Unprecedented Environmental Impacts of Chemical and Biological Warfare: A Critical Appraisal

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Summary

Despite the existence of several mechanisms and frameworks that regulate the use and production of CBWs, they continue to exist, and pose risk to environmental and human health. Their use in wars and conflicts in the past have inflicted severe damages on ecosystems, as evidenced by the cases of different wars. Yet these issues are seldom brought up in the narratives on chemical and biological warfare, except from a moral point of view. The long-term effects of these agents are still ambiguous, but as the world faces a major crisis in the form of the coronavirus pandemic, one needs to reflect upon various aspects of environmental destruction, and its interrelationship with the changing nature of warfare in the 21st Century. In this context, the article attempts to analyse the environmental implications of chemical and biological warfare, by delving into historical examples, and providing an overview of futuristic implications from an environmental point of view.

Introduction

The destructive effects of chemical and biological weapons (CBWs) on ecosystems and human lives have been recorded since time immemorial, yet they have been deployed by both state and non-state actors to debilitate enemies (by inflicting infectious diseases, such as plague and smallpox), and win battles/wars. Any evidence of their use (and related environmental disruptions) dates back to ancient history in many countries, particularly that of Europe, Asia, and North America, where measures such as the use of toxic chemicals (pollutants), and contamination of water bodies were practiced by the armies.[1] For instance, Peloponnesians used a sulfur-based irritant against the town of Plataea (in the 5th century BC)[2], and the Byzantines used 'Greek Fire', which is a napalm-like liquid substance, to attack their enemies.[3] The lethality of these, and other similar agents was such that these would not only incapacitate humans, but also render lands uninhabitable temporarily, or even permanently.

In the 21st century, despite the existence of chemical and biological weapons conventions, as seen in the case of the Syrian conflict, in which chemical agents (for example, sarin and chlorine) were allegedly deployed by both state and non-state actors such as the Daesh or Islamic State of Iraq and Syria, leading to disastrous environmental and public health impacts[4], CBWs may continue to be used in the future by some groups to gain leverage over their adversaries. Hence, there is a need to address the environmental impacts of CBWs, not only of those that were deployed in the past (whose effects are still indeterminable), but also of their plausible use in the future, by both states and violent

non-state actors. At a time when the coronavirus pandemic has unleashed catastrophe across the world, there is a need to relook at the changing nature of warfare, and how such outbreaks can also be exploited by terrorist organisations to their advantage.

Use of CBW's during the World Wars: Long-lasting and Uncertain Environmental Effects

The World Wars led to the emergence of new forms of warfare, guided by the use of CBWs. The birth of modern CBRN (Chemical, Biological, Radiological and Nuclear) warfare is commonly traced to the use of chlorine gas by Germans in the First World War. Not only Germany, but other countries also overtly or covertly engaged in this type of warfare. War-time use and testing of CBWs are known to cause unprecedented damage to the environment. Their impacts in terms of biodiversity loss, and even species extinction have been recorded.

Mustard gas was used widely to disable enemy combatants, and contaminate lands and groundwater during the First World War, indirectly affecting the civilians also. As scientific studies reveal, the environmental effects of its use are long-term in nature, and are yet to be discerned completely.[5] The large-scale use of CBWs during the war led to the signing of the 1925 Geneva Protocol (Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous or other Gases, and of Bacteriological Methods of Warfare), by which the use of CBWs was prohibited in wars.[6] Due to the lack of trust, countries such as France, Italy, Germany, Japan, and Great Britain continued to research on CBWs. Japan, which had initiated its research on biological weapons in the 1920s, carried out a massive biological attack on various Chinese cities during the Second World War, by dispersing plague-infected substances, *B. anthracis*, cholera bacteria, etc. — affecting food and water supplies, and killing thousands of people. During the same time, Germany developed a poisonous gas, called sarin nerve gas, which attacks the nervous system, causing suffocation and death. Sarin is a potent water and food contaminant, and it is known to have hazardous effects on marine and freshwater ecosystems, due to neurotoxicity.[7]

In the early 1940s, British scientists working at Porton Down facility (officially known as Ministry of Defence's Defence Science and Technology Laboratory or DSTL), undertook bomb experiments at Gruinard Island using *Bacillus Anthracis* (*B. anthracis*), which had long-lasting implications.[8] These bombs typically contained "106 special bomblets filled with anthrax spores"[9], and killed several sheep (introduced to the island to check their lethality and feasibility) within days of exposure. Through these explosions, they found that anthrax could be used as a bioweapon. In fact, the British planned to use it in Germany, but ended up not doing so. In any case, the experiments are known to have gone out of control, as an anthrax outbreak occurred on the island in 1943, and the tests had to be eventually terminated, and the island, sealed.[10] It remained in this state until the 1980s, when the British Government decontaminated the island by removing the worst-infected topsoil, and soaking subsoil in formaldehyde, diluted in seawater.[11] However, for years, the fear of transmission of contaminated soils to the Scottish mainland remained.

