

THE LIABILITY FOR ENVIRONMENTAL DAMAGE IN THE GLOBAL CLIMATE CRISIS

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Abstract

The article carries out a comprehensive study of the problem of environmental liability in the context of the global climate crisis, which currently determines the strategic guidelines for the development of international environmental law. The essence and content of environmental liability as a systemic tool for legal response to damage caused to the natural environment, in particular as a result of military actions, is determined. The main trends in the evolution of legal approaches to ensuring environmental safety and compensation for environmental damage in national and international law are revealed. Special attention is paid to the issue of post-war reconstruction of Ukraine, which is considered through the prism of the principles of sustainable development and "green reconstruction". The need to integrate environmental aspects into the strategy for the reconstruction of territories affected by hostilities, using international mechanisms for control, damage assessment, and financial compensation, is substantiated. The norms of international air law, in particular the Chicago Convention of 1944 and modern initiatives of ICAO, regulating transboundary emissions, aviation air pollution, and the participation of states in global climate agreements, are analyzed. It is emphasized that effective environmental responsibility in modern conditions should encompass not only classical legal forms (civil, administrative, criminal), but also international legal and quasi-



judicial responsibility of states and corporations. The results of the study allow us to conclude that the formation of an integrated system of environmental responsibility is a necessary condition for achieving environmental justice, ensuring global climate stability, and restoring the natural balance in the post-war period.

Keywords

Ecological responsibility, climatic crisis, post-war recovery, international air law, ecological security, constant development.

Resumo

O artigo realiza um estudo abrangente do problema da responsabilidade ambiental no contexto da crise climática global, que atualmente determina as diretrizes estratégicas para o desenvolvimento do direito ambiental internacional. São determinados a essência e o conteúdo da responsabilidade ambiental como ferramenta sistémica para a resposta jurídica aos danos causados ao ambiente natural, em particular como resultado de ações militares. São reveladas as principais tendências na evolução das abordagens jurídicas para garantir a segurança ambiental e a compensação por danos ambientais no direito nacional e internacional. É dada especial atenção à questão da reconstrução pós-guerra da Ucrânia, que é considerada através do prisma dos princípios do desenvolvimento sustentável e da «reconstrução verde». É fundamentada a necessidade de integrar os aspetos ambientais na estratégia de reconstrução dos territórios afetados pelas hostilidades, utilizando mecanismos internacionais de controlo, avaliação de danos e compensação financeira. São analisadas as normas do direito aéreo internacional, em particular a Convenção de Chicago de 1944 e as iniciativas modernas da ICAO, que regulam as emissões transfronteiriças, a poluição atmosférica da aviação e a participação dos Estados em acordos climáticos globais. É enfatizado que a responsabilidade ambiental efetiva nas condições modernas deve abranger não apenas as formas jurídicas clássicas (civil, administrativa, criminal), mas também a responsabilidade jurídica internacional e quase judicial dos Estados e das empresas. Os resultados do estudo permitem concluir que a formação de um sistema integrado de responsabilidade ambiental é uma condição necessária para alcançar a justiça ambiental, garantir a estabilidade climática global e restaurar o equilíbrio natural no período pós-guerra.

Palavras-chave

Responsabilidade ecológica, crise climática, recuperação pós-guerra, direito aéreo internacional, segurança ecológica, desenvolvimento constante.

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Introduction

Modern civilization is experiencing a period of profound ecological transformation, caused by the rapid deterioration of the natural environment and the intensification of the consequences of the global climate crisis. This process is accompanied by large-scale ecological, social and economic changes that call into question the sustainability of humanity's existence on the planet. Environmental responsibility in this context appears not only as a legal category, but as a systemic indicator of the readiness of the state and society for conscious coexistence with nature.

In the context of military operations, accompanied by the destruction of ecosystems, pollution of air, soil and water resources, the problem of environmental responsibility acquires particular importance. The war in Ukraine has led to an unprecedented level of environmental damage, which has affected both the national and global ecological balance. The destruction of industrial facilities, forest fires, air pollution by combustion products, leakage of chemical substances and destruction of infrastructure have created a new reality in which environmental safety has become a component of national security.

