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Issue Brief

Warfare and Its Environmental Impact

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Summary

Warfare inflicts severe environmental damage that is often overlooked. The militaries of major powers are also among the most significant sources of carbon emissions, undermining ecosystems, accelerating climate change, and complicating sustainable development efforts.

"When elephants fight, it is the grass that suffers."[1] This ancient proverb from the Kikuyu people of Kenya, when contextualised in terms of war or armed conflict, suggests that it is the environment or nature that is the victim during wars between or among nation-states, or even within different social groups, as in an ethnic conflict.

In the global conflict trends data from the Peace Research Institute of Oslo (PRIO), it was recorded that in 2023, 59 state-based conflicts worldwide resulted in 122,000 battle-related deaths, and 75 non-state conflicts resulted in approximately 21,000 battle-related deaths.[2] Meanwhile, data released by the UN Office of the High Commissioner for Human Rights (OHCHR) in June 2025 reveals that at least 48,384 individuals (civilians) were killed in 2024 in various conflicts, a surge of 40 per cent from 2023.[3]

The cost of human lives in war or armed conflict is undeniable and profound, and the UN Human Rights Chief, Volker Turk, has stated that the global community must take "urgent action" to avoid armed conflicts and civilian deaths. But one should equally give attention to or consider that war or armed conflict not only costs human lives but also inflicts enormous damage on the environment, which is indeed often overlooked as a consequence. The United Nations Environment Programme (UNEP) has aptly captured that the "environment continues to be the silent victim of armed conflicts worldwide".[4]

Environmental Degradation in War and Peace Time

Wars have contributed to ecological destruction in several ways. Environmental sociologist Kenneth Gould once declared that the "most ecologically destructive human endeavour" is "militarisation".[5] To understand the linkage, a conceptual framework called 'warfare ecology' by Gary E. Machlis and Thor Hanson has systematically underlined that environmental destruction occurs at three stages: preparation for war, war, and post-war activities.[6] In short, the environment or biodiversity gets destroyed both during war and in times of peace.

Several pieces of empirical evidence indicate that the environment has become a victim of war. One of the most commonly referenced is the destruction of more than

[1] John Simpson and Jennifer Speake (eds), ***The Oxford Dictionary of Proverbs***, Oxford University Press, Oxford, 2008.

[2] Siri Aas Rustad, **"Conflict Trends: Global Overview, 1946-2023"**, Paper, Peace Research Institute Oslo (PRIO), 2024.

[3] **"UN Data Shows Surge in Civilian Deaths in Conflicts Globally, Highlights Pervasive Discrimination"**, UN Office of the High Commissioner for Human Rights, 18 June 2025.

[4] **"Protecting the Environment During Armed Conflict: An Inventory and Analysis of International Law"**, United Nations Environment Programme (UNEP), 2009.

[5] Kenneth A. Gould, **"The Ecological Costs of Militarization"**, *Peace Review*, Vol. 19, No. 3, 2007, pp. 331–334.

[6] Gary E. Machlis and Thor Hanson, **"Warfare Ecology"**, *BioScience*, Vol. 58, No. 8, 2008, pp. 729–735.

five million acres of forest and 500,000 acres of farmland in Vietnam by the US military using Agent Orange during the Vietnam War.[7] The ongoing war in Ukraine has not only caused thousands of casualties, a refugee crisis and economic shock, but has also brought significant environmental destruction. In particular, the destruction of Ukraine's largest dam, the Kakhovka, on 6 June 2022, has brought long-term ecological and health impacts. Apart from submerging thousands of hectares of land due to the catastrophic flooding, it released highly toxic heavy metals, contaminating river water and thereby threatening human health, drinking water systems and agricultural land.[8]

Similarly, the environmental impact of the war in Gaza has been tremendous, where farmland, water resources and marine life were destroyed by the bombardment carried out by the Israeli Defence Force (IDF). UNEP reports that the Gaza enclave faces "a legacy of environmental destruction that could affect the health and well-being of generations" and risks of irreversible damage to its natural ecosystems.[9]

After the sinking of the Rubymar, a UK-owned freight ship, by the Houthi missile attack on 18 February 2024, it was reported that approximately 21,000 metric tons of ammonium phosphate sulphate fertiliser were lost, posing a grave environmental risk to marine life, including coral reefs and coastal communities that rely on fishing for their livelihood.[10]

