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Implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes

Note by the Secretary-General

The Secretary-General has the honour to transmit to the General Assembly the report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes, Marcos Orellana, in accordance with Human Rights Council resolution 54/10.

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Report of the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes, Marcos Orellana

Military activities and toxics

Summary

In the present report, the Special Rapporteur on the implications for human rights of the environmentally sound management and disposal of hazardous substances and wastes examines the human rights implications of toxics released by military activities. Military activities before, during and after armed conflict generate toxic legacies that harm human health, disrupt ecosystems and livelihoods, and undermine peacebuilding and reconstruction efforts. In his report, the Special Rapporteur documents sources of exposure and their impacts on human and environmental health, and highlights the need for robust legal standards and measures to prevent, mitigate and remediate the harm caused by military contamination, in line with the human rights obligations of States.

I. Introduction

1. Military activities before, during and after armed conflict generate and release chemical agents, heavy metals, radioactive materials and persistent pollutants that can have enduring impacts on human health and the environment. These toxic releases are often unaddressed, remaining embedded in ecosystems and communities and undermining peacebuilding and reconstruction efforts.

2. While the human cost of war is evident in loss of life, displacement and infrastructure destruction, the toxic consequences of military activities receive insufficient attention. Military activities leave enduring toxic legacies in the air, soil and water, whether from depleted uranium rounds, chemical contamination, oil and fuel leaks, or abandoned military equipment and munitions that persist long after hostilities end.

3. In the present report, the Special Rapporteur surveys the diverse sources of toxic exposure and their profound, lasting impacts on human health, ecosystems and post-conflict recovery. Toxic releases from military activities disproportionately affect military personnel and people in vulnerable situations, including women, children, Indigenous Peoples, and displaced and rural communities.

4. In the present report, the Special Rapporteur examines how military activities that release hazardous substances and wastes threaten the rights to life, health, water, food and a clean, healthy and sustainable environment, among others, and assesses how international law addresses those risks. The report covers several contamination pathways, including weapons testing, the manufacturing, production and use of military equipment, base operations and abandonment, infrastructure destruction, the disposal of hazardous waste, and the military's carbon footprint. It also covers practices such as ship breaking and glyphosate spraying, alongside the toxic legacies of weapons including cluster munitions, incendiaries and landmines.

5. In his report, the Special Rapporteur also highlights structural barriers to accountability and transparency. Accountability for harm caused is hampered by latency periods, lack of information and military secrecy, unqualified sovereign immunity, and the burden of proving causation.[1] This underscores the importance of baseline information and monitoring tools, such as satellite remote sensing, and effective remedies, including restitution, clean-up and compensation.[2]

6. The report is informed by a broad consultative process in which the Special Rapporteur invited and received input from Member States, non-governmental organizations, Indigenous Peoples and academics. The Special Rapporteur also held two in-person consultations, in Geneva in 2023 and The Hague in 2024, and three online consultations, in February, March and April 2025. The Special Rapporteur is grateful to those who shared their expertise, insights and perspectives.

II. Sources of exposure: toxic remnants of war

7. Toxic remnants of war are toxic or radiological substances resulting from military activities that form a hazard to humans and ecosystems.[3] These substances can cause immediate and long-term physical injuries, psychological harm and socioeconomic exclusion. They can also deny people access to their lands and exacerbate displacement. The effects of toxic remnants of war may be delayed, widely dispersed and, in some

[1] See A/HRC/60/34.

[2] Ibid.

[3] A/77/10, para. (3) of the commentary to principle 26, Remnants of war.

cases, transmitted across generations. Toxic remnants of war include chemical munitions dumped at sea and pollution from sunken military vessels.[4]

A. Toxic contamination

8. Prior to armed conflict, military activities can generate chemical pollution through weapons manufacturing, testing, training activities, stockpile management, military installations and oil spills.[5] Such pollution has severe consequences for human health,[6] ecosystems and economic activities, among others.[7]

9. In conflict situations, hazardous waste can be generated from the debris of damaged or destroyed infrastructure due to the materials used in the original construction, the hazardous substances stored or used within the object of attack, and the use of weapons.[8] Through documented emissions of metals, in particular lead from ammunition, copper and depleted uranium, military activities contaminate soils and waters with neurotoxic and cardiotoxic particles, posing neurological, cardiovascular and reproductive risks to exposed civilians and service members.[9]

10. In Iraq, for example, military operations left behind vast quantities of hazardous waste. A 2005 report by the United Nations Environment Programme (UNEP) found that Iraq had several thousand contaminated sites around the country, many resulting from military activities.[10] In Yemen, local communities attempted to clear debris and weapons remnants from areas affected by bombing without the necessary protection, exposing themselves to chemical and radiological contamination.[11] In the Syrian Arab Republic, according to information received, workers clearing bombed-out buildings have faced exposure to toxic industrial chemicals, such as ammonia, chlorine and petroleum by-products. In the context of the ongoing civil war in the Sudan, remote monitoring shows that since April 2023, the fighting in Khartoum has damaged more than 400 hazardous industrial sites, most notably repeated fires at the Al-Jili oil refinery that drove a 300 km-smoke plume over the city.[12]

Afghanistan

11. Prolonged conflict in Afghanistan has resulted in long-term soil contamination. Heavy bombardment and the use of toxic munitions have introduced harmful chemicals into the environment, polluting water sources and leaving soil contaminated for decades. These pollutants pose long-term risks to agriculture and public health. The absence of baseline environmental data has compounded the obstacles to accountability, including by obscuring the links between exposure and harm.

[4] A/CN.4/700, para. 255.
[5] Submission from Maximilian Häntzschel. All submissions mentioned in the present report are available from www.ohchr.org/en/calls-for-input/2025/call-input-military-activities-and-toxics.
[6] Sammy Almashat and Melissa McDiarmid, “Toxic chemical exposures among civilians in armed conflicts: the need for research equity, justice, and accountability”, *Inhalation Toxicology* (2024).
[7] Florian Krampe and others, “Armed conflict causes long-lasting environmental harms”, *Environment and Security* (2025).
[8] United Nations Environment Programme (UNEP), *Environmental Assessment of the Gaza Strip following the escalation of hostilities in December 2008–January 2009* (Nairobi, 2024).
[9] Anatoly V. Skalny and others, “Environmental and health hazards of military metal pollution”, *Environmental Research* (2021).
[10] UNEP, *Assessment of Environmental “Hot Spots” in Iraq* (Nairobi, 2005), p. 19.
[11] Submission from the Clínica Jurídica de la Universitat Pompeu Fabra.
[12] See e.g. https://press.un.org/en/2025/sgsm22532.doc.htm and https://ceobs.org/the-environmental-costs-of-the-war-in-sudan/.

Ukraine

12. Since the Russian Federation invaded Ukraine in 2022, explosions have displaced large volumes of soil, leaving behind disturbed earth contaminated with metal debris and ash.[13] The widespread destruction of buildings has released large quantities of asbestos into the environment, posing serious health risks, such as cancer and respiratory diseases, to civilians and first responders exposed to contaminated dust and debris.[14]

13. The 2022 attacks on the Azovstal plant in Mariupol compounded the site's historic steelmaking pollution (cadmium, lead, chromium, arsenic, cyanides, volatile organics, polycyclic aromatic hydrocarbons and phenols) with additional contamination from munitions emissions, explosive damage and the release of asbestos-containing materials.[15] Damage to critical infrastructure, such as ventilation systems and water pumps at industrial sites and coal mines, has led to leaks of toxic substances.[16] In 2015, the fire at the Avdiivka plant, triggered by shelling, caused a massive leak of coke gas containing benzol, toluene, naphthalene, hydrogen sulphide, ammonium and methane.