After the Second World War, numerous chemical agents were dumped in the oceans by countries, such as the United States (US), Soviet Union, and others, including in the Baltic Sea. These include arsenic-containing substances, sulfur mustard, hydrogen cyanide, etc. As some of these agents

degrade over a period of time, the resultant products could be toxic, and could even affect marine ecosystems (albeit the environmental risk assessment is extremely difficult due to the lack of knowledge about their nature and toxicity). However, scientists warn that there is a need to constantly monitor the developments in the disposal sites as their effects are still uncertain and unpredictable, even as fishing activities increase in the affected areas.[12]

The Use of CBWs during the Vietnam War and Consequent Environmental Effects

Despite regulations/protocols, CBWs continued to be utilised by countries. Perhaps, one of the watershed moments with respect to the use of chemical and biological agents in wars, was their extensive, and deplorable application during the Vietnam War by the US military. Apart from using Napalm (a highly gelatinous and flammable liquid), the US military carried out 'Operation Ranch Hand', under which it sprayed an estimated 19 million gallons of defoliants and herbicide (Agent Orange and others) over nearly 6 million acres of land.[13] These were deployed to destroy forests, and to deprive the Viet Cong guerrillas of vegetation cover. By the end of the war, about 3.8 million acres of land were destroyed, and approximately 13,000 livestock died. These agents gave rise to public health-related problems in Vietnam as defoliated areas became more susceptible to diseases, such as plague, cholera, malaria, etc.[14]

Environmentally, it wreaked havoc by contaminating agricultural (paddy) fields, water bodies (rivers, lakes, etc.) soils, and other ecosystems, as well as by infiltrating the food chain (with consequences for human health for many years). At the same time, a large proportion of the forest ecosystems are known to have irreversibly harmed, thereby also disrupting the habitats of several wildlife species. According to reports, the Vietnamese authorities took years to ecologically restore the affected areas, particularly natural defences, mangroves.[15] The Vietnam War, therefore, was a classic example of environmental warfare, carried out by the US, which eventually led to the establishment of the Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques of 1977 (ENMOD).[16]

Environmental Implications of CBWs: A Futuristic Perspective

Due to their extreme lethality, CBWs are regulated by the international community through conventions such as the Biological Weapons Convention (BWC) and Chemical Weapons Convention (CWC). Yet, state and violent non-state actors are engaged in stockpiling chemical and biological agents. Even dismantling of chemical weapons poses adverse environmental risks. The sealing of stockpile storage facilities, excavation of the old/abandoned stockpiles, transportation, and the entire dismantling process needs to be handled through sophisticated, and environmentally safe methods. Although the CWC refers to environmental safeguards that require to be adopted while eliminating chemical weapons (and production facilities), it does not provide standards, which complicates compliance.[17] In the US, due to concerns regarding environmental and human health, the initial proposal to construct three "centralized incinerator facilities" to destroy them had to be shelved in favour of similar facilities in all the nine sites possessing chemical weapons (as declared by them), so that the stockpiles do not have to be transported (that might prove to be risky).[18]

As the world is grappling with the COVID-19 crisis, one needs to remember that the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), whose origin still remains unclear, but it has certainly put a spotlight on the need to prepare more effectively for epidemics and pandemics. More importantly, this crisis points towards the adverse implications of environmental destruction (primarily habitat fragmentation and biodiversity loss), which is considered to be responsible for the outbreak of several epidemics and pandemics in the past few decades, such as Nipah virus infection, Severe Acute Respiratory Syndrome (SARS), and Ebola virus disease, among others.[19] Hence, a holistic, integrated planetary approach is required to deal with the complex challenges of the 21st century, wherein making any actors accountable for wilful destruction of the environment, leading to intended or unintended consequences in the form of a disease outbreak, would be next to impossible. Some of these activities can be clandestinely carried out, and would then go unnoticed. At the same time, certain actors, particularly terrorist organisations and rogue armed groups may even try to capitalise on such disease outbreaks to achieve their political goals.

Disclaimer: The views expressed in the article are personal.

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