The environment is also affected in several ways during peacetime and during periods of war preparation. For example, to establish a military base or infrastructure for military purposes, such as training and testing weapons, a large area of land and sea is often required. Vast areas of forest land are cleared to build transportation routes for the mobility of military vehicles, etc. Meanwhile, due to vested geopolitical interests, some states are constantly preparing for future conflicts. In such a state of preparation during peacetime, vast amounts of fossil fuel are consumed, emitting substantial quantities of carbon dioxide that disrupt landscapes and terrestrial and marine habitats.[11]

Access to such areas for conducting research is challenging, as military facilities remain in the shadows for security reasons.[12] A study on the environmental

[7] Pamela McElwee, **"Revisiting the Environment Legacies of the Vietnam War"**, *Current History,* Vol. 124, No. 863, 2025, pp. 209–215.

[8] O. Shumilova et al., **"Environmental Effects of the Kakhovka Dam Destruction by Warfare in Ukraine"**, *Science*, Vol. 387, No. 6739, 2025, pp. 1181–1186.

[9] **"Environmental Impacts of the Escalation of Conflict in the Gaza Strip: Second Assessment of Environmental Damage and Recommendations for Recovery and Reconstructions Planning"**, UNEP, 2024.

[10] **"Sinking of Motor Vessel Rubymar Risk Environmental Damage"**, U.S. Central Command, 2 March 2024.

[11] Kaitlyn M. Gaynor et al., **"War and Wildlife: Linking Armed Conflicts to Conservation"**, *Frontiers in Ecology and the Environment*, Vol. 14, No. 10, 2016, pp. 533–542.

[12] Michael J. Lawrence et al., **"The Effects of Modern War and Military Activities on Biodiversity and the Environment"**, *Environmental Review*, Vol. 23, No. 4, 2015, pp. 443–460.

degradation from the US military bases established in more than 80 foreign countries found that significant ecological damage had occurred through toxin leaks, accidents, the dumping of hazardous waste, base construction and training involving dangerous materials, in addition to the displacement of the indigenous population from Diego Garcia Island.[13] On the other hand, the Centre for Biological Diversity once issued a cautionary report that the US Navy training exercises in the Pacific Ocean could kill, injure or harass whales, dolphins and other marine mammals.[14] In India, during a training exercise by the Indian Air Force (IAF), several livestock animals were killed and villagers injured in the Dolyngmukh of Kamle district of Arunachal Pradesh.[15]

Military Action, Carbon Emissions and Climate Change

Greenhouse gas (GHG) emission from military action is yet another significant impact on the environment. Military actions are often highly energy-intensive, mainly derived from fossil fuels, and fuel-based combat planes, warships and armoured vehicles emit large amounts of GHGs that contribute to the climate crisis. In addition, facilities at operational bases and the supply chain for weapons and weapons themselves are substantial sources of GHG emissions. For instance, non-nuclear aircraft carriers consume approximately 6000 gallons of fuel per hour, and fighter planes like the F-35A and F-16 often burn 1,500 gallons of fuel per hour.[16]

GHG emissions from the military sector occur both in wartime and peacetime. In a study of the carbon footprint for the first 15 months of the Gaza war, it was found that nearly 1.9 million metric tonnes of carbon dioxide were emitted, exceeding the annual emissions of 36 countries.[17] Also, with a total of 230 million tonnes of carbon dioxide emitted from early 2022 to early 2025, the war in Ukraine has become one of the most significant sources of carbon emissions, equivalent to the annual emissions of Austria, Hungary, the Czech Republic and Slovakia combined.[18]

As of 2022, global militaries were responsible for an estimated 5.5 per cent of the total carbon footprint, enough to rank as the world's fourth-largest GHG emitter.[19]

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[13] David Vine et al., **"Drawdown: Improving U.S. and Global Security through Military Base"**, Quincy Brief No.16, Quincy Institute for Responsible Statecraft, Washington D.C., 2021.

[14] **"Navy to Re-examine Effects of Pacific Training Exercise on Endangered Whales"**, Centre for Biological Diversity, 15 July 2021.

[15] **"Dollungmukh Protest, Demands Shifting of IAF Base"**, *The Arunachal Times*, 13 June 2018.

[16] Andrew Jorgenson et al., **"Militarizing the Climate Crises: An Analysis of the Short-run and Long –run Effects of Militarization on Nations' Carbon Emission, 1990-2020"**, *Social Problem*, Vol. 20, pp. 1–22.

