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NORMATIVE ANALYSIS OF THE ENVIRONMENTAL IMPACTS OF THE ARTILLERY OF THE ARMY OF THE CZECH REPUBLIC IN THE CONTEXT OF CZECH LAW, INTERNATIONAL LAW, AND NATO

ANÁLISE NORMATIVA DOS IMPACTOS AMBIENTAIS DA ARTILHARIA DO EXÉRCITO DA REPÚBLICA TCHECA NO CONTEXTO DO DIREITO DA REPÚBLICA TCHECA, DO DIREITO INTERNACIONAL E DA OTAN

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Abstract
The article analyses the environmental impacts of the artillery activities of the Army of the Czech Republic within the legal and institutional framework of the Czech Republic, the European Union, and the North Atlantic Treaty Organization (NATO). The research combines qualitative analysis of legal regulations, a comparative assessment of three legislative regimes, and a normative proposal of measures aimed at achieving a more environmentally sustainable performance of military functions. Emphasis is placed on soil contamination, the dispersion of toxic metals, acoustic impact, and the legislative limits of military exemptions. The study concludes that although legal frameworks exist at all levels, their practical implementation remains significantly limited due to the persistent lack of specific methodologies, effective monitoring instruments, and adequate institutional incentives. In conclusion, the article proposes concrete legal and organizational measures that may realistically contribute to better aligning defence activities with environmental protection principles without

Resumo
O artigo analisa os impactos ambientais das atividades de artilharia do Exército da República Tcheca no âmbito do quadro jurídico e institucional da República Tcheca, da União Europeia e da Organização do Tratado do Atlântico Norte (OTAN). A pesquisa combina uma análise qualitativa da legislação, uma comparação de três regimes legislativos e uma proposta normativa de medidas voltadas para um desempenho mais ambientalmente sustentável das funções militares. É dada especial ênfase à contaminação do solo, à dispersão de metais tóxicos, ao impacto acústico e aos limites legais das exceções militares. O estudo conclui que, embora existam quadros jurídicos em todos os níveis, sua implementação prática permanece limitada devido à ausência de metodologias específicas, instrumentos de monitoramento e incentivos institucionais. Ao final, o artigo propõe medidas jurídicas e organizacionais concretas que podem contribuir para harmonizar as atividades de defesa com os princípios de proteção ambiental, sem comprometer a capacidade de defesa do Estado.

compromising the state's defence capability overall.

Keywords: Artillery. Army of the Czech Republic. Environmental Law. Defence Policy. Sustainable Security.

Palavras-chave: *Artilharia. Exército da República Tcheca. Direito Ambiental. Política de Defesa. Segurança Sustentável.*

1 INTRODUCTION

Environmental protection has become a priority of global policy over the past decades. Armed forces are also among significant contributors to environmental damage (for example, the massive use of defoliants or munitions containing toxic substances places a substantial burden on the environment) (Horáková *et al*., 2022). The rapid and large-scale disruption of landscapes caused by modern military operations represents a specific form of anthropogenic intervention that can radically alter landscape morphology and limit its capacity to return to its original state (Hupy, 2008). Experience from armed conflicts (e.g., the war in Ukraine) demonstrates that the environment of affected areas remains long-term contaminated by heavy metals and toxic components of munitions (Ivan *et al*., 2025). The need for a systematic legal framework to mitigate these impacts is therefore crucial.

2 MATERIALS AND METHODS

The methodological foundation of the study consists of a combination of systemic, comparative, institutional, and discursive approaches. These approaches enable the analysis of the environmental regulation of artillery activities of the Army of the Czech Republic as a multi-level legal and institutional system encompassing national law, European Union law, international obligations, and NATO standards.

The source base includes legal regulations of the Czech Republic, legal acts of the European Union, relevant international treaties, NATO standardization documents, strategic documents of the Ministry of Defence of the Czech Republic, and scholarly literature focused on the environmental impacts of military activities and their legal regulation.

