

PROTECTION OF THE ENVIRONMENT DURING ARMED CONFLICTS: ECONOMIC AND INTERNATIONAL LEGAL ASPECTS

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Abstract. The environment is one of the casualties of armed conflict. In the context of military operations, a range of ecological impacts is observed, including but not limited to: human casualties; destruction of infrastructure; pollution of air, land and water resources; and damage to forests and nature reserves. Moreover, as military technologies develop, the situation is only getting worse. Environmental damage also has far-reaching economic consequences. All of this suggests that there is a need for high-quality international legal regulation of environmental protection during armed conflicts. The *purpose of this article* is twofold: firstly, to analyse the consequences of environmental damage caused by the Russian Federation's aggression for the Ukrainian economy; and secondly, to identify the existing international legal regulation of environmental protection during armed conflict. In addition, the article will propose ways to solve the identified problems. An analysis was conducted on statistical data pertaining to the environmental damage caused by various armed conflicts. The issue of international legal regulation of the assessment of damage caused to the environment during military conflicts was considered. *Methodology.* In the course of composing the article, the primary focus was on the utilisation of general theoretical methodologies. The analysis and synthesis of existing literature, alongside theoretical generalisation and systematic interpretation, were instrumental in evaluating individual international treaties pertinent to the research topic. *Results.* The article considered the economic consequences of environmental damage caused by the Russian Federation in Ukraine, as well as the content of international legal regulations on environmental protection during armed conflicts and the practice of implementing them. *Practical implications.* The authors have identified the main range of problems existing in the sphere of international legal regulation of environmental protection, and proposed the possible ways of their resolving, on the basis of doctrinal provisions, data from reports of the Ministry of Environment and Natural Resources of Ukraine and the UN, as well as the norms of the current international law. *Value/Originality.* It has been determined that a significant step in enhancing the international legal regulation of environmental protection during armed conflict is necessary. This step involves the enactment of a separate convention aimed at resolving this issue, as well as the adoption of international standards on environmental damage assessment.

Keywords: international law, international environmental law, environmental damage, assessment of environmental damage, economic consequences.

JEL Classification: K00, K1, K3, K33

1. Introduction

The occurrence of armed conflict has been demonstrated to result in considerable damage to both the natural environment and human health. Recent military conflicts, which unfortunately are a constant occurrence in different parts of the world, indicate that

the amount of damage being done to the environment is increasing. The contamination of water resources and air, the significant damage being done to nature reserves, and the harm being inflicted on biodiversity are all examples of the challenges being faced. The aforementioned circumstances give rise to far-

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reaching economic consequences. Moreover, the scientific literature does not provide a single approach to the regulation of the prohibition of certain military actions at the international level, nor does it specify which actions should be restricted in use. Consequently, the necessity to examine the international legal framework governing environmental protection during armed conflict is becoming increasingly apparent.

In the course of the present study, particular attention was directed towards the provisions of the Post-Disaster Needs Assessment report of the Kakhovka Dam Disaster, which was jointly prepared by the Government of Ukraine and the United Nations. The Protocol Additional to the Geneva Conventions of 12 August 1949, relating to the Protection of Victims of International Armed Conflicts (Protocol I), the ENMOND Convention, and other international documents related to environmental protection during armed conflicts were also considered. A particular focus was given to the international legal regulation of the assessment of environmental damage. It is evident that proposals were made *de lege ferenda*. In the composition of this article, the authors partially relied on the scientific achievements of scholars such as O. Gulac, L. Mareček, P. Rowe, Paul C. Szasz, and K. Yemelianenko, among others.

The purpose of our scholarly work is to analyse the provisions of international acts aimed at environmental protection during armed conflict, identify their drawbacks and make proposals for improvement.

2. Environmental Damage in Numbers

It is an irrefutable fact that military operations have always had an impact on the environment. However, concurrent with the advancement of military technology, the magnitude of destruction has increased. The following examples are provided to illustrate this point.

The term 'ecocide' was first used during the Vietnam War, when the herbicide Agent Orange was deliberately employed to cause environmental damage. The massive removal of vegetation through bombing and chemical spraying was a military tactic employed for the first time with the aim of denying cover to opposition forces. Approximately one million people were displaced (International organization for migration, 2025). In the aftermath of the bombing, 10% of the state was destroyed. The most heavily bombed areas of the studied catchment were classified as follows: degraded forest (82%), agricultural land (12%) and forest (6%). Furthermore, 70% of degraded forest corresponds to heavily bombed areas (Lacombe, 2013).