14. The breach of the Nova Kakhovka dam in June 2023 released over 90,000 tons of heavy metals, such as arsenic, nickel and zinc, flooding the Dnipro River and flowing into the Black Sea. This release contaminated protected areas including the Velykyi Luh national nature park.[17]

Gaza

15. Past and ongoing military bombardments and operations in Gaza have led to significant environmental damage, affecting ecosystems, water sources and infrastructure.[18] Fuel tanks and stations have been targeted by the Israeli military forces, increasing the risk of soil and groundwater contamination.[19] UNEP estimates that at least 800,000 tons of debris in Gaza may be contaminated with asbestos.[20] Damage to essential infrastructure, including water wells, distribution networks, sewage systems and water tanks, exacerbates environmental degradation and poses a threat to human health.[21] By rendering the environment uninhabitable, these actions deprive the Palestinian people of their right to live in a clean, healthy and sustainable environment.[22]

Lebanon

16. In Lebanon, experts have warned that the widespread deployment of white phosphorus, indiscriminate booby-trapping of homes and fields, and the lingering

[13] UNEP, *The Environmental Impact of the Conflict in Ukraine: A Preliminary Review* (Nairobi, 2022).
[14] See http://news.un.org/en/story/2024/06/1150906.
[15] See https://ceobs.org/ukraine-conflict-environmental-briefing-industry/#3.
[16] UNEP, *The Environmental Impact of the Conflict in Ukraine: A Preliminary Review* (Nairobi, 2022).
[17] Oleksandra Shumilova and others, "Environmental effects of the Kakhovka Dam destruction by warfare in Ukraine", *Science* (2025).
[18] See A/HRC/55/NGO/105.
[19] Office for the Coordination of Humanitarian Affairs in the occupied Palestinian territory, Humanitarian Situation Update No. 253.
[20] UNEP, *Environmental impact of the conflict in Gaza: Preliminary assessment of environmental impacts* (Nairobi, 2024).
[21] Ibid.
[22] Submission from Al-Haq.

presence of unexploded ordnance have rendered entire villages and farmlands unsafe for return long after the fighting ended.[23]

Cluster munitions and landmines

17. Cluster munitions are weapons that disperse multiple explosive submunitions ("bomblets") over a wide area. Most are unguided and often fail to detonate on impact, leaving behind long-term hazards for civilians.[24] In addition to their explosive threat, these weapons contain heavy metals and toxic chemicals that contaminate soil and reduce its fertility.[25]

18. Landmines, designed to detonate on contact or in proximity, can remain active for years, posing a persistent threat to communities. For instance, landmines deployed during the Second World War are still present near the town of Madama in the Niger.[26] Landmines continue to be deployed in some conflict zones, such as Ukraine, even as demining efforts are actively under way in other States.

Oil spills and fuel leaks

19. Oil spills form a major source of environmental harm in conflict zones. They affect civilian health substantially through inhalation or contact with oils through the consumption of contaminated foods. Oil pollutants are known to cause long-term health issues and have carcinogenic effects.

20. The Middle East has witnessed a notable increase in oil spills.[27] In Iraq, the targeting of oil infrastructure during the 2003 invasion led to extensive oil spills and fires, while the burning of 20 oil wells in 2016 and 2017 by Da'esh caused massive localized pollution, contributing to severe environmental damage and a worsening climate crisis.[28] The Gulf War in 1990–1991 saw retreating Iraqi forces ignite over 700 oil wells, spilling 60 million barrels of oil in the process.[29] In the Syrian Arab Republic[30] and Gaza, concerns persist over oil and fuel leaks from targeted underground deposits, with unknown consequences for soil and groundwater quality.

B. Depleted uranium

21. Depleted uranium is a by-product of the production of enriched uranium and is a radioactive, toxic heavy metal. Often used in ammunition and armoured equipment, it can contaminate the environment upon impact.[31] While initial contamination is typically limited to the immediate vicinity of the impact site, depleted uranium can subsequently disperse into the environment and contaminate water and soil. Individuals can be exposed to depleted uranium through inhalation, ingestion and dermal contact, mainly through depleted uranium dust.[32] Considerable concern also

[23] See communication ISR 1/2025. All communications mentioned in the present report are available from https://spcommreports.ohchr.org/Tmsearch/TMDocuments.
[24] See www.icrc.org/en/law-and-policy/cluster-munitions.
[25] Al-Najar and others, "Assessing Heavy Metals Pollution in the Agricultural Lands of Gaza Strip that Has Undergone Three Successive Wars", *American Journal of Environmental Protection*, vol. 3, No. 4 (2015), p. 157.
[26] Submission from the Niger.
[27] A/HRC/5/5, paras. 8–18.
[28] See https://paxforpeace.nl/publications/living-under-a-black-sky.
[29] See UNEP/GC.16/4/Add.1.
[30] See https://paxforpeace.nl/publications/war-waste-and-polluted-pastures.
[31] A/HRC/5/5, para. 18.
[32] A. Bleise and others, "Properties, use and health effects of depleted uranium: a general overview", *Journal of Environmental Radioactivity*, vol. 64 (2002), p. 101.

exists over the possible impacts of depleted uranium on the health of military personnel during clean-up and de-mining operations. The two most affected organs are the kidneys and the lungs, but in rare cases, serious exposure can increase the risk of cancer.

Kosovo

22. The 1999 Kosovo conflict underscores the environmental and health risks of depleted uranium use in warfare. During the conflict, North Atlantic Treaty Organization (NATO) aircraft fired over 30,000 depleted uranium rounds, leaving behind toxic remains from contaminated jackets buried underground that may have caused external radiation exposure and pose a long-term risk to groundwater and drinking water.[33]

Iraq

23. During the 2003 invasion of Iraq, approximately 116,000 kg of depleted uranium were used by the Coalition Forces.[34] Although depleted uranium munitions were aimed at specific targets, contamination spread widely, affecting more than 1,000 sites, many in populated areas.[35] This environmental pollution affected air, soil and water sources. The population reportedly experienced a 17-fold increase in birth anomalies, along with numerous other health issues linked to the invasion.[36] Public health monitoring, in particular of exposed or vulnerable populations, such as first responders, demining staff, communities living near contaminated sites and scrap metal workers, was hindered by the absence of data on which areas were targeted by munitions.