The primary research instrument is the narrative review method. A narrative review makes it possible to incorporate a broader spectrum of legal and institutional sources and to provide their synthesis, interpretation, and critical evaluation. Unlike a systematic review, which focuses on a narrowly defined problem and follows predetermined data selection criteria, a narrative review allows for more flexible engagement with complex and multi-level topics (Sukhera, 2022).

The narrative approach is particularly suitable for issues that require the interconnection of different legal regimes and institutional frameworks and their normative assessment. These characteristics led to its selection as the principal research method of this study.

3 RESULTS AND DISCUSSION

3.1 Literature review

Scholarly literature increasingly addresses the environmental impacts of military activities across natural sciences, law, and institutional studies. It generally agrees that training with heavy weapons and live fire exercises represents a category of operations associated with elevated environmental risks. At the same time, technological advances in artillery systems, including digital terrain analysis and unmanned platforms, may enable more precise spatial assessment of impacts (Ivan *et al*., 2022). However, the assessment of such activities must extend beyond technical or ecological analysis to include normative evaluation within a multi-level legal framework.

Empirical studies of firing ranges and military training areas document the long-term accumulation of heavy metals and explosive residues in soil and their potential migration into water resources (De Vries *et al*., 2022; Rodríguez Seijo *et al*., 2024; Wirtu, 2025). Artillery training activities are additionally associated with increased environmental risk due to the dispersion of toxic substances and the long-term persistence of contaminants in affected ecosystems (Ivan *et al*., 2026). These findings form the factual basis for applying legal regimes protecting soil, water, and biodiversity. Environmental impacts of artillery activities may thus trigger preventive duties, operational limits, and

liability for environmental damage. Artillery systems may also function as instruments of environmental intervention, for example in wildfire suppression (Korec *et al*., 2025). Research from Central European military areas confirms measurable and spatially concentrated contamination in impact zones, supporting their explicit legal qualification (Šustr *et al*., 2022). Military areas are legally specific. They remain subject to general environmental norms but benefit from certain defence related exemptions (Horáková *et al*., 2022).

In Czech law, the framework is grounded in Act No. 17/1992 Coll., on the Environment, which establishes principles of prevention, polluter responsibility, and sustainable development applicable to armed forces activities. Act No. 100/2001 Coll., on Environmental Impact Assessment, requires assessment of significant projects and strategic documents, while allowing exemptions for documents prepared exclusively for state defence. This raises debate about transparency and precaution. Act No. 167/2008 Coll., on the Prevention and Remedying of Environmental Damage, introduces strict liability for damage to protected environmental components. The defensive nature of an activity does not automatically exclude responsibility. Sectoral legislation, including the Water Act, the Nature and Landscape Protection Act, the Forest Act, and the Air Protection Act, sets specific limits. Their application in military areas remains interpretatively complex and insufficiently systematized.

At the European Union level, environmental protection is a fundamental policy objective. The Habitats Directive and the Birds Directive impose binding protection of Natura 2000 sites, including military areas within the network, subject to strict exemption tests based on overriding public interest and proportionality. Recent instruments such as the Nature Restoration Regulation and the European Climate Law increase normative pressure to prevent ecosystem degradation and reduce emissions. Although defence systems may not always be directly subject to technical emission standards, Member States remain responsible for meeting climate targets, which indirectly affects military planning.

NATO standards constitute a further normative layer. Although formally non-binding, they operate as soft law implemented into national regulations and operational procedures. Documents integrating environmental considerations into operational planning and emission mapping indicate that environmental management is treated as a

component of security policy. The resulting multi-level framework combining national law, European Union law, and alliance standards creates a complex normative environment for artillery activities of the Army of the Czech Republic.

Overall, while academic literature provides detailed insight into environmental burdens associated with military activities, it less systematically analyses their legal qualification in the context of specific defence operations. The interaction between prevention principles, defence exemptions, environmental liability, and obligations under European Union law and NATO standards in artillery training remains insufficiently explored. This creates space for focused normative analysis.