The United Nations Compensation Commission (UNCC), which was established by a resolution

of the United Nations Security Council, estimated the environmental damage caused by the First Gulf War (1990) at 5.26 billion USD (Peter H. Sand, 2005). The marine environment, the atmosphere, and biodiversity were all subject to damage.

According to data provided by the UN Environmental Programme, 39 million tons of debris has been generated during the armed conflict in Gaza. These figures are of particular significance as they indicate that, for each square metre of the Gaza Strip, there is now in excess of 107 kg of debris. As a consequence of the recent conflict, five out of six solid waste management facilities in Gaza have been damaged (UNEP, 2024). This has resulted in an increase in the amount of unprocessed waste that pollutes the environment. Satellite data provided to the Guardian demonstrate that approximately 38-48% of tree cover and farmland has been destroyed (The Guardian, 2024). The Institute for Middle East Understanding (IMEU) has employed the term "environmental apartheid" to draw attention to the considerable environmental damage (IMEU, 2023).

As demonstrated by the data provided by the Ministry of Environmental Protection and Natural Resources of Ukraine, the Russian Federation has been found to be responsible for a minimum of 2,500 environmental crimes on its own territory as a direct result of its aggressive actions against Ukraine. According to the Ministry of the Environment (2025), the area mined and contaminated with explosives extends to more than 174,000 square kilometres, which is approximately equivalent to one-third of Ukraine's total territory. As stated in the Post-Disaster Needs Assessment report of the Kakhovka Dam Disaster, a document which was collaboratively compiled by the Government of Ukraine and the United Nations, the estimated financial loss resulting from the disaster is 2.79 billion USD for infrastructure and assets, and in excess of 11 billion USD for losses sustained. The most significant concern is the long-term environmental impact. The most significant damage was inflicted on infrastructure and assets within the energy and housing sectors. The environment and energy sectors, which are critical to long-term stability and recovery, experienced the highest losses. The environment sector recorded over 6.4 billion USD (58%), while the energy sector accounted for 3.8 billion USD (35%). The agriculture and fisheries sector also suffered major losses (3%), followed by the culture sector (1%), the water and sanitation sector (1%), the municipal services and community infrastructure sector (1%), and the health sector (1%). The environmental consequences of the Kakhovka Dam breach were extensive, with 620 km² of land submerged, 333,000 ha of protected areas and 11,294 ha of forested areas impacted, and significant alterations to river morphology, chemical pollution, and habitat destruction. The PDNA estimates

losses of over 6.4 billion USD in ecosystem services (58% of all losses) due to the impact on protected areas and forests. Recovery from the environmental impact will require 59.5 million USD, with priorities including de-mining, clean-up operations, surveys and assessments of contaminated sites. According to the Post-Disaster Needs Assessment report (2023), some ecological impacts are irreversible and may have cascading effects in other sectors for decades.

As is evident, the environment is subject to considerable destruction in the context of military conflicts. This underscores the necessity for the establishment of effective international legal mechanisms to ensure its protection.

3. International Legal Regulation of Protection of Environment During Armed Conflict

International law is indeed replete with norms aimed at ensuring environmental protection during armed conflicts. However, these norms have shortcomings, which will be the focus of this article.

Article 35(3) and Article 55(1) of Additional Protocol I to the Geneva Conventions, the primary international document aimed at environmental protection during armed conflict, prohibit warfare methods that could cause widespread, long-term and severe environmental damage. It also contains provisions that are indirectly aimed at environmental protection. For instance, Article 54 prohibits attacks on objects that are essential for the survival of the civilian population. Article 56 prohibits attacks on dams, embankments and nuclear power stations.

The issue lies in the ambiguity of the term "natural environment" within the context of international law. Specifically, the term does not align with the established norms and standards of international law that are designed to protect the environment during armed conflict. According to the commentary of the Red Cross of 1987 to Additional Protocol I to the Geneva Conventions, the concept of the natural environment should be understood in the widest sense to cover the biological environment in which a population is living (Commentary, 1987). Nevertheless, the authors feel that this commentary is too general and requires further clarification. The terms "widespread", "long-term" and "severe damage" are not defined in international law, which complicates their application in practice.