C. Radioactive threats

Nuclear testing

24. The atmospheric testing of nuclear weapons causes fallout of radioactive debris. The testing of 67 nuclear weapons between 1946 and 1958 by the United States of America in the Marshall Islands has dramatically increased cancer rates among Marshallese people.[37]

25. Between 1952 and 1957, the United Kingdom of Great Britain and Northern Ireland conducted seven major and hundreds of minor nuclear tests at the Maralinga test site in South Australia. These tests resulted in significant radioactive contamination of the Tjarutja people's lands, leading to detrimental medical, psychological and social effects for affected communities.[38]

26. Many communities continue to suffer from toxic pollution resulting from nuclear tests conducted without consideration for their health and environmental rights.[39] In Algeria, 17 nuclear tests were conducted by France between 1960 and 1966, with one test affecting 10,000 civilians and military personnel and 2,000 individuals in military bases.[40] France also carried out over 200 nuclear tests in French Polynesia without warning local residents of the risks. The health impacts of

[33] UNEP, *Depleted Uranium in Kosovo: Post-Conflict Environmental Assessment* (Nairobi, 2001).
[34] See A/HRC/44/NGO/32.
[35] See https://ceobs.org/wp-content/uploads/2018/03/pax_icbuw_targets_of_opportunity.pdf.
[36] Submission from Rubaii and Griffiths.
[37] See A/HRC/57/77.
[38] A/HRC/57/52/Add.2, paras. 62 and 63.
[39] Submission from Maat for Peace, Development and Human Rights.
[40] See communication DZA 2/2024.

nuclear testing have lasting effects on communities, including birth defects, increased cancer rates and other health problems.[41] Nuclear testing by the Union of Soviet Socialist Republics (USSR) caused lasting environmental damage. Two underground detonations in 1966 and 1968 in Uzbekistan have required ongoing monitoring,[42] and more than 500 nuclear weapons tests in Semipalatinsk, Kazakhstan, have left an enduring legacy of radioactive contamination.[43]

Ukraine

27. On 14 February 2025, a Russian drone strike on the Chernobyl dome, which was designed to allow for the management of radioactive waste from the 1986 explosion of reactor No. 4, including the dismantling of its ageing sarcophagus, ignited fires that lasted for three weeks.[44] This incident illustrates the risks of radiation exposure if the sarcophagus is exposed to the environment. There have been numerous other attacks against nuclear facilities and electricity infrastructure in Ukraine. Such attacks pose serious threats to nuclear safety and increase the risk of environmental fallout.[45]

D. Military scrap

28. Contaminated military scrapyards are globally recognized as a potential source of environmental and human health problems because of the uncontrolled or inadequate ways in which hazardous wastes may be collected, stored and processed. Common issues include soil and water contamination, toxic fumes from burning waste, chemical spills, and improper disposal of hazardous wastes.

29. Unlike civilian scrap, damaged or destroyed military equipment often includes unexploded ordnance, which endangers both workers and nearby communities.[46] Contamination from abandoned military equipment can have long-term health consequences for humans and the environment.[47]

E. Ship breaking and naval pollution

30. Ship breaking is widely considered an environmentally harmful practice due to its significant ecological impacts.[48] These include emissions into the air, soil and water, and the generation of hazardous materials during dismantling operations.[49] Exposure to these materials can lead to serious health issues, including respiratory illnesses and cancer. In 2006, the French aircraft carrier *Clemenceau*, which contained large quantities of asbestos and other hazardous materials, was being towed to India for dismantling. This raised significant health and environmental concerns and, following public outcry and legal challenges, the vessel was recalled to France.[50]

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[41] See communication FRA 6/2024.
[42] Submission from Uzbekistan.
[43] See A/HRC/30/40/Add.1.
[44] Submission from Greenpeace Ukraine. See also Erika Weinthal and Carl Bruch, “Protecting Nuclear Power Plants During War: Implications from Ukraine”, *The Environmental Law Reporter*, vol. 53 (2023).
[45] See communication RUS 10/2024. See also www.greenpeace.org/international/explore/energy/russian-military-threat-ukraine-nuclear-reactors-facilities-map/.
[46] UNEP, *Assessment of Environmental “Hot Spots” in Iraq* (Nairobi, 2005), pp. 114 and 115.
[47] Submission from PAX.
[48] See A/HRC/54/25/Add.2.
[49] See A/78/169.
[50] Marcos Orellana, “Shipbreaking and Le Clemenceau Row”, *ASIL Insights*, vol. 10 (2006).

31. The sinking of the decommissioned *São Paulo* aircraft carrier in 2023 by the Brazilian Navy also illustrates the risks of naval pollution. Its sinking introduced toxic substances into the marine environment, posing a long-term threat to marine ecosystems.[51]

F. Per- and polyfluoroalkyl substances

32. Widespread contamination is a persistent issue at military bases and munitions factories,[52] threatening the health and well-being of both military personnel and civilians.[53] A major contributor to this problem is the use for training and emergencies of firefighting foams containing per- and polyfluoroalkyl substances (PFAS). PFAS are often called "forever chemicals" due to their inability to biodegrade and have been linked to serious health issues, including cancer and birth defects.[54]

33. PFAS contamination is so severe in current and former United States military bases that they account for the vast majority of PFAS-contaminated sites designated by the Environmental Protection Agency as among the country's most hazardous due to PFAS contamination.[55]

34. A serious water pollution problem exists in the Ryukyu Islands, including Okinawa, where high concentrations of perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), which belong to the class of PFAS chemicals, have contaminated the tap water of over 450,000 people in seven municipalities.[56] This has raised a number of environmental concerns, including allegations of adverse impacts on women's reproductive rights.[57] The firefighting training facility at Kadena airbase reportedly has high concentrations of PFAS.[58]

35. In Australia, the country's PFAS investigation and management programme has identified approximately 28 defence sites that are now either undergoing investigations or have reached the stage of determining management options.[59]

G. Glyphosate

36. Glyphosate is a broad-spectrum herbicide that, when sprayed from an aircraft, can drift through the air and harm surrounding crops, soils, waters, vegetation and wildlife.[60] Between 1994 and 2015, the Colombian military and anti-narcotics police sprayed more than 1.8 million hectares with glyphosate to eradicate illicit coca crops, causing damage to ecosystems and harm to human health.[61]

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[51] See www.gov.br/ibama/pt-br/assuntos/notas/2023/ibama-solicita-informacoes-a-marinha-para-reduzir-impactos-de-afundamento-do-porta-avioes-sao-paulo-em-alto-mar and www.theguardian.com/world/2023/feb/04/brazil-sinks-aircraft-carrier-in-atlantic-despite-presence-of-asbestos-and-toxic-materials.

[52] See https://ceobs.org/pfas-forever-chemicals-are-in-munitions-and-other-military-applications-too.

[53] A/CN.4/700, para. 239.

[54] Submission from PAX.

[55] See www.epw.senate.gov/public/index.cfm/superfund-sites-identified-by-epa-to-have-pfas-contamination.

[56] See communications JPN 1/2025 and JAL USA 6/2025.

[57] Submission from Ginowan Churamizu-kai and All Okinawa Council for Human Rights.

[58] Submission from Okinawa Prefectural Government.

[59] A/HRC/57/52/Add.2, para. 88.

[60] See A/77/183.

[61] Submission from Dejusticia.

37. Indigenous Peoples have long protested against the environmental degradation, displacement, disruption of cultural practices and adverse health effects caused by glyphosate spraying.[62] Specific studies have linked glyphosate exposure to serious impacts on reproductive and intergenerational health, including birth defects and leukaemia.[63]

III. Impacts on human and environmental health

38. Toxic substances released by military activities often leave profound and lasting scars on human health, ecosystems and the climate system. Civilians, Indigenous Peoples, displaced communities and military personnel are among the most affected and face increased risks of cancer, chronic illness and social marginalization.

A. Adverse impacts on affected communities

1. Long-term health impacts, including cancer clusters

39. Beyond acute and blast injuries, one of the most serious health consequences of armed conflict is the elevated risk of cancer resulting from exposure to radiation and toxic substances. The United Nations Scientific Committee on the Effects of Atomic Radiation has found increased cancer risk due to low radiation doses in exposed human populations, for instance among survivors of the Hiroshima atomic bombing.[64] Nuclear testing has also had lasting health repercussions for affected communities. For example, nuclear testing conducted by the United States between 1946 and 1958 led to increased cancer rates among residents of the Marshall Islands.