The post-war reconstruction of Ukraine requires a fundamentally new approach to environmental policy planning. It is not only about eliminating the consequences of environmental crimes, but also about building a system of "green" development, based on the principles of sustainability, resource efficiency and climate neutrality. In this process, it is important to integrate international legal standards of environmental



responsibility, in particular the norms of international air law that regulate anthropogenic impacts on the atmosphere and transboundary pollution.

It is worth noting that the international community is increasingly considering climate responsibility in a broader context – as a moral and legal obligation of states, corporations and citizens to future generations. In this sense, environmental responsibility goes beyond the classical legal mechanism and turns into a multi-level risk management system that includes legal, economic, technical and ethical tools.

The relevance of the topic is due to the need to find effective forms and mechanisms of environmental responsibility in the context of growing climate challenges, Ukraine's integration into the European legal space, and the implementation of national post-war recovery strategies. It is important to determine the limits of legal liability for environmental damage caused by military activities, as well as to harmonize legal approaches with international environmental protection standards.

Literature review

The problem of environmental liability of states and business entities for environmental damage is the subject of active scientific discussion in domestic and foreign legal, environmental and economic science. Modern research focuses on defining the essence of environmental liability, its role in the system of environmental law, mechanisms for implementing compensation for damage caused, and the development of models of sustainable environmental restoration in the context of the climate crisis.

Foreign authors Tahir et al. (2024), Kalfagianni and Young (2022) and Coelho et al. (2023) consider environmental liability through the prism of international environmental law, which is formed on the basis of the principles of "polluter pays" and "harm prevention". Their works emphasize that the effective implementation of these principles is key to ensuring environmental justice on a global scale.

Researchers Atadoga et al. (2024), Achmad and Yulianah (2022) emphasize that the modern concept of environmental responsibility is increasingly becoming global in nature, since environmental damage has a transboundary impact and requires collective efforts of states to prevent it. International climate agreements play a special role in this process: United Nations Framework Convention on Climate Change (United Nations, 1992b). Kyoto Protocol this the United Nations Framework Convention on Climate Change (United Nations, 1997) and Paris Agreement (United Nations, 2015), which define the legal framework for the responsibility of states for the climate consequences of their activities.

Domestic scientists Dolynska et al. (2023), Sydorova et al. (2024) and Markevych et al. (2022) examine environmental liability in the context of the development of the national system of environmental law in Ukraine. They emphasize the need to modernize the legislation in accordance with European standards, in particular Directive 2004/35/ EC (European Parliament & Council, 2004), which introduces the principle of full compensation for environmental damage.

In recent years, scientific works have been actively developing the concept of international legal responsibility of states for environmental offenses, including those



related to military activities (Kooijman, 2023; Minkova, 2023). Researchers point out that the destruction of the natural environment during armed conflicts is not only a humanitarian but also an ecological catastrophe, which requires the creation of special mechanisms for assessing damage and reparations.

In this context, considerable attention is paid to the issue of post-war ecological restoration. European and Ukrainian studies by Aliksieienko et al. (2023), Pereira et al. (2022) and Solokha et al. (2023) propose an approach according to which environmental restoration after armed conflicts should be carried out according to the principles of the "green transition" – with the integration of environmental, energy and climate goals. It is emphasized that environmental responsibility in the post-war period should include not only a compensatory, but also a restorative component aimed at the sustainable development of territories.

A significant body of scientific work concerns international air law as a component of the environmental regulation system. In the works Rahn et al. (2024), Ekici and Sohret (2021) and Balli and Caliskan (2021) consider the environmental aspects of aviation activities, in particular emission control mechanisms and the CORSIA implementation and market-based program measures (2022), developed by EASA (2022). The researchers note that international air law is increasingly integrated into the global climate governance system, forming the legal framework for reducing the impact of aviation on the atmosphere.

Ukrainian experts Ovdienko et al. (2021) and Smerichevskyi and Gura (2021) emphasize that Ukraine's inclusion in international aviation and climate programs is an important condition for fulfilling its obligations within the framework of the European Green Deal (European Commission, 2019, 2024). At the same time, the issue of legal liability for transboundary air pollution becomes particularly relevant in conditions of martial law, when the level of technogenic risks increases.

