



Environmental Issue in a Conflict Zone : The Influence of Security Actors on the Ukrainian-Russian Border

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Abstract: *The Russian invasion of Ukraine, which began in February 2022, has not only caused a humanitarian crisis but also triggered severe environmental consequences, particularly along the Ukrainian-Russian border. This study explores how military actions, occupation of sensitive ecological zones, and the targeting of industrial and critical infrastructure have led to widespread environmental degradation. Using a qualitative approach grounded in document analysis and legal frameworks, the research highlights how security actors have influenced the scale and nature of environmental damage. The findings reveal serious threats to soil quality, water safety, air purity, and biodiversity, as well as disruptions to waste management and energy systems. The paper also discusses the role of ecocide as a potential legal category for holding actors accountable for deliberate environmental harm. By situating the war within the broader context of environmental security and conflict ecology, the study argues for stronger international mechanisms to address ecological risks in armed conflict and post-war recovery.*

Keywords: *Ecocide, Environmental Degradation, Environmental Security, Security Actors, Ukraine Conflict.*

Abstrak: Invasi Rusia ke Ukraina, yang dimulai pada Februari 2022, tidak hanya menyebabkan krisis kemanusiaan tetapi juga memicu konsekuensi lingkungan yang parah, terutama di sepanjang perbatasan Ukraina-Rusia. Studi ini mengeksplorasi bagaimana aksi militer, pendudukan zona ekologi sensitif, dan serangan terhadap infrastruktur industri dan kritis telah menyebabkan degradasi lingkungan yang luas. Dengan pendekatan kualitatif yang didasarkan pada analisis dokumen dan kerangka hukum, penelitian ini menyoroti bagaimana aktor keamanan telah mempengaruhi skala dan sifat kerusakan lingkungan. Temuan penelitian mengungkapkan ancaman serius terhadap kualitas tanah, keamanan air, kebersihan udara, dan keanekaragaman hayati, serta gangguan pada sistem pengelolaan limbah dan energi. Artikel ini juga membahas peran ekosida sebagai kategori hukum potensial untuk mempertanggungjawabkan aktor yang sengaja menyebabkan kerusakan lingkungan. Dengan menempatkan perang dalam konteks yang lebih luas dari keamanan lingkungan dan ekologi konflik, studi ini mendesak adanya mekanisme internasional yang lebih kuat untuk menangani risiko ekologi dalam konflik bersenjata dan pemulihan pasca-perang.

Kata kunci: Keamanan Lingkungan, Konflik Ukraina, Ekosida, Aktor Keamanan, Degradasi Lingkungan.

1. INTRODUCTION

Natural disasters, economic crises, conflicts, terrorism, and war are just a few of the ongoing problems that humanity faces. Israel, Palestine, Syria, and Ukraine are recent instances of countries that have long engaged in direct military operations. On February 24, 2022, Russia launched its massive invasion of Ukraine, which is still going on today (Hanoshenko, Halaktionov, & Huber-Humer, 2024, p. 1). Nowadays Humanity is facing serious challenges from environment issue until politics and wars. This study case is going to talk about how can this problem happened especially the impact of Russia invaded Ukraine. Russian military intervention in Ukraine has resulted in mass migration, poverty,

home devastation, loss of life, and destruction of military and civil infrastructure. The economic standing of the nations and the standard of living for the populace both declined as a result of these conflicts. Furthermore, the environment of the nations that are the targets of invasion is under danger due to the acts of Russian military. It concerns the intentional acts of the occupiers that result in man-made mishaps and jeopardize the environmental safety of millions of people who reside well outside of the lines of conflict (Shevchenko & Horiacheva, 2024, p. 1). The most prominent impact of this war was loss of life, environmental issue and causes to the infrastructure in the Ukraine. Economic and politics are also among the most affected in addition, Russian troops threat Ukraine as the objects of aggression.

As of October 2023, approximately 500,000 military personnel from both Ukraine and Russia have suffered fatalities or injuries during the conflict. Additionally, 30,000 civilians have lost their lives or sustained injuries, as reported by the Office of the High Commissioner on Human Rights. Furthermore, the war's indirect health consequences are likely responsible for an even higher incidence of civilian illness and death, attributed to malnutrition, infectious diseases, worsening of chronic conditions, maternal and infant health issues, as well as mental and behavioral health disorders. These indirect health repercussions are mainly driven by forced displacement and the destruction of civilian infrastructure. In November 2023, the UNHCR: The United Nations Refugee Agency indicated that nearly 6.3 million Ukrainians had fled the country, 5.0 million had been displaced internally, and over 17 million were in need of humanitarian aid. The military actions of Russia have inflicted significant damage on civilian infrastructure related to healthcare, agriculture and food supply, water and sanitation, energy, transportation, and communication. Moreover, the conflict has severely impacted Ukraine's economy and has negatively influenced food and energy security in numerous countries (Hryhorczuk, et al., 2024, p. 2). By late 2023, the war had harmed about 500,000 soldiers and 30,000 civilians. Many more people got sick due to hunger, poor healthcare, and stress from the conflict. Over 6 million Ukrainians fled the country, and 5 million had to leave their homes but stayed in Ukraine. The fighting has destroyed hospitals, farms, roads, and power lines, making life harder in Ukraine and causing problems for food and energy supplies in other countries too.