40. Substances such as heavy metals, fuel hydrocarbons, radioactive materials, unexploded ordnance waste and endocrine disrupting compounds may have serious long-term health effects. Environmental exposure to military toxins has been shown to result in cancers, birth defects, disorders of reproductive, immune, neurological and neurobehavioral functions, and organ failure or dysfunction.[65]

2. Indigenous Peoples, displaced communities and rural populations

41. Indigenous Peoples face a grave threat to their health, lands and territories following armed conflicts and subsequent exposure to toxic substances, sometimes resulting in the forced relocation of communities.[66] They may also be displaced from their ancestral lands due to weapons testing, and even be misled into returning to contaminated sites, as in the case of the Marshallese people.[67]

42. Military bases are often constructed on Indigenous lands without the consent of Indigenous Peoples. In addition, when bases are abandoned, dangerous remnants of military operations are left behind, such as fuel, polychlorinated biphenyls, metals from heavy equipment, oil containers and even buried radioactive waste. The Indigenous People of Sivuqaq in Alaska have denounced cancer clusters in their community resulting from abandoned United States military bases.[68]

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[62] See communication COL 13/2020.
[63] A/77/183, para. 43.
[64] See A/48/46.
[65] Ted H. Schettler, “Reverberations of Militarism: Toxic Contamination, the Environment, and Health”, *Medicine and Global Survival*, vol. 2 (1995).
[66] A/77/183, para. 1.
[67] Submission from the Marshall Islands.
[68] Submission from Alaska Community Action on Toxics.

43. The consequences of military-related environmental contamination are especially severe for Indigenous Peoples, who have a deep connection to their territories and resources and depend on the natural environment for their subsistence and cultural identity.[69] The water from the culturally significant Chunnaga spring can no longer be used for drinking in Okinawa, Japan, following military contamination.[70]

B. Exposure of veterans and military personnel

44. Veterans have long been affected by the significant consequences of toxic exposure linked to military service during armed conflict. A primary source of exposure is the inhalation of toxic fumes during military operations.

45. The adverse health effects observed in veterans are varied. Symptoms include chronic headaches, widespread pain, mood disturbances, respiratory problems, persistent and unexplained fatigue, memory problems and other cognitive difficulties, gastrointestinal disturbances and rashes. Such a spectrum of symptoms has been documented across multiple conflicts and is frequently referred to as "chronic multi-symptom illness".[71] The burning of waste at military sites, in so-called open burn pits, has also been linked to neuroinflammation, cognitive impairment and elevated risks of respiratory and cardiovascular disease among deployed personnel.[72]

46. Another example of the health issues linked to military toxic exposure occurred during the Gulf War, when veterans were exposed to smoke and fumes from the Kuwait oil well fires, among other hazards. Exposure led to a range of symptoms including memory loss, headaches, weakness, fatigue and mood changes.[73]

47. Despite the considerable body of evidence suggesting a strong connection between military toxic exposure and chronic illnesses, there remains a significant gap in adequate healthcare support and recognition for veterans suffering from these conditions.

C. Impacts on biodiversity, marine ecosystems and climate change

1. Deforestation and loss of biodiversity

48. During the Viet Nam War, the United States sprayed 20 million gallons of Agent Orange and other herbicides, many of which contained dioxins and other hazardous substances, defoliating over 1.25 million hectares of forest.[74] The herbicides also caused several types of cancers and other serious conditions in the people exposed, and the intergenerational impacts have yet to be fully understood.[75]

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[69] See A/77/183.

[70] Submission from Goya Hatsuko.

[71] Bryann DeBeer and others, "The Association Between Toxic Exposures and Chronic Multi-symptom Illness in Veterans of the Wars of Iraq and Afghanistan", *Journal of Occupational and Environmental Medicine*, vol. 59 (2017).

[72] Athena W. Brooks and others, "Neuroinflammation and Brain Health Risks in Veterans Exposed to Burn Pit Toxins", *International Journal of Molecular Sciences*, vol. 25 (2024).

[73] T. A. Bullman and H. K. Kang, "The effects of mustard gas, ionizing radiation, herbicides, trauma, and oil smoke on US military personnel: the results of veteran studies", *Annual Review of Public Health* (1994).

[74] See www.unep.org/news-and-stories/story/rooting-environment-times-conflict-and-war. See also Laure Verheyen, "War's Silent Victim: The Environment" (2017).

[75] Dennis Normile, "The Fog of War", *Science* (2025).

49. From the perspective of biodiversity conservation, safeguarding protected areas in armed conflict is key.[76] For example, in Rwanda, the 1994 conflict led to the pollution of rivers, deforestation and the killing of endangered gorillas and other wildlife in protected areas by mines, among other impacts.[77]

50. Training activities often result in vegetation destruction, chemical and heavy metal contamination and harm to wildlife.[78] Artillery bombings result in the burning of standing trees in plantations, managed forests and natural woods.[79]

2. Marine ecosystems

51. The construction of military bases can significantly damage marine ecosystems. For example, a new United States base to replace the Futenma facility is being built in Oura Bay, Henoko, Japan, on top of coral reefs.[80]

52. Naval operations can also degrade marine habitats. Marine-based sources, ranging from shipping and leisure vessels to military activities and illicit dumping, contribute nearly one fifth of all marine plastic waste.[81]

53. Legacy pollution also continues to pose risks to the marine environment in many parts of the globe.[82] An estimated 1.6 million tonnes of munitions from the two World Wars remain on the seafloor of the North Sea and the Baltic Sea, posing ongoing risks to marine life.[83] More than 10,000 unexploded munitions in the estuary of the Eagle River in Alaska represent a continued threat to beluga whales, waterfowl and salmon.[84]

3. Greenhouse gas emissions

54. Military activities are a significant source of greenhouse gas emissions, from fuel to large-scale operations, and are often unassessed. The combined carbon footprint of the world's militaries is roughly 5.5 per cent of the global total, meaning that if the global militaries were a country, they would have the fourth-largest footprint in the world.[85]

55. During the Gulf War, more than 600 Kuwaiti oil wells were ignited, releasing vast quantities of carbon dioxide, sulphur dioxide and nitrogen oxides, which together generated severe air pollution and black rain that fell as far afield as Iraq, the Islamic Republic of Iran and Türkiye.[86] The toxic legacy of the war in Ukraine[87] includes

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[76] Elaine Hsiao and others, "Protected zones in context", *International Review of the Red Cross* (2023).

[77] Samuel Kanyamibwa, "Impact of war on conservation: Rwandan environment and wildlife in agony", *Biodiversity and Conservation*, vol. 7 (1998).

[78] Michael Lawrence and others, "The effects of modern war and military activities on biodiversity and the environment", *Environmental Reviews* (2015).

[79] Hailemariam Meaza and others, "Managing the environmental impacts of war: what can be learned from conflict-vulnerable communities?", *Science of the Total Environment* (2024).

[80] Submission from the Association of Comprehensive Studies for Independence of the Lew Chewans.

[81] Marcus Eriksen, "Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea", *PLOS One* (2014).

[82] International Tribunal for the Law of the Sea, Advisory Opinion C31, Declaration of Judge Pawlak, para. 6.

[83] European Commission, "The underwater menace: EU funding helps detect unexploded bombs" (2022).