Foreign studies by Amorim-Maia et al. (2022) and Sardo (2023) also focus on the formation of principles of climate justice – a concept that assumes equal responsibility of states and corporations for the climate consequences of activities, as well as the need for legal protection of environmental human rights.

Thus, the analysis of scientific literature shows that the problem of environmental responsibility is considered in world science as a multi-level phenomenon, covering legal, political, economic and ethical aspects. In the conditions of post-war reconstruction of Ukraine, the issue of determining the volume of environmental damage, establishing responsibility for its infliction and developing mechanisms for environmental restoration becomes key in the process of integrating the state into the European and international legal space.

Materials and methods

The research is of a theoretical and analytical nature and is aimed at identifying methodological principles, trends and legal mechanisms for the formation of a system of environmental responsibility in the context of the global climate crisis. The main focus is on the analysis of the conceptual foundations of environmental law, international



regulations, approaches to compensation for environmental damage, as well as on substantiating the model of environmentally oriented post-war recovery of Ukraine.

In the process of work, the methods of theoretical analysis, synthesis, comparison, induction, deduction, systematization and generalization of scientific and regulatory sources were used, which allowed to identify the regularities of the development of the institute of environmental responsibility and determine the main directions of its evolution in the modern international legal space. The application of the comparative legal method made it possible to compare the provisions of the national environmental legislation of Ukraine with European directives and international agreements in the field of environmental protection.

Analysis of scientific works by Ukrainian and foreign researchers has shown that effective environmental responsibility requires the integration of legal, economic, managerial and ethical aspects, which ensure the transition from a punitive to a restorative model of environmental law. Such an approach makes it possible to combine the principles of "polluter pays" and "environmental justice", which is the basis for the formation of international environmental policy.

A comparative study of international acts was carried out according to the criteria of legal regulation of environmental responsibility, determination of subjects of obligations, compensation mechanisms and control over the implementation of environmental norms. The results obtained showed that the most effective are systems that combine national regulation with international monitoring and financial instruments (quotas, funds, climate compensations).

The study theoretically substantiates the concept of post-war ecological restoration as a component of the state policy of sustainable development. Its key components are identified as:

- legal consolidation of the obligation of the aggressor state to compensate for environmental damage;
- creation of a national register of environmental crimes;
- introduction of a system for assessing environmental damage taking into account international standards;
- development of "green" technologies and renewable energy in the process of territorial reconstruction.

To describe the functioning of the environmental liability system, systemic and structural-functional approaches were used, which made it possible to determine its main legal functions: preventive, aimed at preventing environmental damage by controlling environmentally hazardous activities; restorative, which involves compensation and restoration of natural resources after their degradation; regulatory, aimed at establishing legal norms and standards of environmental behavior; integration, to ensure interaction between national and international environmental institutions.

During theoretical modeling, a general framework for environmental responsibility was developed, which includes four key components:



1. Regulatory and legal – international agreements, laws, codes and by-laws.
2. Institutional – state bodies, international environmental courts, etc.
3. Procedural – the procedure for assessing, investigating, and compensating for environmental damage.
4. Socio-ethical – the formation of environmental awareness, a culture of responsibility and climate justice.

The results obtained confirm that the formation of an effective system of environmental responsibility is not only a legal, but also a civilizational process that determines the future of the sustainable development model. Such a system should combine legal norms, economic incentives and moral and ethical principles of environmental protection, ensuring a harmonious balance between the needs of society and the capabilities of the planet.

Results

The results of the study indicate that the evolution of environmental responsibility is not only a process of updating legal norms, but also a manifestation of a deep worldview transformation that encompasses all levels of social development – from institutional to value. There is a transition from an anthropocentric paradigm, within which nature was considered as a resource for satisfying human needs, to an ecocentric model, in which nature is recognized as an independent value, and human activity is only one of the factors of the global ecosystem.