[17] Benjamin Neimark et al., **"War on Climate: A Multitemporal Study of Greenhouse Gas Emissions of the Israel-Gaza Conflicts"**, SSRN, 2025.

[18] Lennard de Klerk et al., **"Climate Damage Caused by Russia's War in Ukraine: 24 February 2022-23 February2024 by Initiative on GHG Accounting of War"**, Ecoaction, 13 June 2024,.

[19] **"How Big are Global Military Carbon Emissions?"**, Scientists for Global Responsibility (SGR), 8 July 2022.

But this is only an estimate, since the actual data are unknown because reporting of military carbon emissions is exempted under the 1997 Kyoto Protocol. Moreover, under the United Nations Framework Convention on Climate Change (UNFCC), it is only 'voluntary' for countries to disclose their annual military carbon emission. Since reporting is not mandatory, it creates a significant gap in measuring actual output and, in turn, leads to failure to design effective policy mechanisms.

In terms of military carbon emissions, it is confirmed that the US Department of Defense (DoD), being the single largest institutional consumer of fossil fuels, is the largest single source of carbon emissions.[20] If the US DoD were considered a nation-state, it would be the 47th largest emitter in the world. With 900 bases in the United States and another 800 overseas, it emitted a total of 636 million metric tons of carbon dioxide between 2010 and 2019.[21]

Accurate accounting of carbon emissions, especially from the military sector, is, however, imperative for designing effective policy mechanisms to tackle the climate crisis. Ironically, the countries with the most significant military expenditures failed to maintain transparent records of their military emissions. For instance, the United States, with US$ 880.1 billion in military spending in 2023, is the world's largest military spender and falls under the UNFCCC Annexe I category, which obliges countries to report their emissions every year. It has failed to submit any emission inventory report to the UNFCC for the 2025 submission of 2023 data.[22]

Against the backdrop of the US withdrawal from the Paris Agreement, it is unlikely to submit its carbon emissions report in the near future. The Russian Federation, another Annexe I country with US$ 100 billion in military spending in 2023, is the third-largest military spender. However, data is not clearly separated between civilian and military carbon emissions.[23] On the other hand, China, a non-Annexe I country that spent US$ 300 billion in 2023, ranked second-largest in military expenditure and faces no formal obligation to report its emissions. Although it voluntarily submitted an emission inventory report, the data covers only 2021 emissions, and there is no military emissions data.[24]

Curbing carbon emissions from military activities remains pertinent to addressing the climate crisis. But emissions from the military sector are likely to increase due to a surge of global military expenditure, reaching US$ 2,718 billion in 2024, an increase of 9.4 per cent from 2023, the highest since at least the end of the Cold

[20] Neta C. Crawford, **"Pentagon Fuels Use, Climate Change and Costs of War"**, Watson Institute International &Public Affairs, Brown University, 13 November 2019.

[21] Oliver Belcher et al., **"Hidden Carbon Costs of the 'Everywhere War': Logistics Geopolitical Ecology, and the Carbon Boot-print of the US Military"**, *Transactions of the Institute of British Geographers*, Vol. 45, No. 1, 2019, pp. 65–80.

[22] **"The Military Emission Gap"**, Conflict and Environment Observatory.

[23] Ibid.

[24] Ibid.

War.[25] The steepest rise in military expenditure is mainly attributed to the ongoing war in Ukraine and the consequent increase in military spending among North Atlantic Treaty Organization (NATO) member states, as well as to armed conflict in the Middle East.

With the backdrop of rising military spending, a report by the UN Secretary General notes that "rising military spending runs counter to the very objectives, principles and purpose of the United Nations". It warns that although rising military expenditure is not a new phenomenon, "its recent intensification poses the risk of it becoming 'normalised' and regarded as inevitable".[26]

Way Forward

The environment is at the core of each of the Sustainable Development Goals (SDGs). Hence, protecting the environment and conserving biodiversity are vital, as they provide not only ecosystem services, or what is called 'natural capital', such as food, water and medicine, for all life on earth, but also help mitigate climate change.[27] However, as illustrated, the environment is being degraded and biodiversity destroyed by militarisation, both during war and in peacetime, thus achieving sustainable development is a challenge.

