the proof of violations of international obligations, the substantiation of

compensation claims, and the qualification of conduct under international criminal law.

As A.S. Fadeev rightly observes in Modern Military Conflicts and Prospects for the Development of Methods of Warfare, under peaceful conditions the object of environmental assessment is relatively stable, state and industrial monitoring systems function, and environmental changes usually occur gradually. Armed conflict, by contrast, fundamentally alters this situation: impacts are serial, multifactorial, and frequently chaotic; the affected territory is constantly shifting; and ordinary procedures for collecting evidence and calculating damage become manifestly insufficient. In legal terms, this means that standard approaches to establishing causal links and determining the extent of damage must be substantially adapted to the specific characteristics of the wartime context.

In our view, the starting point for any methodologically sound assessment of environmental damage under such conditions should be an understanding of the environment not as a set of isolated components, but as a complex system of interrelated elements. This perspective lies at the core of the systems approach, within which an impact on one environmental component, such as the contamination of a water body, must necessarily be examined in connection with its consequences for other components, including soil, vegetation, wildlife, and public health.

As A.A. Nazarov notes in International Legal Protection of the Environment during the Conduct of Hostilities, the systems approach makes it possible to overcome the fragmented nature of assessment and to establish how damage to one element of the natural environment extends to adjacent ecosystem components and ultimately affects the living conditions of the population. This proposition is especially significant in the context of armed conflict, where environmental impacts are generally simultaneous, cumulative, and mutually reinforcing.

A logical development of this perspective is the ecosystem approach. According to G.A. Fomenko, author of The Ecosystem Approach in Territorial Management of Natural Resource Use and Environmental Protection, this approach assesses environmental harm through the functional characteristics of ecosystems, including biogeochemical cycles, productivity, resilience to stress, and capacity for self-recovery. It appears justified to argue that the ecosystem approach provides the most adequate framework for understanding that armed conflict may disrupt not only individual natural objects, but also the integral mechanisms through which natural systems function. The restoration of such mechanisms may require decades.

The international legal significance of both approaches is difficult to overstate. Many existing instruments, including the Draft Principles of the United Nations International Law Commission on the Protection of the Environment in Relation to Armed Conflicts, use categories such as “long-term” and “severe” damage. The assessment of such categories is practically impossible without taking systemic and ecosystem interconnections into account. In other words, the very structure of legal criteria for environmental damage implicitly presupposes the use of a methodology that goes beyond component-by-component analysis.

The interdisciplinary nature of assessment logically follows from the systems-based and ecosystem-oriented perspective. As convincingly demonstrated in M. Zgurovsky’s work The Impact of Armed Conflicts on Planetary Environmental Security, a comprehensive assessment requires the simultaneous use of methods from several scientific fields. From the natural-scientific perspective, the methods of ecology, geography, hydrology, soil science, geochemistry, and ecotoxicology are employed. The technical component includes engineering diagnostics, satellite image processing, geographic information systems, and modelling of pollution dispersion. Social and medico-social methods, in turn, make it possible to take into account increases in morbidity, changes in economic activity, and deterioration in the quality of life of the affected population.

This interdisciplinary approach corresponds to contemporary trends in international environmental law. The United Nations Framework Convention on Climate Change, for example, proceeds from the need for a scientifically grounded assessment of anthropogenic impacts on the climate system and the use of complex monitoring systems, which likewise presupposes the integration of methods from different scientific disciplines. In the context of armed conflicts, however, the results of interdisciplinary assessment acquire direct legal significance, since they serve as the basis for confirming violations, substantiating causal links, and calculating compensable losses.

The practical implementation of the methodological approaches outlined above is impossible without a developed system of indicators. In the context of international law, such indicators perform a dual function: they ensure the quantitative and qualitative recording of harm and, at the same time, provide the basis for its legal qualification.

With regard to atmospheric air, as shown in K.R. Garaeva's work Monitoring Sources of Atmospheric Air Pollution, the key indicators include concentrations of suspended particulate matter, nitrogen and sulphur oxides, hydrocarbons, combustion products, and specific toxic substances released as a result of the destruction of industrial facilities. In this context, both background pollution and local concentration peaks associated with fires, explosions, or industrial accidents must be taken into account. At the international legal level, the obligation to conduct such monitoring follows, in particular, from the Convention on Long-Range Transboundary Air Pollution, which provides for the establishment of monitoring systems based on regular sampling and standardized methods of analysis.