While in the twentieth century environmental regulations performed a supporting function, aimed mainly at regulating industrial or economic activities, in the twenty-first century they have become a central element of the global security system, on a par with economic, energy and political factors. This shift in the role of environmental law is due to a number of factors, the key ones being:

1. Awareness of the inevitability of climate change caused by anthropogenic influence, which requires new approaches to preventing environmental disasters.
2. Institutionalization of international environmental law, which goes beyond national systems and forms supranational mechanisms of influence and control.
3. Development of international cooperation and a system of collective responsibility based on the Paris principles Agreement (2015) and The Glasgow Climate Pact (UNFCCC, 2021), which define common but differentiated responsibilities of states in the field of climate policy.

Thus, environmental responsibility ceases to be an exclusively legal category, acquiring the status of a global ethical and civilizational concept that determines the nature of humanity's interaction with the natural environment.

The analysis revealed that the transition from a punitive to a restorative model is accompanied by a change in goals, tools and mechanisms of influence. If earlier the main task of law was punishment for the harm caused, today the emphasis is shifted to



preventing environmental risks, managing climate processes and ensuring the long-term sustainability of natural systems, which is reflected in Table. 1.

Table 1. Evolution of environmental responsibility models

Comparison criterion	Punitive model (20th century)	Regenerative model (21st century)
Main goal	Punishment of the violator, elimination of consequences	Compensation for damage, prevention of environmental risks
Legal basis	National environmental legislation, criminal provisions	International agreements, sustainable development principles, ESG standards
Mechanisms of influence	Fines, administrative sanctions, prosecution	Environmental funds, carbon markets, climate quotas, compensation programs
Subjects of responsibility	Enterprises, individuals, government agencies	States, corporations, international alliances, global environmental institutions
Control tools	Environmental inspections, local checks	International audits, satellite monitoring, digital databases (UNEP, IPCC, ESA)
Expected result	Elimination of the consequences of the violation	Reducing environmental risks, increasing the resilience of systems and the environmental culture of society

Source: compiled by the author based on United Nations (2015), UNFCCC (2021), European Parliament & Council (2004) and ICAO (2016)

As can be seen from the table, in the twenty-first century there is a shift in emphasis from reactive to preventive mechanisms. Environmental liability is viewed not as the final stage of a crime, but as a risk management tool aimed at preventing crises that could have catastrophic consequences for the biosphere and humanity.

A comparative analysis of international documents (1972-2024) showed that the number of regulatory legal acts that use the term "environmental responsibility" or "climate liability", increased by more than 8 times (Table 2).

Figure 2 shows the dynamics of the growth of the number of international legal acts containing provisions on environmental or climate responsibility. The graph demonstrates the exponential nature of the development: if in the 1970s and 1980s mainly declarative documents were adopted, aimed at forming general principles of environmental protection (United Nations, 1972), then since the 1990s there has been an institutionalization of international environmental law.

In the 1990s and 2000s, a contractual framework for global climate policy was formed, establishing specific mechanisms for control, financing, and reporting.

This trend indicates a gradual transition from the declarative to the operational level of legal regulation: environmental responsibility is acquiring a financial and economic



dimension through the creation of climate funds, carbon markets, and emission compensation mechanisms.