The invasion of Ukraine by Russia presents significant challenges to global peace and the welfare of numerous individuals, particularly at a moment when environmental concerns and worldwide issues like climate change necessitate coordinated efforts among

all nations (Filho, Eustachio, Fedoruk, & Lisovska, 2024, p. 1). The Russian invasion of Ukraine presents significant challenges to international peace and human security, particularly at a time when urgent global issues such as climate change and environmental degradation demand coordinated and unified action from the international community. The conflict has clearly impacted Europe's security, particularly by undermining its established military and territorial stability (Vogler, 2023). Nevertheless, the repercussions go beyond conventional security matters. The war has resulted in considerable environmental and climate-related effects, highlighting a significant connection between military security and climate issues. The war-affected economies of both Russia and Ukraine, as well as those of allied nations, have produced considerable carbon emissions (BBC, 2022). This scenario has diminished global progress towards climate commitments, as evidenced by the stagnation observed during the 2022 UN Climate Conference in Sharm el-Sheikh. Additionally, the surge in energy prices and increased competition for energy resources have prompted some countries to reevaluate their reliance on coal and other fossil fuels, which had previously been declining in many developed countries (Kolmaš, 2023, p. 2). This highlights how armed conflict can reverse progress on climate goals by intensifying fossil fuel dependence, redirecting resources away from sustainable energy, and disrupting multilateral cooperation. The case of the Russia–Ukraine war shows that climate policy cannot be separated from global security dynamics. Therefore, any meaningful environmental response must also address the broader geopolitical structures that influence energy access and emissions behavior.

Humanity continues to face an array of compounding global crises natural disasters, pandemics, economic instability, political unrest, terrorism, and war. Among the most devastating in recent history is the full-scale invasion of Ukraine by the Russian Federation, which began on February 24, 2022 (Hanoshenko, Halaktionov, & Huber-Humer, 2024, p. 1). This war has not only inflicted immense human suffering but also generated profound consequences for the environment, infrastructure, and global security architecture. Russia's aggression has resulted in mass displacement, widespread destruction of civilian and military infrastructure, economic decline, and environmental degradation. Millions of Ukrainians have been displaced, both internally and abroad, with over 17 million requiring humanitarian assistance by late 2023 (Hryhorczuk, et al., 2024, p. 2). The war has severely disrupted healthcare, agriculture, energy, and water systems, exacerbating public health crises and undermining essential services. These impacts extend far beyond the borders of Ukraine, influencing energy security and food supply

chains globally. In particular, the environmental dimension of this conflict demands urgent attention. From toxic pollution of air, soil, and water caused by bombardments and industrial sabotage, to forest fires, radiation risks near nuclear facilities, and the massive carbon footprint of wartime activities, the war has magnified Ukraine's preexisting environmental vulnerabilities (Shevchenko & Horiacheva, 2024, p. 1). The widespread use of heavy artillery and the targeting of fuel depots and chemical plants have left behind a toxic legacy that will likely persist for decades (The Environmental Impact of the Conflict in Ukraine, 2022). Furthermore, the ecological consequences of the war are deeply intertwined with geopolitical dynamics. The destruction of natural ecosystems and industrial zones has triggered environmental risks comparable to historical wartime ecocide (Wirtu & Abdela, 2025). Soil contamination, biodiversity loss, and the release of hazardous substances into aquatic systems have intensified regional and transboundary environmental insecurity (Solokha , et al., 2024). These phenomena underscore the strategic role of environmental protection in conflict zones and post-conflict reconstruction efforts.