The scientific literature does not provide a single approach to the regulation of the prohibition of certain military actions at the international level. Richard A. Falk offers a definition of environmental warfare that encompasses all weapons and tactics that are employed with the intention of either destroying the environment itself or of disrupting the established relationship between humanity and nature in a manner

that is both ongoing and pervasive. The proposal entails the implementation of the International Convention on the Crime of Ecocide, encompassing any actions committed with the intent to disrupt or destroy, in whole or in part, a human ecosystem. This encompasses a wide range of actions, including mass destruction, the utilisation of chemical herbicides, the deployment of bombs and artillery in substantial quantities, which pose a threat to people, animals, and crops, techniques aimed at modifying the weather, and the forcible removal of human beings or animals from their customary habitats (Falks, 1973). According to Martin A. Mattes and Michael Bothe, nuclear explosions beneath the Antarctic, cloud-seeding operations, and artificially induced hailstorms should also be regulated at an international level (Martin A. Mattes, 1975).

Other scholars have also proposed introducing ecocide as a distinct international crime (Gulyás et al., 2022; 2023; Krasnova, 2017; Novak et al., 2024; Vashchenko, 2021). At the same time, Lukáš Mareček points out that, in certain situations, an intentionally caused ecological disaster can form part of a crime against humanity, genocide, or terrorism. Consequently, this may result in the establishment of individual criminal responsibility (Mareček, 2023).

The adoption of the International Convention on Ecocide is unlikely in the near future because states are reluctant to take on new responsibilities. Moreover, it is evident that there is a substantial corporate lobby that is opposed to the recognition of ecocide as an international crime.

As posited by Jozef Goldblat, the prevailing treaties designed to protect the environment during the war period are characterised by a certain degree of vagueness. For instance, an analysis of the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (ENMOD convention) reveals that the scope of its prohibitions remains ambiguous (Goldblat, 1997). He also points out that the requirement for widespread, long-lasting or severe environmental damage makes this convention ineffective, as it does not significantly contribute to the humanisation of war technology or the restriction of the arms race. In this article, the authors agree with the scholar that it is unclear how to prove the hostile intentions of the perpetrator of hostile actions. It should be noted here that the difficulty of proof is also inherent in other international norms related to environmental protection during armed conflict. For instance, "expected damage", which is required to determine a violation of international law according to Additional Protocol I to the Geneva Conventions, is also challenging to substantiate. Therefore, this is not only a weak point of the ENMOD convention.

Another disadvantage of the ENMOD convention is that it can only be used between the contracting

parties, as it was considered innovative and not codifying international customary law at the time of its signing. Today, it has 78 state parties.

A further issue that merits attention is the absence of established norms within international law that are specifically designed to safeguard animals during armed conflicts. As P. Paľuchová accurately observes, the primary focus of international humanitarian law is the protection of human life. While the protection of animals cannot be considered a direct objective, it can be achieved by means of the protection of human rights (Paľuchová, 2024). It is also important to note that there is currently no methodology for determining the damage caused to biodiversity during military conflict.

O. Ružička (2024) correctly identifies that appropriate legal regulation engenders legal stability and certainty in the event of dispute resolution. In consideration of the aforementioned general formulations of provisions of international law that are intended for the protection of the environment during military conflicts, it is evident that their specification in international documents is an imperative necessity.

4. International Legal Regulation of Assessment of Environmental Damage Caused by Armed Conflict

In instances of environmental degradation resulting from armed conflicts, the assessment of such damage becomes a crucial aspect for the purpose of obtaining reparations. It is regrettable that no international document exists which employs a unified methodology for the assessment of environmental damage caused by military actions. This complicates the task of international courts in determining the extent of damage caused.

For instance, as K. Yemelianenko observes, the UN Compensation Commission encountered significant challenges in ascertaining the extent of environmental damage inflicted upon Kuwait during the Gulf War. It is imperative to acknowledge the evidence of a causal relationship with the pollution of groundwater and the sea area in Kuwait, which arose due to the absence of pre-war monitoring data, and which subsequently affected the effectiveness of the implementation of the mechanism for compensation of environmental damage. Furthermore, when considering the environmental damage caused by the Commission, there were concerns regarding the quality of the analyses performed, the interpretation and comparison of data, as well as the possibility of using alternative approaches in determining and calculating the value of ecosystem services (Yemelianenko, 2024).