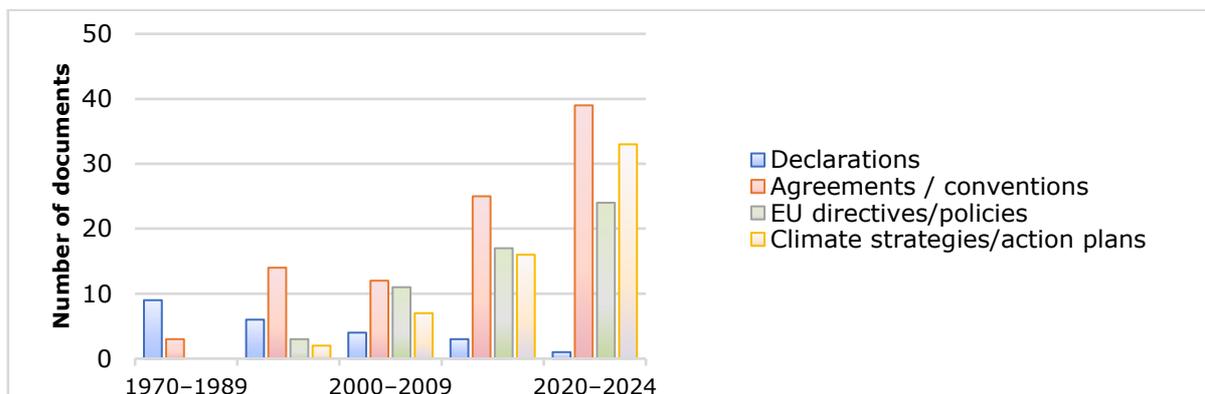
Thus, global environmental policy is evolving from principles of moral appeal to a structured system of obligations that integrates states, corporations, and international institutions.

Table 2. Dynamics of development of international legal acts on environmental liability (1972–2024)

Period	Number of adopted acts	Key documents
1970–1989	12	Stockholm Declaration (1972), Convention on Long range Transboundary Air Pollution (1979)
1990–1999	25	Rio Declaration on Environment and Development (1992), Kyoto Protocol this the United Nations Framework Convention on Climate Change (1997)
2000–2009	34	Johannesburg Declaration on Sustainable Development (2002), Directive 2004/35/EC of the European Parliament and of the Council (2004)
2010–2019	61	Paris Agreement (2015), The European Green Deal (2019)
2020–2024	97	The Glasgow Climate Pact (2021), COP28 Outcomes Summary (2023), European Commission (Net-Zero Industry Act, 2024)

Source: compiled by the author based on UNFCCC (2021; 2023), UNECE (1979), United Nations (1972; 1992a;1997; 2002; 2015), European Parliament & Council (2004), European Commission (2019, 2024), ICAO (2016), UNEP (2023)

Figure 1. Dynamics of development of international legal acts in the field of environmental responsibility (1972–2024)



Source: compiled by the author

As shown in Figure 1, the dynamics demonstrate an exponential growth in the number of international agreements in the field of environmental responsibility.

From 12 documents in the 1970s and 1980s, the number of acts increased to 97 in 2020s and 2024, which means an increase of more than 700% over half a century. It is



noteworthy that the structure of the documents has also changed: if in the 1970s declarations of a general nature prevailed (75%), then in the 2020s more than 40% of the documents are of a contractual and binding nature, and about 30% are of a strategic and political nature, aimed at the implementation of climate neutrality. These data indicate that the international community is gradually moving from a moral and declarative to a normative and binding paradigm, where environmental responsibility has not only ethical, but also legal and economic content. Thus, in the twenty-first century, environmental responsibility is transforming from a legal instrument of punishment into a comprehensive mechanism for managing global risks, integrated into financial markets, sustainable development policies, and the international climate governance system.

The trends of the global transformation of environmental responsibility identified in the study are directly reflected in the national context of Ukraine, which, after the beginning of the armed aggression, faced an unprecedented scale of environmental losses. If at the global level there is a shift in emphasis from punishment to prevention, then in Ukrainian realities this logic acquires a concrete dimension – the transition from fixing the consequences of military actions to the formation of a system of ecological restoration based on the principles of restorative justice. The analysis made it possible to determine that the environmental consequences of the war in Ukraine are multi-level in nature:

- local: soil contamination with heavy metals, petroleum products, explosive residues;
- regional: destruction of aquatic ecosystems, degradation of forests and protected areas;
- global: increased emissions of greenhouse gases and toxic aerosols due to mass fuel combustion, which causes transboundary atmospheric pollution.

In this context, environmental responsibility acquires an international legal character, since it concerns not only domestic violations of environmental legislation, but also environmental crimes that have global consequences for the climate stability and ecological security of the region. As a result of the study, a conceptual model of environmentally oriented post-war recovery was developed, which involves a combination of legal, institutional and technological mechanisms of environmental responsibility (Table 3).