3.2 Legal framework of the Czech Republic

The constitutional order of the Czech Republic establishes the value framework for assessing the environmental impacts of artillery activities. State defence is defined as a fundamental function of public authority (Article 43 of the Constitution; Constitutional Act No. 110/1998 Coll.), while environmental protection is simultaneously recognized as a constitutionally protected value (Article 7 of the Constitution) and an individual subjective right (Article 35 of the Charter of Fundamental Rights and Freedoms). These values are not hierarchically ordered and therefore require the application of the principle of proportionality. The state must demonstrate that environmental interventions linked to military training are necessary, suitable, and proportionate to the pursued defence objective.

A key normative deficit arises from the absence of an explicit mechanism requiring the systematic application of proportionality testing to artillery training activities. Training is treated as an inherent element of state defence, yet its environmental impacts are not independently assessed in terms of their intensity and scope. As a result, constitutional value balancing remains largely non-operational at the procedural level.

Act No. 17/1992 Coll., on the Environment, incorporates the principles of prevention and precaution, implying an obligation to actively prevent foreseeable environmental damage. Empirical research confirms long-term accumulation of heavy metals and explosive residues in firing ranges and training areas. Despite this predictability, Czech law does not mandate regular environmental audits of impact zones

or the publication of monitoring results. Consequently, the preventive principle remains largely declaratory.

Significant limitations also exist in the liability regime for environmental damage under Act No. 167/2008 Coll. This framework is designed to address identifiable harmful events, whereas artillery activities generate cumulative and diffuse environmental burdens over time. This mismatch between incident-based liability and gradual environmental degradation renders the application of liability mechanisms practically difficult. The broader doctrinal distinction between public and private liability regimes further illustrates the structural complexity of allocating responsibility for damage arising from military activities (Horák *et al*., 2024).

Further weaknesses appear in the Environmental Impact Assessment regime under Act No. 100/2001 Coll. Exemptions for defence-related documents weaken ex ante environmental control. Although such exemptions are legitimate, their scope is not subject to regular proportionality review, allowing environmentally significant changes in training infrastructure to avoid systematic public assessment.

Sector-specific legislation establishes general environmental limits but does not reflect the specific characteristics of impulsive noise and fragmentation contamination associated with modern artillery systems, particularly 155 mm calibres. Legal standards are based on generalized pollution models rather than military technological realities, leading to a gap between technological development and normative regulation.

From an institutional perspective, military training areas operate under a special administrative regime in which environmental oversight is largely internal. Broader defence policy analyses also emphasize that resource allocation and strategic planning in the defence sector require rational modelling and systemic evaluation mechanisms, which may influence the institutional prioritization of environmental considerations within military structures (Šlouf *et al*., 2023). Transparency and public participation are limited, raising potential tensions with the Aarhus Convention and the constitutional right to environmental information. Czech legal doctrine stresses that the first pillar of the Aarhus Convention establishes a positive obligation to ensure access to environmental information, even in areas where security-related limitations are invoked (Hak *et al*., 2022). Similar deficits in transparency and communication within the armaments sector

have been identified in defence policy analyses, highlighting weakened public accountability in military governance (Vyklický & Pikner, 2023).

In summary, the Czech legal framework is formally extensive but structurally ill-suited to the cumulative nature of artillery-related environmental burdens. Regulation remains fragmented and reactive, lacking a coherent system of environmental due diligence tailored to the defence sector.

3.3 Legal framework of international law

International law establishes a supranational framework that constrains the exercise of state sovereignty, including defence activities. The regulation of environmental impacts of military operations is, however, dispersed across several normative branches: general principles of state responsibility, international humanitarian law, human rights obligations, and UN environmental conventions. As a result, the framework is normatively strong but operationally fragmented.

A core principle is the obligation not to cause environmental harm to other states, articulated in the Stockholm Declaration (1972) and reaffirmed in the Rio Declaration (1992), now widely regarded as part of customary international law. In the context of artillery activities, this principle is relevant primarily in cases of transboundary pollution of water or air. In practice, however, international law responds mainly to demonstrable transboundary damage, not to cumulative environmental burdens confined within national territory. This creates a normative asymmetry: environmental protection is stronger when an international dimension is present than in cases of purely domestic military impacts.