[84] Submission from Alaska Community Action on Toxics.

[85] See https://ceobs.org/wp-content/uploads/2022/11/SGRCEOBS-Estimating_Global_MIlitary_GHG_Emissions_Nov22_rev.pdf.

[86] See https://researchbriefings.files.parliament.uk/documents/POST-PN-23/POST-PN-23.pdf.

[87] UNEP, "The toxic legacy of the Ukraine War" (2023).

attacks on oil storage depots and refineries[88] and the burning of forests by Russian military forces as a tactic of war, which releases inordinate quantities of carbon dioxide into the atmosphere and destroys important carbon sinks.[89]

IV. International instruments relevant to toxics and military activities

56. While some provisions of international humanitarian and disarmament law address environmental harm, key gaps remain in ensuring accountability, remediation, protection and compensation for affected communities. International human rights law, which continues to apply during armed conflict and occupation, offers a critical framework for addressing toxic military releases and legacies. Multilateral environmental agreements, although not conflict-specific, remain applicable and help to limit toxic exposures. Meanwhile, the growing discourse on ecocide signals a shift towards recognizing severe environmental harm as a matter of international criminal concern.

A. International human rights law

57. International human rights law continues to apply in times of armed conflict, complementing and reinforcing the protections afforded by international humanitarian law.[90] The International Court of Justice has affirmed this principle time and again, noting that human rights treaties do not cease to apply in situations of armed conflict or occupation, except where lawful derogations are made.[91] This includes international obligations under the International Covenant on Civil and Political Rights, the International Covenant on Economic, Social and Cultural Rights, and regional human rights instruments, all of which require States to respect and protect human rights at all times, including during military operations.

1. Interference with human rights

58. Hazardous substances and wastes resulting from military activities can profoundly interfere with the enjoyment of a wide range of human rights, both in peacetime and armed conflict. The use, storage and disposal of toxic substances by military forces must thus be assessed not only against international humanitarian rules but also in accordance with the human rights obligations of States to prevent exposure to hazardous substances and ensure access to justice and effective remedies. This underscores the need to address military-related toxic harm through a lens that integrates human rights, particularly in conflict-affected and post-conflict settings, where institutional capacity may be weak and affected populations are most vulnerable.

59. Acute or chronic exposure to hazardous chemicals, unexploded ordnance or radioactive materials threatens the right to life. The right to the highest attainable standard of physical and mental health can also be undermined by military activities, as exposure to heavy metals, PFAS, depleted uranium, polychlorinated biphenyls,

[88] See https://ceobs.org/joint-investigation-into-the-attacks-on-kremenchuk-oil-refinery-ukraine.
[89] See www.un.org/en/peace-and-security/how-conflict-impacts-our-environment.
[90] A/HRC/5/5, paras. 56 and 57.
[91] *Legality of the Threat or Use of Nuclear Weapons*, *I.C.J. Reports 1996*, para. 25; *Legal Consequences of the Construction of a Wall in the Occupied Palestinian Territory*, *I.C.J. Reports 2004*, para. 106; *Armed Activities on the Territory of the Congo*, *I.C.J. Reports 2005*, para. 216; and *Legal Consequences Arising from the Policies and Practices of Israel in the Occupied Palestinian Territory, Including East Jerusalem*, *I.C.J. Reports 2024*, paras. 99 and 100.

explosive remnants and other hazardous pollutants can cause cancers, respiratory illnesses, reproductive disorders, psychological trauma and other serious illnesses. Contamination of water sources affects the right to safe and clean drinking water and sanitation. Toxification of soils can infringe on the right to adequate and nutritious food, particularly where agricultural land is rendered unusable due to pollution or where toxins bioaccumulate in crops and livestock. The contamination of air, water and soil, the destruction of ecosystems and biodiversity, and the further disruption of the climate system can breach the right to a clean, healthy and sustainable environment.

60. These toxic harms often disproportionately affect already marginalized communities, including Indigenous Peoples, women, children and displaced persons, exacerbating existing inequalities.[92] Furthermore, secrecy surrounding military operations and the classification of environmental data as confidential may interfere with the right to information, the right to participate in public affairs and the right to an effective remedy.

2. Remedies

61. Accountability is an essential aspect of human rights protection. Remedies for human rights infringements in the context of toxics may include, among others, restitution, compensation and rehabilitation.[93] The International Court of Justice has held that damage to the environment, in and of itself, is compensable under international law.[94] The United Nations Compensation Commission held that the "primary emphasis must be placed on restoring the environment to pre-invasion conditions, in terms of its overall ecological functioning rather than on the removal of specific contaminants".[95]

62. Restoring the environment to its pre-conflict physical state may be "materially impossible" or "involve a burden out of all proportion to the benefit deriving from restitution".[96] In making these determinations, economic considerations should not be seen in isolation from culture and development, and they should not negate the critical importance of environmental clean-up for the effective enjoyment of human rights. In addition, the broader civil liability regime used to repair ecological damage remains inadequate, leaving many environmental harms unaddressed and unremedied.[97]

B. International humanitarian law

63. The relevance of international humanitarian principles, instruments and rules concerning the release of toxic and dangerous products during armed conflict was examined by the Special Rapporteur previously.[98] Not only do the cardinal principles and rules on the conduct of hostilities, such as distinction, proportionality and precautions, apply to the use of hazardous substances during hostilities, but there also exist specific rules aimed at limiting environmental damage during conflict.[99]

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[92] See A/77/183, A/79/163 and A/HRC/33/41.
[93] See A/HRC/60/34 and A/HRC/36/41.
[94] *Armed Activities on the Territory of the Congo (Democratic Republic of the Congo v. Uganda)*, I.C.J. Reports 2022, para. 348
[95] S/AC.26/2003/31, para. 48.
[96] International Law Commission, Responsibility of States for Wrongful Acts (2001), article 35.
[97] Submission from Burkina Faso.
[98] A/HRC/5/5, paras. 47–55.
[99] See also Australia, Manual of the Law of Armed Conflict, 2006, para. 5.50; Côte d'Ivoire, Droit de la guerre: Manuel d'instruction, livre III, tome 1, p. 35; Kingdom of the Netherlands, Humanitair Oorlogsrecht: Handleiding, 2005, para. 0465; and Republic of Korea, Operational Law Manual, 1996, p. 126.

64. Moreover, human rights law can play a decisive role in filling the accountability and remedial gaps left by international humanitarian law and arms control instruments by imposing affirmative State obligations that go beyond prohibitions on specific conduct or weapons. For example, where disarmament treaties lack explicit requirements for environmental remediation, States are still obliged to protect the rights to life and health through clean-up of toxic remnants and provision of medical care to affected communities. The right to information and public participation under human rights law can strengthen military environmental assessments and weapons review processes, including those under article 36 of the Protocol I Additional to the Geneva Conventions of 1949, ensuring that civilian populations receive timely warnings about contamination risks. In addition, embedding references to economic, social, cultural and environmental rights into training or guidelines on the conduct of hostilities would recognize that environmental protection is not merely a collateral benefit but an integral component of lawful military operations.