The Russian-Ukrainian war has also disrupted global climate governance. Energy shortages and market volatility caused by sanctions and destroyed supply lines have prompted some nations to revert to fossil fuels, undermining the global energy transition and stalling progress on climate goals. As Kolmaš (2023) argues, this regression in environmental policy illustrates how global security and climate policy are inextricably linked. This study investigates the environmental impact of the Russia-Ukraine conflict, with a particular focus on the role of security actors along the Ukrainian-Russian border. By examining the interface between conflict dynamics, ecological damage, and international response, this paper contributes to a deeper understanding of how armed conflict transforms environmental governance. It also highlights the necessity of incorporating ecological security into broader peacebuilding and reconstruction frameworks. In this context, the role of security actors state militaries, non-state actors, and international peacekeeping institutions becomes critical. These actors not only influence the extent and nature of environmental degradation during conflict but also determine the trajectory of environmental recovery and legal accountability post-conflict. Addressing environmental degradation in war zones, therefore, requires an integrated approach that brings together international law, environmental science, conflict resolution, and human security.

2. THEORITICAL REVIEW

This study draws upon an interdisciplinary theoretical foundation that combines the concepts of environmental security, ecocide, and conflict-driven environmental degradation. These frameworks offer a lens through which to examine the environmental consequences of military operations, particularly those led by state and non-state security actors during the Russian invasion of Ukraine.

Environmental Security and Conflict Impact

Environmental security, as defined in contemporary policy and academic literature, extends beyond traditional state-centric defense to include the safeguarding of ecosystems and natural resources as essential to human well-being and stability. The war in Ukraine has underscored how environmental systems become both targets and casualties of armed conflict. According to (Filho, Eustachio, Fedoruk, & Lisovska, 2024), the widespread release of pollutants into soil, water, and air caused by explosions, fires, and military waste has not only damaged the Ukrainian environment but also posed a threat to human health and public infrastructure. These disruptions illustrate the environmental vulnerability of conflict zones and the necessity of integrating ecological concerns into broader security assessments.

This concept is reinforced by (Hryhorczuk, et al., 2024), who argue that the environmental dimension of the war, including chemical contamination and radiation risk, directly undermines civilian health and long-term recovery. Their work highlights the need to treat environmental degradation not as collateral damage, but as a central issue of post-conflict reconstruction and international humanitarian law.

Environmental Security Theory is a conceptual approach that expands the traditional understanding of national and international security by incorporating environmental elements as an integral part of a country's stability and survival. In this approach, environmental damage is no longer seen as a secondary consequence of conflict, but as a major threat that can exacerbate social instability, worsen humanitarian disasters, and even trigger new conflicts in the future. This theory emphasizes that severe environmental degradation whether in the form of water pollution, forest destruction, soil contamination, or toxic emissions from military activities is a factor that can directly disrupt the geopolitical order and the welfare of civilian populations.

In the context of the Ukraine-Russia conflict, this theory is highly relevant. The full-scale war that began in February 2022 has caused systematic destruction of environmental infrastructure along the border between the two countries. Air strikes on fuel facilities, bombing of chemical industrial areas, and occupation of conservation areas such as nature reserves and wetlands not only impact local ecosystems but also create transnational risks such as cross-border pollution, changes in river flow patterns, and atmospheric degradation. This demonstrates that environmental damage in conflict zones is not a side effect but a strategic component of military operations that have far-reaching implications for human security and regional ecosystems.

Ecocide and Legal Responsibility

The concept of ecocide provides a legal and ethical framework for understanding the scale and intention behind environmental destruction during war. As noted by (Wirtu & Abdela, 2025), ecocide refers to deliberate actions resulting in severe, widespread, or long-term environmental harm. The war in Ukraine has presented multiple cases where environmental damage appears intentional or strategically advantageous for example, the targeting of fuel depots and chemical plants. The UNEP (2022) report similarly indicates that long-term contamination and ecological disruption from such acts pose serious risks not only to local populations but also to neighboring regions.

Moreover, the targeting of protected areas, such as Ramsar wetlands and zones under the Emerald Network, as documented by Leal Filho et al. (2024), points to the deliberate undermining of environmental treaties and conservation frameworks. This raises critical questions about accountability and the gaps in international legal systems when addressing environmental crimes during warfare. Ecocide Theory is a developing legal and ethical approach that recognizes large scale environmental destruction as a form of international crime. Like genocide or crimes against humanity, ecocide is seen as an act that not only harms ecosystems, but also threatens human life on a large scale. This theory is rooted in the idea that deliberate and systematic environmental damage, especially during armed conflict, can no longer be considered a side effect of war. Instead, it must be seen as a serious crime that violates the principles of environmental justice and global moral responsibility.

In the context of Russia's invasion of Ukraine, the application of ecocide theory becomes particularly relevant. As demonstrated by Wirtu and Abdela (2025), there is strong evidence that certain military actions were carried out with full awareness of their

environmental impacts. Attacks on chemical industrial facilities, the burning of fuel depots, and the bombing of energy and agricultural infrastructure not only cause physical damage but also create long-term contamination of soil, water, and air. In many cases, this damage is widespread and will have an impact for decades to come.