One of the key factors in protecting the environment in the context of war and armed conflict is how states implement or uphold the 27 legal principles on the 'Protection of the Environment in relation to Armed Conflict' (PERAC), adopted by the UN General Assembly on 7 December 2022.[28] Though it is not legally binding, the scope outlines environmental protection during both war and peacetime. Apart from calling on the states to implement measures in legislative, judicial and administrative terms for the safety of the environment in relation to armed conflict, it also calls on the states to designate areas of environmental importance as 'protected zones' in the event of an armed conflict and provisions on ecological protections should be made where military forces are present.

The World Meteorological Organisation confirmed that, with a global mean near-surface temperature 1.55 Celsius above the 1850-1900 average, 2024 was the warmest year in the 175-year observational record.[29] Breaching 1.5 degrees Celsius

[25] Xiao Liang et al., **"Trends in World Military Expenditure, 2024"**, Stockholm International Peace Research Institute (SIPRI), April 2025.

[26] **"The Security We Need: Rebalancing Military Spending for a Sustainable and Peaceful Future—Report of the Secretary General"**, United Nations.

[27] Yadvinder Malhi et al., **"Climate Change and Ecosystems: Threats, Opportunities and Solution"**, *Philosophical Transactions of the Royal Society B*, Vol. 375, 2019, pp. 1–8.

[28] **"Protection of the Environment in Relations to Armed Conflicts"**, Resolution/adopted by the General Assembly, UN General Assembly 77th session, United Nations Digital Library, 2022.

[29] **"WMO Confirms 2024 as Warmest Year on Record at About 1.55 C Above Pre-industrial Level"**, World Meteorological Organisation, 10 January 2025.

indeed serves as a wake-up call for humanity to accelerate mitigation policies. Yet, to achieve the Paris Agreement's goal of well below 2 degrees Celsius, it has "barely moved the needle", as UNEP has highlighted.[30] Also, it warned that global temperatures will likely exceed 1.5 degrees Celsius within the following decades.

Thus, with the backdrop of the perilous situation that is going to unfold in the climate crisis, curbing carbon emissions from the military sector cannot be ignored, and accurate reporting of data is essential. Former NATO Secretary-General Jens Stoltenberg at the UN Climate Summit (COP 26) in Glasgow has rightly pointed out that "there is no way to reach net zero without also including emission from military".[31] To overcome the challenges of carbon emissions from the military sector, innovation or strengthening the Paris Agreement Framework, primarily by ending the practice of reporting fossil fuel consumption, is needed. Former Chief of the British General Staff, General Sir Mark Carleton-Smith, suggested that the UK's "current equipment programme is possibly the last to be dependent on fossil fuel".[32]

Hence, developing new low-carbon energy sources is another necessary condition for addressing the climate crisis. To achieve carbon neutrality by 2060, as announced by Chinese President Xi Jinping in September 2020, the Chinese PLA has taken steps to build a secure and sustainable military energy system by promoting solar, ocean and hydrogen energy for military purposes.[33] Similarly, in January 2025, Norway became the first country to successfully operate F-35 fighter jets using biofuel known as Sustainable Aviation Fuel (SAF).[34]

The solution to environmental degradation and the climate crisis depends on several variables. In a landmark 'advisory opinion' by the International Court of Justice (ICJ) on 23 July 2025, the Court unanimously concluded that the challenges posed by the climate crisis are "urgent and existential" to humanity and that states are therefore legally obliged to protect and reduce the emission of GHGs.[35] This verdict marks a pivotal step towards strengthening environmental regulations, requiring the global community not only to comply with existing rules but also to create new rules for lasting, satisfactory solutions to ecological destruction.

[30] **"Emission Gap Report 2025: Off Target"**, UNEP, 4 November 2025.

[31] **"Remarks by NATO Secretary General Jens Stoltenberg at the High-level Roundtable 'Climate Peace and Stability: Weathering Risk Through COP and Beyond' in Glasgow, UK"**, North Atlantic Treaty Organization (NATO), 2 November 2021.

[32] **"Army Could Phase Out Fossil Fuels to Attract Ecofreindly Recruits, Senior General Says"**, *The Telegraph*, 13 September 2019.

[33] **"PLA Expedites Construction of New Military Energy Support System"**, Ministry of National Defence of the People Republic of China, 7 June 2022.

[34] **"Norway Operates F-35s on Biofuel"**, Government of Norway, 15 January 2025.

[35] **"Obligations of States in Respect of Climate Change"**, International Court of Justice (ICJ), 23 July 2025.

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