International humanitarian law constitutes another relevant layer. Additional Protocol I to the Geneva Conventions prohibits methods of warfare that cause widespread, long-term, and severe damage to the environment (Articles 35(3) and 55). These criteria are cumulative and interpreted restrictively, resulting in a very high activation threshold. Consequently, environmental protection is triggered only in extreme wartime situations, while peacetime artillery training remains largely outside this legal regime. International humanitarian law thus provides a value-based standard rather than an effective regulatory tool for routine military activities.

The ENMOD Convention (1976), which prohibits the military use of environmental modification techniques, further confirms the international consensus on protecting the environment from military harm. Its scope, however, is narrowly focused on deliberate environmental manipulation as a method of warfare and does not cover conventional weapons use, including artillery. Again, regulation is robust for exceptional cases but weak for ordinary practice.

Greater practical relevance lies in the Aarhus Convention (1998), which guarantees access to environmental information, public participation, and access to justice. States remain obliged to provide environmental information related to military activities, subject to national security exceptions. The key issue is the breadth of these exceptions: overly expansive interpretations may systematically restrict access to information on contamination in military training areas. International law thus establishes a transparency standard, but its effectiveness depends on domestic implementation.

Environmental conventions such as the Convention on Biological Diversity (1992) and the Convention on the Protection and Use of Transboundary Watercourses impose general obligations to prevent ecosystem degradation and pollution. These duties also apply to military activities affecting protected habitats or water resources. However, the obligations are formulated in broad terms and lack specific operational limits for military training, leaving implementation largely to national law.

Soft-law developments within the UN, including General Assembly resolutions on environmental protection in armed conflict (UNGA, 2022), emphasize the growing expectation of environmental responsibility. While not legally binding, they contribute to normative evolution without creating directly enforceable rules.

Overall, international law provides a strong ethical and normative framework for environmental protection in relation to military activities, but it is characterized by high activation thresholds, general formulations, and the absence of sector-specific standards for routine peacetime training. Regulation is effective in extreme scenarios such as large-scale wartime damage or transboundary disasters but considerably weaker in addressing the cumulative environmental burden of everyday military operations.

3.4 Framework of NATO

The NATO normative framework represents a specific regulatory layer situated between international law and domestic implementation. NATO is not a legislative authority in the classical sense, and its documents do not constitute binding international law. Nevertheless, through standardization agreements (STANAGs), doctrinal documents, and methodological guidance, it creates a structured system that member states incorporate into national defence structures. The environmental dimension of military activity is institutionalized primarily through the concept of environmental protection in military operations and STANAG 7141 (NATO, 2024), which requires the integration of environmental considerations into the planning, conduct, and termination of operations.

From a legal-theoretical perspective, STANAGs represent soft law. They are not judicially enforceable and are not directly reviewable by national courts. Their binding force derives from political commitments to interoperability and harmonization of operational procedures. Implementation occurs through internal defence regulations and military doctrine, creating a framework that is operationally binding for armed forces but formally separate from public legislative processes. Interoperability still depends on nationally implemented education, standards, and institutional adaptation (Šustr *et al*., 2025).

STANAG 7141 requires the identification of environmental risks, assessment of impacts on soil, water, and biodiversity, waste management planning, and post-operation remediation. Modern tactical decision-support systems increasingly employ algorithmic spatial modelling for the deployment of observation posts and artillery-related assets, demonstrating how operational planning has become strongly data-driven and analytically structured (Stodola *et al*., 2020; Neubauer *et al*., 2024). Conceptually, this represents a progressive model, as environmental protection is embedded within operational planning rather than treated as an external constraint. However, the framework is procedural rather than substantive. It does not establish concrete quantitative limits, binding emission thresholds, soil contamination standards, or specific noise limits for artillery activities.