According to a report from the United Nations Environment Programme (UNEP), such actions have caused soil contamination by heavy metals, the spread of toxic waste in residential areas, and increased radiation risks due to military tensions around nuclear facilities such as the Zaporizhzhia Nuclear Power Plant. UNEP emphasizes that the scale and nature of this destruction opens the door for international legal recognition of ecocide as an effort to strengthen accountability during conflicts. The theory of ecocide challenges the current state of international law, which has been weak in addressing environmental damage during wars. The absence of clear mechanisms to prosecute those responsible for ecological destruction leaves many countries free from legal consequences for their actions. Furthermore, the recognition of ecocide as an international crime also signals that the environment is no longer merely a domestic concern but a matter of global interest. This concept seeks to protect future generations from an invisible yet systemically dangerous legacy of destruction. In other words, the use of ecocide theory in your study not only provides a critical analysis of the military's role but also underscores the need for more responsive international legal reforms that prioritize ecological justice.

3. METHODOLOGY

This research employs a qualitative, interdisciplinary methodology to investigate the environmental consequences of the Russia-Ukraine war, with a particular focus on the roles of security forces operating near border regions. Given the ongoing nature of the conflict and the complexity of its ecological impacts, the study is grounded in the analysis of secondary data and documentary sources. It draws upon diverse disciplines—environmental science, conflict ecology, and international law—to provide a holistic understanding of wartime environmental degradation. Primary data sources include peer-reviewed academic articles, scientific studies from relevant journals, and authoritative reports from international organizations such as the United Nations Environment Programme (UNEP), the Office of the High Commissioner for Human Rights (OHCHR), and the UN Refugee Agency (UNHCR). Additional materials encompass Ukrainian governmental publications, NGO assessments of environmental and humanitarian damage, and legal documents including international treaties such as the Geneva Protocol I and the

ENMOD Convention. Notably, recent academic works by Hanoshenko et al. (2024), Hryhorczuk et al. (2024), and Shevchenko & Horiacheva (2024) are incorporated to anchor the study in the most current research.

The analytical framework is informed by a conflict-ecology perspective, which explores how environmental damage is shaped by the political, military, and social dynamics of warfare. This framework assesses immediate ecological harms—such as water contamination, deforestation, and toxic emissions—alongside the legal responsibilities and operational behaviors of military and paramilitary forces, including both Russian and Ukrainian troops, peacekeepers, and local law enforcement. It also investigates how environmental degradation is strategically weaponized and the implications this holds for post-conflict recovery and environmental governance. The temporal scope of the research spans from February 2022 to December 2024, and it focuses geographically on war-affected regions along the Ukraine-Russia border. Due to ongoing hostilities and limited field access, the research does not include direct environmental sampling or fieldwork; instead, it synthesizes satellite imagery, remote sensing data, and published expert analyses. While this limits the ability to conduct primary verification, the methodology facilitates a comprehensive review of existing findings and highlights crucial directions for future in-situ investigation.

4. RESULTS AND DISCUSSION

The environmental impacts of the Russia–Ukraine conflict are far reaching, multifaceted, and in many cases irreversible. This war, unlike many in the recent past, has shown how security actors can significantly shape not only the trajectory of the conflict but also the extent and nature of environmental degradation. Unlike natural disasters, the destruction caused during wartime is often intentional, calculated, and deeply intertwined with military objectives. The widespread destruction of infrastructure both civilian and industrial has led to critical environmental consequences. As outlined by (Hryhorczuk, et al., 2024), explosions, the use of heavy artillery, and the targeting of energy infrastructure have caused chemical contamination across multiple domains soil, water, and air. These effects are not just localized to conflict zones but have the potential to affect broader ecosystems and even cross international borders through water bodies and air currents.

Security actors have played a direct role in this destruction. Military decisions such as the bombing of chemical plants, oil refineries, and agricultural storage sites have led to large-scale pollution events. According to (Shevchenko & Horiacheva, 2024), Russian

forces have deliberately targeted high-risk environmental zones, including fuel storage depots and critical agricultural infrastructure. This not only cripples local economies but also releases harmful substances like polycyclic aromatic hydrocarbons (PAHs), heavy metals, and hydrocarbons into the environment. The occupation of ecologically sensitive zones by military forces has further complicated the situation. As (Filho, Eustachio, Fedoruk, & Lisovska, 2024) report, over 20% of Ukraine's protected natural areas including Ramsar wetlands and nature reserves under the Emerald Network have been directly affected. Some of these areas have seen troop movements, fortifications, and even active combat. These actions threaten biodiversity, disrupt natural regeneration cycles, and compromise the ecological integrity of regions designated for conservation. Remote sensing data has confirmed the physical scale of damage. (Serhii, Viktor, & Olena, 2022) note that satellite images show extensive forest fires, soil erosion, and altered land cover resulting from both direct shelling and the passage of heavy armored vehicles. In many areas, soils have been compacted, microbial activity suppressed, and toxic residues left behind from explosives and fuel combustion. This damage goes far beyond cosmetic or temporary change it alters the land's ability to regenerate, affecting agriculture and human settlement for decades to come.