1. Rules on the conduct of hostilities and recent legal initiatives

65. The last decade has witnessed important developments in the normative landscape regarding the protection of the environment in relation to armed conflicts. Two recently developed instruments, by the International Committee of the Red Cross (ICRC) and the International Law Commission, clarify the legal obligations related to environmental protection in the context of armed conflict.[100]

66. In 2020, ICRC updated its guidelines on the protection of the natural environment in armed conflict, which are a restatement of the law as it stands in the eyes of ICRC. While preserving the substance of the initial 1994 version, the updated guidelines distinguish clearly between binding rules and non-binding recommendations, set out applicable customary and treaty law in a structured manner, and provide accompanying commentaries to aid interpretation and clarify legal sources.

67. In 2022, the International Law Commission adopted a set of 27 principles that codify and progressively develop international law pertaining to the protection of the environment in relation to armed conflict.[101] The principles cover the entire conflict cycle and are intended to enhance the protection of the environment throughout that cycle. Principle 26, on remnants of war, stipulates that parties to armed conflicts "shall seek, as soon as possible, to remove or render harmless toxic or other hazardous remnants of war under their jurisdiction or control that are causing or risk causing damage to the environment". The phrase "as soon as possible" offers guidance to parties to armed conflicts without imposing an undue burden on their operations.[102] A key feature of this principle is its applicability to all parties to an armed conflict, including non-State armed groups, in line with the scope of the Protocol on Explosive Remnants of War to the Convention on Certain Conventional Weapons, which extends to both international and non-international armed conflicts. In the commentary to principle 26, the International Law Commission states that the principle is intended to apply in situations of occupation.[103]

68. Leaking vessels and leftover ammunition pose risks to the marine environment for many States, threatening both public health and prospects for economic development.[104] Against this backdrop, the International Law Commission, in

[100] Stavros Pantazopoulos, "Greening the Law of Environmental Protection in Armed Conflicts", *Netherlands Yearbook of International Law* (2023), p. 89.
[101] See A/CN.4/L.968 and General Assembly resolution 77/104.
[102] A/CN.4/750, para. 293.
[103] A/77/10, para. (6) of the commentary to principle 26.
[104] A/CN.4/700, para. 260.

principle 27, on remnants of war at sea, urges States and relevant international organizations to cooperate to ensure that remnants of war at sea do not constitute a danger to the environment. This emphasis on the duty of cooperation highlights an important point of convergence between international environmental law and international humanitarian law.[105] Furthermore, in principle 23, the Commission calls on States and international organizations to share and grant access to relevant information in accordance with applicable international law, while in principle 24, relevant actors are urged to cooperate with respect to post-armed conflict environmental assessments and remedial measures.

2. Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques

69. The 1976 Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques primarily addresses large-scale environmental manipulation. It underscores the risks of using natural processes, such as floods, droughts or ecosystem disruption, for hostile purposes that can lead to or exacerbate toxic contamination. For instance, induced flooding could mobilize buried hazardous waste, as was the case when Russian military forces allegedly destroyed the Nova Kakhovka dam in Ukraine in 2023, and artificial droughts might concentrate pollutants. Under Article I of the Convention, States Parties are prohibited from engaging in military or any other hostile use of environmental modification techniques, including the use of herbicides,[106] as the means of destruction, damage or injury to another State Party.

3. Weapon-specific and disarmament treaties

70. The obligations enshrined in the following weapon-specific and disarmament treaties reflect a growing recognition that the use and long-term legacy of certain weapons interfere with the effective enjoyment of the rights to life, health, physical integrity, water, food, and a clean, healthy and sustainable environment, among others. This is particularly evident in areas where clearance of hazardous remnants is delayed or insufficient, and where communities remain directly exposed to toxic residues left behind by armed conflict. Even where legal instruments do not explicitly address environmental protection, their obligations and restrictions increasingly align with the broader understanding that a human rights-based approach is essential to regulating the transfer and use of harmful weapons and ensuring recovery and accountability in the aftermath of conflict.[107]

71. Many international treaties address weapons that, beyond their immediate destructive effects during conflict, leave behind long-lasting harmful substances or contamination in the environment. While these treaties have achieved broad ratification, with some enjoying near-universal membership, their implementation remains uneven, and critical normative gaps persist. Several instruments, including those under the Convention on Certain Conventional Weapons framework, do not explicitly regulate the environmental consequences of weapons use. In addition, key military States have refused to ratify treaties such as the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, the Convention on Cluster Munitions and the Treaty on the Prohibition of Nuclear Weapons, limiting their global reach and impact. Even where clearance, assistance and transparency obligations exist, enforcement and compliance

[105] See https://ukraine.un.org/en/295829-flooding-was-%E2%80%98just-beginning%E2%80%99-kakhovka-dam-disaster-two-years.

[106] ENMOD/CONF.II/12, part II, pp. 11 and 12.

[107] See A/HRC/59/L.16.

mechanisms are often weak, and there is limited integration of environmental remediation into post-conflict recovery efforts.

72. The Convention on Certain Conventional Weapons, which has 128 States Parties, is notable for its flexibility, as it allows the adoption of separate protocols to address emerging threats and technological developments in warfare. The Convention and its Protocols, while primarily focused on humanitarian protections, also help to curb the toxic contamination of the environment caused by the use, remnants or disposal of certain conventional weapons.

73. Amended Protocol II annexed to the Convention on Certain Conventional Weapons, which has 107 States Parties, regulates the use of landmines, booby-traps and similar devices. These weapons can cause long-term environmental contamination and expose civilians to hazardous substances. Article 10 (1) requires the removal or rendering harmless of such devices after the cessation of active hostilities, implicitly acknowledging their enduring risks. While Amended Protocol II does not explicitly address environmental or toxic impacts, the legacy of these weapons includes soil degradation, leaching of explosive residues and contamination from metal components. Article 11 calls for international cooperation and assistance in the clearance of such devices.

74. The use of incendiary weapons can cause severe environmental and toxic consequences, particularly when used in populated areas. Protocol III to the Convention on Certain Conventional Weapons, which counts 117 States Parties, governs the use of incendiary weapons. Article 2 (2) prohibits the use of air-delivered incendiary weapons against military objectives located within concentrations of civilians, thus acknowledging their indiscriminate and inhumane effects. Incendiary weapons not only cause devastating burns and injuries but can also leave behind toxic residues that contaminate soil, water and air. These effects may be prolonged, especially where such substances infiltrate civilian infrastructure or agricultural land.

75. White phosphorus is a substance with multiple military applications, such as illumination, smoke screening and incendiary effects, and its use raises serious concerns due to its severe toxic and environmental consequences. When deployed, it can cause acute toxicity if inhaled or ingested, result in deep, slow-healing burns, and release hazardous residues that persist in soil and water, posing long-term risks to human health and ecosystems. Although instruments of international humanitarian law do not explicitly ban white phosphorus, its use is subject to varying legal constraints depending on the context and the circumstances of its use.

76. Protocol V to the Convention on Certain Conventional Weapons, which has 99 States Parties, explicitly addresses the dangers posed by explosive remnants of war, including unexploded ordnance and abandoned explosive devices, which often contain toxic substances such as heavy metals, explosives and propellants. Article 3 obliges States Parties to clear, remove or destroy explosive remnants of war in territories under their control after active hostilities have ended. Although Protocol V does not expressly reference environmental contamination, the deterioration and detonation of explosive remnants of war can result in the leaching of toxic chemicals into soil and groundwater. Article 8 calls for cooperation and assistance, including technical, material and financial support, to address these legacies.