In the context of the artillery of the Army of the Czech Republic, NATO standards are relevant particularly during allied training and exercises, including impact area management and unexploded ordnance handling. Recent research analysing the effects of artillery munition on terrain mobility further demonstrates that the physical transformation of training areas after repeated shelling has measurable operational and environmental consequences, thereby reinforcing the need for systematic assessment within military planning frameworks (Sedláček *et al*., 2024). Yet the absence of measurable environmental benchmarks limits their regulatory precision.

NATO has also developed methodologies for mapping greenhouse gas emissions within the defence sector (NATO, 2023), reflecting the growing linkage between climate change and security policy. While this contributes to strategic awareness and encourages decarbonization discussions, it remains methodological rather than legally enforceable.

Institutionally, NATO operates with limited public transparency. Environmental standards are primarily implemented within military hierarchies, and external oversight depends on national legal systems. NATO does not function as a supranational enforcement authority for environmental compliance. If domestic monitoring or liability frameworks are weak, NATO standards do not independently correct these deficiencies.

The principal normative deficit of the NATO layer lies in the absence of binding material limits and external enforcement mechanisms. Environmental governance relies largely on self-regulation and institutional culture. From an analytical standpoint, NATO provides significant procedural integration of environmental considerations into military management, but it does not replace the need for a clear and enforceable national legal framework. In the case of Czech artillery activities, NATO serves as an impetus for modernization of environmental management rather than as a comprehensive regulatory regime.

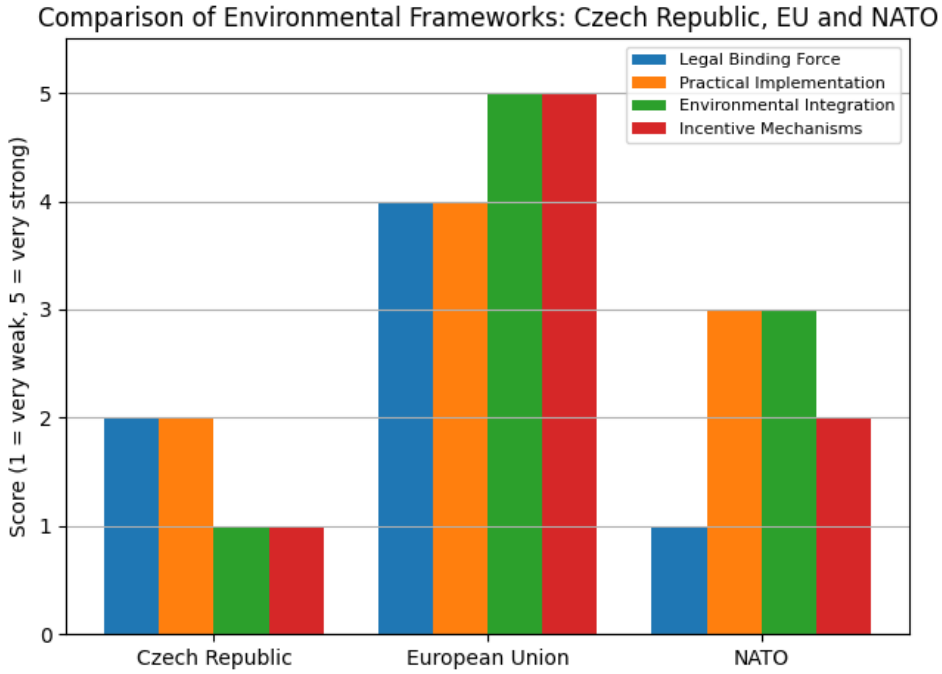
3.5 Comparison of legislative frameworks

To provide a synthetic overview of differences between the national, EU, and NATO regulatory levels, a comparative evaluation model was applied. Its results, illustrated in Figure 1, compare the three legal and institutional frameworks across four analytical criteria: legal binding force, practical implementation, degree of environmental

integration, and the existence of incentive mechanisms. The assessment uses a five-point scale, where 1 represents a very weak level and 5 a very strong level of the respective criterion.