The issue of waste generated during war is another critical dimension. As observed by (Hanoshenko, Halaktionov, & Huber-Humer, 2024), the conflict has created a surge in hazardous military and civilian waste, including abandoned vehicles, rubble from demolished buildings, chemical residues, and medical waste. In many affected regions, the infrastructure for waste processing has been destroyed, leading to the uncontrolled dumping of toxic material in unregulated sites, which poses long-term health risks and environmental hazards. One of the most alarming aspects of the conflict has been the risk posed to nuclear facilities. The seizure of the Zaporizhzhia Nuclear Power Plant by Russian forces has drawn international concern over the possibility of radioactive contamination (Hryhorczuk, et al., 2024) . The risk of ecological catastrophe from such actions is not hypothetical it echoes past disasters like Chernobyl, and highlights how the militarization of environmental threats has reached unprecedented levels.

On a broader scale, the war has severely disrupted global environmental governance and climate commitments. (Kolmaš, 2023) emphasizes that the geopolitical fallout from the conflict, particularly the disruption of natural gas supplies and the resulting energy insecurity in Europe, has led some countries to return to coal and other fossil fuels. This development not only stalls progress on the Paris Climate Agreement targets but also

highlights how deeply interconnected military conflicts and global climate policy have become. The war has also intensified calls to recognize ecocide as an international crime. (Wirtu & Abdela, 2025) argue that the scale and intentionality of environmental destruction during the Ukraine war meet the criteria for ecocide a deliberate act causing widespread and long-lasting environmental harm. Incorporating ecocide into international law would serve not only as a form of justice for affected regions but also as a deterrent against future environmental targeting in warfare.

Importantly, the role of security actors cannot be viewed solely in terms of destruction. These actors, particularly international institutions and post-conflict reconstruction teams, also have a vital role in environmental remediation. However, as current research shows, there remains a significant gap between international legal principles and their enforcement on the ground (The Environmental Impact of the Conflict in Ukraine, 2022). Without a stronger mechanism for accountability, security actors may continue to operate with impunity when it comes to environmental harm.

5. CONCLUSION

The Russian invasion of Ukraine has brought to light a deeply alarming dimension of modern warfare: the weaponization and systemic degradation of the environment. As demonstrated throughout this study, the war has not only inflicted devastating humanitarian losses but has also triggered widespread and potentially irreversible environmental harm. Soil contamination, water pollution, deforestation, biodiversity loss, and the targeting of industrial and nuclear infrastructure have all contributed to a growing ecological crisis that extends well beyond Ukraine's borders. Security actors, especially military forces and occupying troops, have played a central role in this ecological devastation. The strategic targeting of high-risk environmental assets such as fuel depots, wetlands, agricultural storage sites, and protected nature reserves illustrates a troubling trend in modern conflict where environmental destruction is used not only as a tactic of war but also as a tool of long-term disruption. This calls for a significant reevaluation of how environmental protection is treated in both wartime conduct and post-conflict recovery. At the same time, the conflict has underscored the inadequacy of current international legal frameworks in addressing environmental crimes during armed conflict. While concepts like ecocide are gaining traction in scholarly and legal circles, enforcement remains weak, and accountability for environmental harm is rare. The failure to hold

violators accountable enables continued environmental degradation, further endangering ecosystems and the people who depend on them.

Moreover, the war's consequences for global climate and energy policy are substantial. As countries scramble to secure energy amid supply disruptions, some have regressed on their climate commitments by returning to coal and other high-emission sources. This dynamic illustrates the intricate link between environmental governance and international security, and reinforces the urgent need for integrated policies that address both. This study has shown that environmental degradation in war zones is neither incidental nor peripheral it is integral to the nature of modern conflict. Therefore, it must be treated as a matter of international urgency. Environmental protection should be embedded in conflict resolution, peacekeeping operations, and long-term reconstruction efforts. Security actors must be held accountable not only for human rights violations but also for environmental damage, which can affect generations to come.

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