77. The 1992 Convention on Chemical Weapons, which enjoys almost universal ratification, with 191 States Parties, plays a crucial role in the prohibition and elimination of chemical weapons. Such weapons pose significant and long-lasting risks to both human rights and the environment. While some gaps in implementation remain, the Convention affirms that the use of toxic chemicals as weapons is categorically unacceptable under any circumstances. These substances can cause

acute or permanent harm to human health and disrupt ecosystems by contaminating soil, air and water, destroying plant life, and undermining agricultural productivity. Moreover, the risks are not confined to battlefield use: the storage, disposal or abandonment of chemical munitions, particularly where destruction is delayed or improperly conducted, can result in serious toxic exposures.

78. The use of hazardous pesticides to displace communities in Brazil has raised questions on the scope and definition of chemical weapons under the Convention on Chemical Weapons.[108] The Convention's scope is not limited to the lists in its annexes.[109] Moreover, the way the definition of chemical weapons is drafted suggests that the Convention's intent is for broad coverage to amplify its protective reach. The definition of chemical weapons excludes toxic chemicals intended for "purposes not prohibited under this Convention", including industrial, agricultural and other peaceful purposes. Accordingly, the use of hazardous pesticides to displace communities would be covered by the Convention's definition of chemical weapons, because using pesticides to displace communities is not an agricultural use.

79. In addition, the Convention on Chemical Weapons defines toxic chemicals as those that harm humans or animals. This definition leaves out chemical harm to plants, which can result in significant toxic impacts to territories and communities.

80. The Convention on Cluster Munitions, which has been ratified by 111 States Parties, and the Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on Their Destruction, with 166 States Parties, address not only the use and proliferation of specific weapons but also their long-term environmental and human health consequences. Under article 4 of the Convention on Cluster Munitions, States Parties are required to clear cluster munition remnants "as soon as possible", in recognition of the fact that these remnants pose persistent risks, including soil and water contamination from toxic substances such as heavy metals, explosive residues and propellants. Article 5 of the Anti-Personnel Mine Ban Convention also obliges States to clear mined areas "as soon as possible". Both treaties also emphasize victim assistance: article 5 of the Convention on Cluster Munitions and article 6 (3) of the Anti-Personnel Mine Ban Convention require States to ensure medical care, rehabilitation and socioeconomic inclusion, which may include addressing the health impacts of toxic exposure from munitions remnants. Article 7 of both treaties requires transparency through annual reporting, including measures taken to address contamination.

81. Steps taken or considered by Estonia, Finland, Latvia, Lithuania, Poland and Ukraine to withdraw from the Anti-Personnel Mine Ban Convention threaten to unravel decades of progress, risking renewed civilian suffering and worsening toxic contamination.[110]

82. The Treaty on the Prohibition of Nuclear Weapons, which has 73 States Parties, recognizes the catastrophic humanitarian and environmental consequences of nuclear weapons, including long-lasting toxic contamination.[111] Under article 6, States Parties are required to provide assistance to individuals affected by the use or testing of nuclear weapons, including medical care, rehabilitation and psychological support, as well as to take necessary and appropriate measures towards the environmental remediation of contaminated areas. Article 7 encourages international cooperation

[108] See communication BRA 6/2022 and A/HRC/45/12/Add.2.

[109] Submission from Honduras.

[110] See www.ohchr.org/en/press-releases/2025/07/un-human-rights-chief-volker-turk-gravely-alarmed-steps-withdraw-anti.

[111] See communication DZA 2/2024, p. 5.

and assistance to support the implementation of these obligations, reinforcing the human rights-based approach to addressing the legacy of nuclear harm.

83. These obligations acknowledge that radioactive contamination from the use or testing of nuclear weapons can severely affect human rights, in particular the rights of Indigenous Peoples and other historically marginalized groups. The Treaty on the Prohibition of Nuclear Weapons thus reflects an emerging normative framework that connects the prohibition of particularly harmful weapons with long-term obligations to remedy their toxic and radioactive legacies.

C. Multilateral agreements on chemicals and waste

84. Multilateral agreements on chemicals and waste establish international standards for the management, movement and disposal of hazardous substances. Given that these agreements do not explicitly provide otherwise, they continue to apply to military activities before, during and after armed conflict, adapted to its exigencies. Their provisions can play a crucial role in protecting human rights by strengthening capacities and limiting toxic exposures arising from military operations, weapons use, and post-conflict waste.

85. The 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal establishes a framework for the environmentally sound management of hazardous and other waste, including military waste, notably through restrictions and controls on the export of waste to countries lacking the capacity to manage it safely. Under article 4, Parties are obliged to minimize the generation of hazardous waste, ensure its environmentally sound disposal and prohibit its export to States lacking the capacity or consent to manage it safely. These obligations become even more pressing during armed conflict, when waste management systems are often disrupted. By promoting transparency, prior informed consent, and safe handling, the Convention supports the protection of human rights, including before, during and after armed conflict.

86. The 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter and its 1996 Protocol establish a general prohibition on the dumping of hazardous materials at sea, including industrial and chemical wastes commonly associated with military activities. While article VII (4) of the Convention and article 10 (4) of the Protocol provide that the instruments do not apply to vessels and aircraft entitled to sovereign immunity, such as those operated by military forces, States Parties are nonetheless expected to take appropriate measures to ensure that these vessels and aircraft act in a manner consistent with the objectives of the Convention and the Protocol. This obligation reflects the overarching purpose of these instruments, namely, to prevent marine pollution caused by dumping.

87. The Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade promotes informed decision-making on the trade of hazardous chemicals, many of which are used in military activities. By requiring prior informed consent for the export of listed substances, the Convention helps to prevent the uncontrolled movement of toxics that could compromise human rights, especially in conflict-affected regions.

88. Many substances used in military activities, such as certain flame retardants, explosives and pesticides, fall within the scope of the 2001 Stockholm Convention on Persistent Organic Pollutants. The Convention aims to eliminate or restrict the production and use of persistent organic pollutants due to their toxicity, persistence in the environment, capability for long-range transport, and potential to bioaccumulate and harm human health. The continued applicability of the Convention

during armed conflict reinforces the obligation to manage and dispose of such substances responsibly, helping to safeguard human rights, particularly in conflict-affected and post-conflict areas.

D. Ecocide

89. The Rome Statute of the International Criminal Court criminalizes the environment-specific war crime of "intentionally launching an attack in the knowledge that such attack will cause … widespread, long-term and severe damage to the natural environment which would be clearly excessive in relation to the concrete and direct overall military advantage anticipated" in international armed conflicts. Although this provision establishes a high threshold for prosecution, the 2023 destruction of the Nova Kakhovka dam in Ukraine may provide the first opportunity to test its scope and enforceability. The Office of the Prosecutor has expressed its intention to publish a policy on environmental crimes in 2025.[112]

90. Seeking to strengthen the environmental protections in the Rome Statute, Vanuatu, Fiji and Samoa invoked its article 121 to propose a formal amendment in September 2024. This proposal suggested the inclusion of a stand-alone crime of ecocide in article 5, and corresponding changes to the preamble and article 8.[113] The proposal builds on the following definition of ecocide that was put forward by a non-governmental independent panel: "unlawful or wanton acts committed with knowledge that there is a substantial likelihood of severe and either widespread or long-term damage to the environment being caused by those acts".[114] This definition further conceptualizes "wanton" to mean "with reckless disregard for damage which would be clearly excessive in relation to the social and economic benefits anticipated".