Of particular note is the integration of the principles of international air law into the process of environmental recovery. Aviation is one of the key sectors where a new logic of environmental responsibility is being formed. In this context, the International Aviation Emissions Compensation and Reduction System, introduced by ICAO (1944), plays an important role, providing for the purchase of carbon quotas by air carriers to neutralize their emissions.

The use of similar mechanisms in Ukraine after the end of the war could become an innovative direction of “green recovery” of aviation infrastructure, where the reconstruction of airports and the restoration of air traffic will be accompanied by the implementation of sustainable development standards and monitoring of environmental impacts.



Table 3. Conceptual model of ecologically oriented post-war recovery

Direction	Content	Expected result
Legal	Development and implementation of mechanisms to hold the aggressor state accountable for environmental damage in accordance with international law. Use of the provisions of the 1944 Chicago Convention on the safety of airspace and the protection of the environment from pollution by aviation activities.	Creation of an internationally recognized system of compensation for environmental damage.
Institutional	Formation of the National Register of Environmental Damages, integrated into the databases of UNEP, ICAO, IPCC. Providing an evidentiary base for legal proceedings and transparent distribution of funding.	Increasing trust in international environmental processes, effective monitoring.
Technological	Introduction of "green" technologies, development of environmentally friendly aviation, use of biofuels, digital monitoring systems for emissions and atmospheric pollution.	Environmental restoration based on the principles of sustainable development, reducing the carbon footprint.

Source: compiled by the author

Figure 2 presents a structural and functional diagram of the interrelationships of the elements of environmental responsibility in the post-war reconstruction of Ukraine, which demonstrates the systemic interaction of three interconnected blocks: legal, institutional, and technological. Together, they form the framework of post-war environmental responsibility of Ukraine in the context of the global climate crisis.

At the top of the system is a global ecocentric paradigm that defines the methodological basis of the study: nature is viewed not as a resource, but as a value. Law, in turn, is presented as a mechanism for ensuring its security.

The legal block is based on international humanitarian, environmental, and air law. It provides for the creation of mechanisms to hold the aggressor state accountable, record environmental war crimes, and develop mechanisms for compensation for environmental damage, including through a special international compensation fund.

Chicago plays a key role in this block. Convention (ICAO, 1944) and the CORSIA system (ICAO, 2016), which form the framework for regulating air pollution and controlling emissions in the aviation sector.

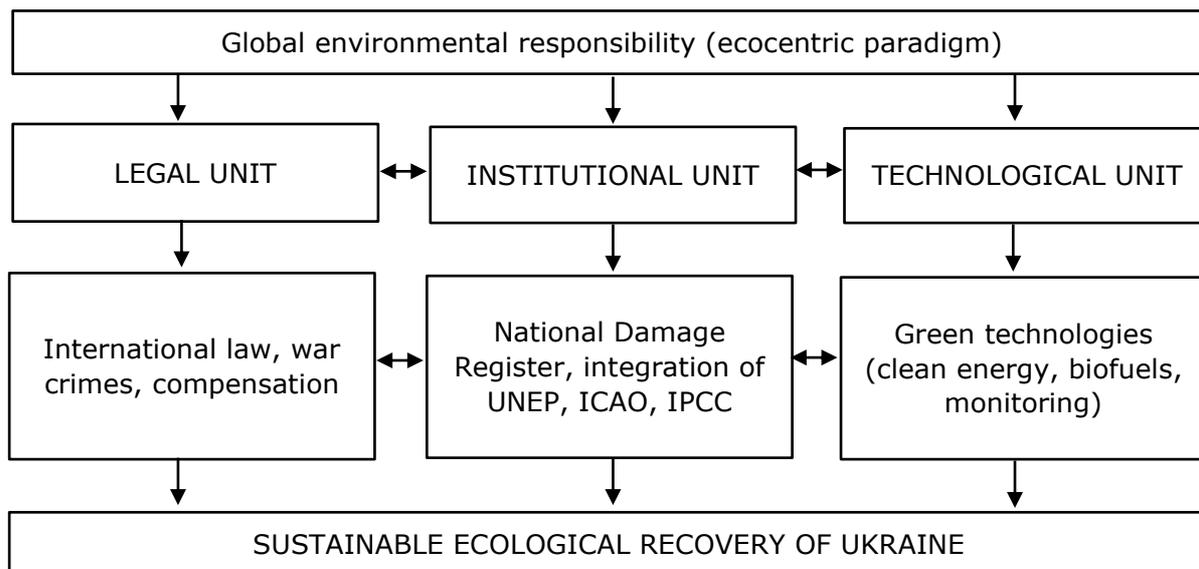
World Bank databases. Environment Situation Room, Data Distribution Center and CORSIA Central Registry. This block aims to create a transparent system of reporting and data use in international legal proceedings. It acts as a link between legal obligations and the practical implementation of environmental policy.