Figure 1

Comparison of Environmental Legislative Frameworks of the Czech Republic, the European Union, and NATO



The Czech Republic achieves low to medium scores across all categories. Although legal binding force and formal implementation of environmental norms exist, their practical impact on artillery training remains limited. Environmental integration is weak and incentive mechanisms are largely absent. The national framework is characterized by a reactive approach, the lack of sector-specific methodologies, and a predominance of internal regulation with limited external oversight.

The European Union records the highest values in all criteria. EU law is marked by strong legal binding force, effective institutional enforcement, and systematic integration of environmental considerations into public policies. Despite certain exemptions for the defence sector, Member States remain responsible for fulfilling environmental and climate objectives. The EU also operates a relatively developed

system of incentive and coordination instruments that indirectly influence defence activities.

NATO emerges as a framework with medium to low legal binding force but a clearly developed procedural integration of environmental considerations. At the operational level, contemporary research confirms that artillery units increasingly rely on constructive simulation tools to evaluate the effectiveness and protection of firing batteries within firing positions, reflecting the ongoing technological transformation of modern artillery systems (Havlík *et al*., 2024). Alliance standards emphasize risk management, planning, and command responsibility rather than binding material limits. Their motivational effect derives primarily from interoperability requirements and institutional culture, rather than from legally enforceable obligations.

4 CONCLUSION

The conducted normative analysis indicates that the Czech Republic faces a specific opportunity to transform the environmental dimension of artillery activities from a predominantly reactive regulatory field into a systematically managed component of modern defence policy. Just as the European security environment increasingly integrates “hard” and “soft” instruments of power, the relationship between defence and environmental protection must move beyond the traditional dichotomy between security and ecology and be replaced by the concept of sustainable defence.

The Czech, EU, and NATO frameworks together create a foundational architecture that enables such a transformation. The European Union provides a high level of legal binding force and institutional enforceability, NATO offers procedural integration of environmental considerations into operational planning, and the Czech legal order incorporates constitutional and statutory principles of prevention, proportionality, and responsibility. The core problem therefore lies not in the absence of norms, but in the insufficient institutional coordination among them and the lack of sector-specific specialization for artillery activities.

As in other areas of security cooperation, it is essential to move from declaratory commitments toward a formally embedded, long-term strategic framework. In the context of the Armed Forces of the Czech Republic, this implies the establishment of a systematic

model of environmental due diligence within the defence sector, including regular monitoring of impact areas, transparent reporting compatible with the protection of classified information, unified methodologies for assessing cumulative contamination, and clearly defined institutional responsibility for remedial measures. Such a framework should be understood not as an administrative burden, but as an integral element of professional risk management in modern armed forces.

At the same time, dialogue between the defence and environmental sectors must be strengthened at national, EU, and NATO levels. The Czech Republic has the potential to actively shape the European debate on environmental responsibility in the defence sector, similarly to how some states position themselves in the field of climate security. Joint research platforms, data sharing on contamination of training areas, engagement of the academic community, and the development of specialized expert centres can facilitate a shift from isolated regulation toward an integrated security policy.

Existing risks must also be acknowledged. Fragmentation of legal regimes, broadly interpreted defence exemptions, limited public oversight of military training areas, and the absence of quantified limits for specific military impacts represent systemic vulnerabilities. If left unaddressed, these issues may gradually erode public trust and generate tensions between the constitutionally protected values of national defence and environmental protection.

The scientific contribution of this study lies in linking defence law with environmental responsibility and in identifying the normative space where these domains intersect. The findings suggest that the future of defence policy will be shaped not only by technological modernization and interoperability, but also by the capacity to integrate environmental standards into everyday military practice.

It can therefore be concluded that the environmental regulation of artillery activities within the Armed Forces of the Czech Republic has the potential to evolve from a marginal legal issue into a model example of sustainable security architecture. If systematically developed, this approach may enable the Czech Republic to contribute to the formation of a new European security culture in which environmental protection is understood not as a limitation of defence, but as its integral and strategic component.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.