For surface water and groundwater, according to N.A. Sokolova, author of Water Resources: International Legal Protection during Armed Conflicts, the relevant indicators include the content of petroleum products, heavy metals, persistent organic pollutants, suspended solids, and microbiological parameters. Particular importance is attached to identifying pollution hotspots caused by the destruction of wastewater treatment facilities, dams, pipelines, and other hydraulic or industrial infrastructure. These indicators correspond to the obligations set out in the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. The Protocol on Water and Health to that Convention additionally links the sanitary and hygienic parameters of water to the protection of public health, thereby strengthening the medico-social dimension of assessment.

The condition of the soil cover, as shown in O.A. Gordienko's work The Impact of Military Operations on Soils, is assessed on the basis of toxicant content, signs of erosion and degradation, changes in the structure of the soil profile, the presence of technogenic deposits, and mechanical disturbances. In areas of intensive hostilities, remnants of ammunition and weapon fragments constitute an important indicator, since they create a long-term risk of secondary contamination. Although there is no specialized international treaty devoted exclusively to soil protection, a number of environmental agreements, including the Convention on Biological Diversity and the United Nations Convention to Combat Desertification , indirectly imply the use of soil indicators as a basis for developing ecosystem conservation measures. For law-enforcement purposes, it is fundamentally important that such data make it possible to distinguish ordinary technogenic pollution from the specific consequences of military operations, which is essential for the qualification of violations of international obligations.

In addition to component-specific indicators, indicators characterizing the condition of ecosystems as integral formations are acquiring independent and steadily increasing significance. As V.A. Chernov notes in Ecosystem Changes in the Structure of Socio-Economic Relations, structural indicators include biodiversity parameters: the number of species, changes in species composition, the ratio between dominant and rare species, and the destruction or fragmentation of habitats. Functional indicators, in turn, reflect the ability of ecosystems to perform key natural functions, including biomass production, regulation of the water regime, maintenance of environmental quality, and provision of migration routes. In the context of international law, these indicators acquire decisive importance, since they may serve as the basis for assessing whether the damage caused meets the criteria of being "widespread," "long-term," and "severe," as enshrined in Articles 35 and 55 of Additional Protocol I to the Geneva Conventions. Without ecosystem indicators, such an assessment would inevitably remain incomplete.

Moving from indicators to the direct means of obtaining them, three principal groups of instruments should be distinguished, each possessing its own capabilities and limitations in the context of armed conflict.

Traditional field and laboratory methods, as V.I. Veklenko indicates in Management and Control Instruments for Combating Environmental Pollution, include the sampling of air, water, soil, vegetation, and living organisms, followed by chemical, physicochemical, biological, and microbiological analysis. Laboratory tests using test organisms make it possible to assess the potential danger of pollutants to ecosystems, while the condition of certain species of plants, invertebrates, and fish may serve as an indicator of long-term pollution. At the same time, in zones of active hostilities, the application of these methods is sharply limited by security risks and the physical

inaccessibility of territories.

It is precisely because of these limitations that remote sensing tools acquire special importance. As A.Yu. Bryukhanov notes in Methodological Approaches and Basic Principles for Assessing Environmental Damage, satellite imagery makes it possible to identify infrastructure destruction, fire hotspots, oil spills, areas of deforestation, and vegetation degradation, while ensuring the relative safety of specialists and the rapid acquisition of data. At the level of international law, remote-sensing results are increasingly recognized as admissible evidence, including in the practice of international judicial and quasi-judicial bodies.

The use of unmanned aerial vehicles makes it possible to obtain more detailed information at the local level and to collect up-to-date data on hard-to-reach and potentially dangerous areas. According to a report of the United Nations Environment Programme, a drone may serve as a low-cost and minimally invasive tool for environmental management specialists, while its maneuverability and the high quality of the images obtained make it an effective instrument of environmental monitoring. In our view, in the context of armed conflicts, this tool can substantially narrow the gap between the need for current environmental information and the physical impossibility of conducting ground-based surveys.

It should be emphasized, however, that none of the instruments listed above is self-sufficient. Satellite data provide a general picture but do not allow the chemical composition of pollutants to be established. Drones provide local detail but cannot replace laboratory analysis. Field studies are the most informative, yet they are often the least accessible under conflict conditions. Accordingly, the key methodological requirement is the complementarity of instruments: their mutually reinforcing use depending on the phase of the conflict, the nature of the affected territory, the type of environmental harm, and the resources available.

Reference to international instruments confirms that modern law demonstrates a stable tendency toward the normative consolidation of the obligation to conduct scientifically grounded and comprehensive assessments of environmental damage. At the level of existing treaties, such an obligation is reflected in a number of specialized conventions, ranging from the Convention on Long-Range Transboundary Air Pollution to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Although these treaties were developed primarily for peacetime conditions, the obligations contained therein, according to most scholars, do not automatically cease to apply upon the outbreak of an armed conflict. As N.A. Sokolova emphasizes in International Protection of the Environment during Armed Conflicts: Traditions of Legal Regulation and New Approaches to Interpretation, this approach is substantiated through the concept of the continuing nature of states' environmental obligations.