The technological block covers the implementation of the principles of "green recovery", in particular the introduction of renewable energy sources, environmentally friendly aviation, digital systems for monitoring air, water and soil pollution. This block ensures the transformation of environmental responsibility into a practical plane of sustainable development.



All three blocks are combined into a common mechanism that ensures sustainable ecological recovery of Ukraine, focused on achieving climate neutrality, restoring natural ecosystems, and preventing future environmental disasters.

Figure 2. Structural and functional diagram of the interrelationships of elements of environmental responsibility in the post-war reconstruction of Ukraine



Source: compiled by the author

The presented structural and functional scheme shows that environmental responsibility in the post-war period cannot be limited to fixing damage only – it must become an active tool for managing restoration. Its successful implementation is possible only if legal and technological mechanisms are combined in a single system of environmental governance.

The key features of this system are:

1. International legitimacy – participation of international organizations in monitoring, auditing, and financing recovery.
2. Transparency and evidence – digital platforms for collecting environmental data and open monitoring databases.
3. Innovation – use of clean energy technologies, autonomous monitoring, and bioengineering solutions.
4. Justice – the “polluter pays” principle applies to the aggressor state and entities that have caused environmental damage.

In such a system, the post-war reconstruction of Ukraine becomes a model of a new generation of environmental law, which combines the principles of restoration, compensation, and prevention, ensuring a balance between human security and the security of nature.



Discussion

The problem of environmental responsibility in the context of the global climate crisis goes beyond the boundaries of traditional legal regulation, acquiring a complex political, economic and ethical dimension. The results of the study confirm that the modern system of environmental law is undergoing a profound transformation – from a punitive and repressive to a restorative and managerial model. In this process, environmental responsibility is considered not only as a legal instrument of punishment, but as a mechanism for ensuring the sustainability of ecosystems and social justice.

A comparative analysis of international approaches has shown that most EU and North American countries have already moved to an integrated model of “environmental management”, in which responsibility is based on the principles of transparency, partnership and prevention. Ukraine is at the stage of active formation of this system. After the start of armed aggression, the environmental dimension of security acquired strategic importance – the war revealed the vulnerability of the natural environment as a component of national security. According to UNDP (2023) and the Ministry of Environmental Protection and Natural Resources of Ukraine (2024), more than 30% of the country's territory has been subjected to various forms of environmental pollution, which requires the creation of new legal and technological mechanisms for restoration.

The conceptual model of post-war ecological recovery developed in the study is consistent with the approaches of international institutions and demonstrates that an effective system of responsibility should include three interrelated components: legal, institutional and technological. Their integration provides the opportunity not only to compensate for losses, but also to form a new culture of environmental management, focused on risk prevention.

The legal aspect, which involves holding the aggressor state accountable, faces a number of practical and political challenges. As an analysis of international experience shows, the legal recognition of environmental war crimes is still fragmentary (Rahn et al., 2024; Balli & Caliskan, 2021). At the same time, Ukraine is setting a precedent that could become the basis for expanding the jurisdiction of the International Criminal Court in the field of environmental crimes. This opens up the prospect of forming a new approach to climate justice, where state responsibility for environmental damage is considered as part of restoring the global ecological balance.