The International Court of Justice encountered comparable challenges in the dispute between Costa

Rica and Nicaragua concerning certain activities undertaken by Nicaragua in the border region (ICJ, 2018). Despite the ICJ's initial optimism, the report falls short in providing a detailed methodology for calculating the environmental damage and its subsequent compensation. The court's decision was positive insofar as it ruled that the loss of environmental services also constitutes environmental damage. Nevertheless, the absence of a detailed account of the methodological approach employed in the assessment of damage constitutes a notable deficiency.

It is the opinion of the present author that the international community should develop international standards for assessing damage caused during military actions.

5. Conclusions

An analysis of the international legal regulation of environmental protection during armed conflicts has revealed a number of its shortcomings. It is evident that none of the international documents which regulate the conduct of military operations contain a definition of the terms "widespread", "long-term" and "severe" damage to the natural environment. The definition of these terms is imperative as they serve as pivotal indicators of whether humanitarian norms of international law have been transgressed. This is crucial for the establishment of states' responsibility for environmental degradation during armed conflicts, as well as for the determination of individual criminal culpability for the commission of war crimes. It is notable that the Rome Statute also does not define these terms. The absence of a definitive definition for these terms is a salient factor contributing to the inability to hold any individual accountable for environmental degradation. The definition of environmental damage that is required for the recognition of a violation of humanitarian law, which is worded in such a way that it must be both "widespread" and "long-term" as well as "severe", also presents a disadvantage. It is the opinion of the authors of this study that the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques provides a more precise definition of the prerequisite for establishing a war crime. It is sufficient that one of the aforementioned characteristics of damage is met, since it is not necessary for the damage to be "widespread", "long-term", or "severe".

Analysis of documents published by Ukraine's Ministry of Environmental Protection and Natural Resources and the Kakhovka Dam Disaster Post-Disaster Needs Assessment report, which was prepared jointly by the Ukrainian government and the United Nations, shows that even when the strictest criteria are used to determine environmental damage, it is

clear that the damage is "widespread", "long-term" and "severe".

Notwithstanding the dismal outlook for the ratification of a convention on environmental protection during armed conflicts, it is asserted that such a convention is imperative. It should prioritise human interests and the protection of biological diversity, aim to preserve ecosystems and provide clear definitions for terms used in Additional Protocol I to the Geneva Conventions that are not defined

elsewhere. Furthermore, it is considered essential to adopt international standards on environmental impact assessment. This would enhance legal certainty and facilitate the practical application of international norms.

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References:

- Goldblat, J. (1977). The Environmental Warfare Convention: How Meaningful Is It? *Ambio*, Vol. 6 (4), p. 216–221.
- Gulac, O., Marchenko, O., Kapitanenko, N., Kuris, Y., & Oleksenko, R. (2022). State environmental policy on the issue of legal regulation of fire safety in the forests of Ukraine. *Cuestiones Políticas*, Vol. 40(74), p. 195–206.
- Gulac, O., Oleksenko, R., Kaluha, V., Kravchenko, O., & Yukhymenko, N. (2022). Overcoming the environmental crisis in the forestry sector of Ukraine in the context of the ecocentric paradigm. *Revista de la Universidad del Zulia*, Vol. 13(38), p. 59–71.
- ICJ, Certain Activities Carried Out by Nicaragua in the Border Area (Costa Rica v. Nicaragua), Compensation, Judgment, I.C.J. Reports 2018, p. 55.
- IMEU (2022). Fact Sheet: Israel's Environmental Apartheid in Palestine. Available at: <https://imeu.org/article/environmental-apartheid-in-palestine>
- International organization for migration. Pierret Alain, Guillaume Lacombe and Chu Thai Hoanh (2022). Environmental and migratory consequences of the Vietnam War policies. Available at: <https://environmentalmigration.iom.int/blogs/environmental-and-migratory-consequences-vietnam-war>
- Krasnova, Yu. (2017). The law of environmental safety of Ukraine: theoretical aspects. Monograph. Kyiv: NULLES of Ukraine, 589 p.
- Lacombe Guillaume, Pierret Alain. (2013). Hydrological impact of war-induced deforestation in the Mekong Basin. *Ecohydrology*, Vol. 6, p. 901–903.
- Mareček, L. (2023). Ochrana environmentálnych noriem prostriedkami medzinárodného trestného práva [Protection of Environmental Norms by Means of International Criminal Law]. In: Ružička, O., Ťažká, V. (eds.): Bratislavské právnické fórum 2023: právny štát v medzinárodnom práve a medzinárodné právo v právnom štáte [Bratislava Legal Forum 2023: the Rule of Law in International Law and International Law in the Rule of Law] (pp. 24–40). Bratislava: Právnická fakulta Univerzity Komenského v Bratislave.
- Martin A. Mattes, Michael Bothe. (1975). Environmental Policy and Law. Volume 1, Issue 3, December 1975, Pages 136–137.
- Ministry of the Environment (2024). More than 2,500 crimes against the environment committed by Russian Federation were recorded in Ukraine. Available at: <https://www.ukrinform.ua/rubric-economy/3776555-v-ukraini-zafiksuvali-ponad-25-tisaci-zlociniv-proti-dovkilla-aki-vcinila-rosia.html>
- Novak, T., Melnyk, V., Kovalchuk, I., Pakhomova, A., & Nastina, O. (2024). Legal Support for Sustainable Agroecological Development: Evidence from Ukraine. *European Journal of Sustainable Development*, 13(2), 247. DOI: <https://doi.org/10.14207/ejsd.2024.v13n2p247>
- Paluchová, Petra. Protection of animals during armed conflict. In: Current issues of international environmental law: through the lens of public international law and private international law. Bratislava: Comenius University in Bratislava. Faculty of Law, 2024, s. 55–66 [online]. ISBN (online) 978-80-7160-724-3.
- Peter H. Sand. (2005). Compensation for Environmental Damage from the 1991 Gulf War. *Environmental Policy and Law*, Vol. 35 No. 6, p. 244–249. Available at: https://www.researchgate.net/publication/292506890_Compensation_for_environmental_damage_from_the_1991_Gulf_War
- Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977. Commentary of 1987. Article 55 – Protection of the natural environment. Available at: <https://ihl-databases.icrc.org/en/ihl-treaties/api-1977/article-55/commentary/1987>
- Richard A. Falks. (1973). Environmental Warfare and Ecocide – Facts, Appraisal, and Proposals. *Bulletin of Peace Proposals*, Vol. 4, No. 1, p. 80–96.
- Ružička, O. International administration of the territory as a means of environmental protection. In: Current issues of international environmental law: through the lens of public international law and private international law. Bratislava: Comenius University in Bratislava. Faculty of Law, 2024, s. 47–53 [online]. ISBN (online) 978-80-7160-724-3.
- The Guardian. Ecocide in Gaza: does scale of environmental destruction amount to a war crime? (2024). Available at: <https://www.theguardian.com/environment/2024/mar/29/gaza-israel-palestinian-war-ecocide-environmental-destruction-pollution-rome-statute-war-crimes-aoe>

The Post Disaster Needs Assessment report of the Kakhovka Dam Disaster. (2023). Available at: <https://ukraine.un.org/en/248860-post-disaster-needs-assessment-report-kakhovka-dam-disaster>

UNEP. Damage to Gaza causing new risks to human health and long-term recovery – new UNEP assessment (2024). Available at: <https://www.unep.org/news-and-stories/press-release/damage-gaza-causing-new-risks-human-health-and-long-term-recovery>

Vashchenko, Y. (2021). Access to Modern Energy Services Through the Prism of Children's Rights: An Overview from the Perspectives of the Convention on the Rights of the Child and the Policy and Law Approaches of Certain EU Member States and Ukraine. *International Comparative Jurisprudence*, Volume 7, Issue 1, p. 75–87. DOI: <http://dx.doi.org/10.13165/j.icj.2021.06.006>

Yemelianenko, K., Ladychenko, V., Yarynko, B. (2024). International legal and national mechanisms for overcoming the environmental consequences of the armed aggression of the Russian federation against Ukraine. *Law of Ukraine*, Vol. 10 (1), p. 151–165.

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