At the level of soft-law instruments, particular attention should be paid to the Draft Principles of the United Nations International Law Commission, which emphasize the importance of an interdisciplinary approach, consideration of both immediate and delayed consequences of environmental impact, and the use of all available sources of data, from remote information-gathering tools to local field observations. Although this document is not legally binding, it shapes the doctrinal framework and offers guidelines that may serve as a basis for future codification.

Thus, the study conducted makes it possible to conclude that the assessment of environmental damage in the context of armed conflicts constitutes a complex interdisciplinary task. Its methodological foundation should be formed by systems and ecosystem approaches, which allow the natural environment to be examined as an integral and interconnected system. A system of component-based and ecosystem indicators not only ensures the recording of damage, but also serves as the basis for its qualification under international law. Detection tools, ranging from traditional laboratory methods to remote sensing and unmanned aerial vehicles, should be applied complementarily, taking into account the specific features of each situation. A review of international treaties and the work of the United Nations International Law Commission confirms that the international community is moving toward a comprehensive, scientifically grounded assessment model oriented toward the consideration of both immediate and delayed consequences and the restoration of damaged ecosystems. At the same time, the practical implementation of this model continues to be constrained by limited access to conflict-affected territories, insufficient standardization of methodologies, and the absence of a specialized international mechanism capable of ensuring systematic post-conflict environmental assessments and the effective use of their results in legal proceedings.

References

- **Academic literature:**

1. Брюханов А.Ю. «Методологические подходы и основные принципы оценки экологического ущерба», Журнал «АгроЭкоИнженерия», 2006г., с.13-18;
2. Векленко В.И. «Инструменты управления и контроля по борьбе с загрязнением окружающей среды», Журнал «Вестник Курской государственной сельскохозяйственной академии», 2019г., с.93-104;
3. Гараева К.Р. «Мониторинг источников загрязнения атмосферного воздуха», Журнал «Молодой ученый», 2023г., с.5-11;
4. Гордиенко О.А. «Влияние военных действий на почвы», Журнал «Эко вектор», 2025г., с.1354-1366;
5. Згуровский М. «The Impact of Armed Conflicts on Planetary Environmental Security», Книга «Studies in Systems, Decision and Control», 2025г., с.1-19;
6. Назаров А.А. «Международно-правовая защита окружающей среды в условиях проведения боевых действий», Журнал «Молодой исследователь Дона», 2020г., с.118-120;
7. Соколова Н.А. «Международная защита окружающей среды в период вооруженных конфликтов: традиции правового регулирования и новеллы толкования», Журнал «Lex Russica», 2021г., с.84-95;
8. Соколова Н.А. «Водные ресурсы: международно-правовая защита в период вооруженных конфликтов», Журнал «Lex Russica», 2024г., с.117-125;
9. Фоменко Г.А. «Методы оценки экологических ущербов», учебно-методическое пособие / Г.А. Фоменко, М.А. Фоменко, К.А. Лошадкин. — Ярославль: АНО НИПИ «Кадастр», 2012. — 140 с.;
10. Чернов В.А. «Экосистемные изменения структуры социально-экономических отношений», Журнал «Мир новой экономики», 2022г., с.113-124;
11. Фадеев А.С. «Военные конфликты современности, перспективы развития способов их ведения. Прямые и непрямые действия в вооруженных конфликтах 21 века», Журнал «Военная мысль», 2019г., с.33-41;
12. Фоменко Г.А. «Экосистемный подход в территориальном управлении природопользованием и охраной окружающей среды», Журнал «Проблемы региональной экологии», 2018г., с.50-66.

- **International legal instruments:**

1. Draft Principles on the Protection of the Environment in Relation to Armed Conflicts, with Commentaries, 2022.
2. United Nations Convention on Long-Range Transboundary Air Pollution, 1979.
3. Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 1992.
4. Protocol on Water and Health to the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes.
5. United Nations Convention on Biological Diversity, 1992.
6. United Nations Convention to Combat Desertification, 1994.
7. Additional Protocol to the Geneva Conventions relating to the Protection of Victims of International Armed Conflicts, 8 July 1977.
8. United Nations Convention on the Protection and Use of Transboundary Watercourses and International Lakes, 1992.
9. United Nations Framework Convention on Climate Change, 1992.