The institutional component of the creation of a National Register of Environmental Damage – is key to ensuring the evidentiary basis in legal proceedings and transparent distribution of compensation. Similar initiatives were successfully implemented in Croatia and Bosnia and Herzegovina after the wars of the 1990s. However, the Ukrainian approach is more innovative due to digital integration with international databases, which allows for global verification of damage and access to climate funds.

The technological dimension of environmental responsibility is linked to the implementation of the principles of green recovery, where priority is given to the introduction of environmentally friendly technologies, clean energy, the disposal of military waste and the restoration of natural ecosystems. This is consistent with the European Commission (Net-Zero Industry Act, 2024) and the Paris Agreement (United



Nations, 2015), which define the shared responsibility of states for reducing greenhouse gas emissions.

Despite significant progress, Ukrainian practice remains fragmented, especially in the areas of inter-agency coordination, damage assessment, and financing of ecological restoration projects. Existing donor assistance programs are mostly focused on humanitarian or infrastructure goals, while the ecological component requires a specialized funding mechanism.

Thus, the results of the study indicate that environmental responsibility in the twenty-first century is becoming a strategic factor in state policy and a component of international security. For Ukraine, this process has a dual significance, as a mechanism for environmental restoration after the war, and as a tool for integration into the global climate governance system.

A promising direction for further research is the development of a single national strategy for environmental responsibility, which will combine legal, institutional and technological components into a single digital ecosystem. Such an approach will ensure a sustainable and just transition to a climate-neutral economy, strengthening Ukraine's international image as a state that is forming a new culture of responsibility – not only legal, but also moral, towards future generations.

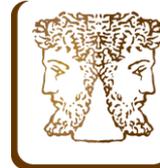
Conclusions

The study confirmed that environmental responsibility in the twenty-first century is taking on a systemic and multidimensional character, becoming a key element of global climate policy. It is transforming from a punitive instrument into a mechanism for environmental risk management that integrates the legal, economic, institutional and technological foundations of sustainable development.

The evolution of the concept of environmental responsibility indicates a transition from an anthropocentric to an ecocentric paradigm of thinking, where nature is viewed not as a resource, but as an equal subject of ecosystem interaction. This shift is reflected in the content of international documents, which increasingly provide not only for punishment for damage caused, but also for the restoration of natural systems and the prevention of new environmental disasters.

An analysis of the dynamics of international legal acts (1972–2024) has shown an exponential growth in the number of agreements enshrining the principles of environmental or climate responsibility. This trend indicates a transition from a declarative to an operational level of regulation, where environmental norms become part of the international security architecture.

The post-war context of Ukraine creates unique conditions for a practical rethinking of the principles of environmental responsibility. Large-scale environmental damage caused by armed aggression requires the formation of a system capable of simultaneously ensuring legal prosecution of perpetrators, objective assessment of damage, and implementation of long-term environmental restoration programs. In this context, environmental responsibility acquires not only a national, but also an international legal dimension, since it concerns environmental crimes with transboundary consequences.



International air law plays a growing role in shaping the modern system of environmental liability, especially in aspects related to atmospheric pollution, aviation emissions, and ensuring the safety of airspace during military operations. Chicago Norms The Convention and the supporting documents of the International Civil Aviation Organization establish a legal framework for monitoring the impact of aviation activities on the climate and for redressing environmental damage (ICAO, 1944). This demonstrates the integration of international air law into global environmental policy, strengthening interstate liability mechanisms.

The conceptual model of ecologically oriented post-war recovery proposed in the study combines three components – legal, institutional and technological. Their synergy creates the basis for building an effective system of environmental responsibility, which can become part of the broader European climate architecture.

An effective environmental policy of Ukraine in the post-war period should be based on the following principles: the rule of international law, transparency and demonstrability of compensation for damages, digital integration of national environmental registers into international monitoring systems, as well as alignment with the goals of the Paris Agreement and the European Green Deal.

Thus, environmental responsibility in the twenty-first century becomes an indicator of the civilizational maturity of the state, its ability to act within the framework of global environmental ethics. For Ukraine, this approach has a dual meaning: as a mechanism for post-war environmental restoration and as a tool for integration into the system of international environmental and air law, which forms new standards of justice, security and sustainable development.

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