91. Debates on the crime of ecocide reflect a growing consensus that serious environmental damage, including from military toxics, can no longer be treated as a collateral issue. As highlighted by the United Nations High Commissioner for Human Rights, Volker Türk, by recognizing ecocide as an international crime, the international community "would also promote the human rights to access justice and effective remedy, including for violations of the right to a clean, healthy and sustainable environment."[115]

92. These debates are informed by at least two decades of sustained normative and institutional developments at the national level on the use of criminal law to protect the environment. Moreover, several States have passed legislation that criminalizes ecocide, in varying formulations, often in the context of corporate or governmental activities.[116] These developments are relevant to debates on complementarity of the International Criminal Court, among others.

93. Human rights principles and standards are also relevant to the discussions on ecocide at the International Criminal Court. For example, the principle of legality holds that crimes must be established by law, proscribes retroactive effects of criminal laws, and posits that the act or omission which constitutes a criminal offence must be clearly defined, so that any person may understand what the prohibited conduct is.

[112] See www.icc-cpi.int/sites/default/files/2024-12/2024-12-18-OTP-Policy-Environmental-Crime.pdf.
[113] See ICC-ASP/23/26.
[114] See www.stopecocide.earth/legal-definition.
[115] See www.ohchr.org/en/statements-and-speeches/2024/12/hc-turk-recognising-ecocide-international-crime?sub-site=HRC.
[116] See https://ecocidelaw.com/existing-ecocide-laws/.

Accordingly, definitions of the crime of ecocide that hinge on post-facto balancing of development considerations may run afoul of this cardinal principle.

V. Conclusions and recommendations

94. **Contamination resulting from military activities has profound and lasting consequences for both human health and the environment. These impacts are not limited to combat zones or active warfare; they occur before, during and after military conflict. Toxic exposure affects not only military personnel but also civilians and communities, often in violation of international law.**

95. **Contamination caused by military activities arises from multiple sources: the use of certain weapons, such as depleted uranium, the construction, operation and abandonment of military bases, weapons testing (including nuclear weapons), equipment used in training (such as firefighting foams containing PFAS or lead ammunition), military scrapyards, oil spills and ship-breaking operations. These activities release hazardous substances that infiltrate air, soil and water systems and expose local populations. Military personnel involved in clean-up operations often suffer additional exposures.**

96. **The human and environmental health consequences of military toxics are severe and often long term. Communities and military personnel have faced increased rates of cancer, organ failure, infertility, birth defects and psychological harm. Despite these well-documented harms, the environment and vulnerable communities continue to bear the brunt of toxic military practices, with little accountability or remediation. Indigenous Peoples and local communities are often displaced or forced to live amid dangerous contamination, particularly from polluted water sources near military sites. The damage inflicted on nature is equally alarming: polluting ecosystems, affecting biodiversity, aggravating the climate emergency and threatening endangered species.**

97. **Addressing military-related toxic contamination is essential for the protection of human rights, human health and the environment. Recognition of the full life cycle of contamination – before, during and after conflict – is critical. The environmental pollution resulting from peacetime military activities underscores the urgent need for policies that ensure environmental safety and the prevention of toxic impacts throughout the production, operation and disposal of military equipment.**

98. **A strengthened legal and institutional response to the environmental and human rights implications of military-related toxics is urgent, including preventive action, transparency and post-conflict assessment and remediation. The human rights dimensions of toxic exposures resulting from military activity call for accountability and support the development of robust legal standards and effective practical measures to prevent, mitigate and remediate the harm caused by military contamination.**

99. **States and international bodies must take meaningful action to uphold human rights and prevent exposure to hazardous substances that result from military activities. In addition, the devastating environmental and health impacts detailed in the present report underscore the imperative to relentlessly pursue peace and question rising military expenditures that siphon resources from vital human rights obligations. Without such efforts, both people and the planet will continue to suffer the long shadows of war and military activities.**

100. **The Special Rapporteur recommends that States:**

(a) **Strengthen international and domestic legal frameworks to protect human rights adversely affected by toxics released from military activities and ensure accountability for resulting health and environmental damage;**

(b) **Develop an inventory of pollutants released by military activities that can adversely affect humans and the environment and strengthen capacities for health and environmental monitoring, including through ethical research on affected populations and the release of relevant targeting data, burn pits data and information on toxics released to the environment;**

(c) **Integrate environmental safeguards into military operational planning and rules of engagement to anticipate and prevent adverse toxic impacts;**

(d) **Embed human rights due diligence obligations in military manuals and environmental security doctrines, ensuring that the rights to life, health, water, food, and a clean, healthy and sustainable environment guide all military activities;**

(e) **Implement preventive measures during the production, storage and transport of explosive ordnance to avoid the occurrence of explosive remnants of war and their environmental impact;**

(f) **Require environmental risk assessments at all stages of explosive ordnance and munitions life cycle, including production, storage, transport, use and disposal;**

(g) **Include assessments of toxic effects on the environment in their weapons review procedures;**

(h) **Conduct environmental risk assessments for all arms transfers and oblige any enterprises involved to perform human rights and environmental due diligence;**

(i) **Adopt measures to safeguard protected areas that may be adversely affected by armed conflict;**

(j) **Ratify disarmament treaties and treaties regulating the use of weapons and implement them through a human rights-based approach;**

(k) **Prohibit depleted uranium munitions, while immediately requiring full transparency on firing locations, long-term environmental monitoring of contaminated sites, and funded medical surveillance and clean-up programmes for affected civilians, workers and military personnel;**

(l) **Prohibit the use of white phosphorus, including through Protocol III to the Convention on Certain Conventional Weapons;**

(m) **Explore the development of a new international instrument to address toxic remnants of war, potentially through a sixth protocol to the Convention on Certain Conventional Weapons, that stipulates responsibilities for States and mechanisms for data-sharing, clean-up, remediation and victim assistance;**

(n) **Support the inclusion of the crime of ecocide in the Rome Statute of the International Criminal Court, in a formulation consistent with human rights principles and standards;**

(o) **Clarify and strengthen the application of multilateral agreements on chemicals and waste to military contexts, including during armed conflict and occupation;**

(p) **Ensure access to environmental and health data related to military activities and support efforts at documentation of toxic impacts;**

(q) **Establish clear military protocols on disclosing contaminated sites, unexploded ordnance and environmental damage to civilian authorities and affected communities;**

(r) **Establish and strengthen mechanisms for civilian reporting of environmental contamination due to military activities;**

(s) **Develop early warning mechanisms to alert civilian and humanitarian actors to toxic exposures during and after hostilities;**

(t) **Mandate post-conflict environmental assessments and, where feasible, during armed conflict, as an integral component of peacebuilding, in cooperation with relevant stakeholders;**

(u) **Enhance international cooperation and technical assistance to ensure that toxic remnants of war under the jurisdiction or control of a party to an armed conflict be identified and removed or rendered harmless as soon as possible, with priority support for resource-constrained States;**

(v) **Provide targeted training for first responders, whether they are miliary personnel, civilians or local authorities, on the identification of toxic hazards, safe removal and health-protection measures;**

(w) **Guarantee adequate protection and equipment for military and civilian personnel involved in environmental clean-up;**

(x) **Promote the use of culturally appropriate remediation techniques in conflict-affected areas;**

(y) **Ensure that remedies include clean-up, victim assistance mechanisms and financial support for healthcare costs;**

(z) **Expand healthcare infrastructure and improve water, sanitation and waste management in communities affected by radioactive or chemical contamination, while integrating environmental monitoring and data-sharing between health and environmental authorities.**