

---

# War and the Environment: Human Health Consequences of the Environmental Damage of War

Jennifer Leaning, M.D.

---

*. . . when in feudal times the aim of a king was to bring his truculent barons to heel, the primitive artillery of that period was found invaluable to deprive them of their power of resistance—their castles. But had its destructive effect been such that, not only their castles, but their retainers, serfs, orchards and cattle within a radius of several miles would be obliterated, nothing would have been left to bring to heel—the means would have swallowed the end.<sup>1</sup>*

The human cost of war has been amply detailed in accounts that trace the toll exacted by all forms of weapons or other direct military action against human beings. The effect of war on the environment, as a general topic, has not received equivalent attention, and what notice it has attracted has arisen only recently. The subject of this chapter, the impact of war-induced environmental damage on human health, can be seen as an aspect of the general topic of war and the environment, and from this perspective it appears to have followed a similar time course of mild, late-blooming interest. Yet if the notion of environment is expanded to mean the human environment—the social, economic, and physical structures that constitute the niche in which human beings live and thrive—then it is evident that classic discussions of war have touched upon some of these factors (such as disease, famine, and exposure) that constitute secondary assaults on human health induced by the environmental damage of war.

The reasons for this relative delay in placing an analysis of war in an environmental context are beyond the scope of this discussion, ex-

cept insofar as three developments contributing to the current high level of concern about the environment and its impact on human health all have recent roots in the years since the end of World War II.

- The evolution in the destructiveness of conventional weapons and the development of nuclear, chemical, and biological weapons have produced concrete evidence and theoretical grounds for the argument that the environment is vulnerable in many ways to the consequences of human aggression and can, in fact, be so damaged that it may fail to sustain the lives of those who survive the immediate, direct effects of the weapons.
- Military forces around the world have incorporated this technology-based potential for environmental destruction into modern war-fighting strategies, employing techniques of deliberate environmental destruction to weaken the defense and attack capacities of the enemy.
- The industrial and technical enterprises required to produce these highly sophisticated conventional weapons and weapons of mass destruction have drained societies of human and material resources, caused widespread environmental degradation, and inflicted serious harm on an unknown number of people.

There are four specific activities in the preparation or conduct of war that can be seen as harming the environment in ways that are particularly pernicious to human health: the production and testing of nuclear weapons, aerial bombardment, the planting of land mines, and the defoliation or despoilment of land, air, or water.

---

---

### Production and Testing of Nuclear Weapons

The development during World War II of vast military industries capable of producing nuclear weapons has had a tremendously negative impact on local, regional, and global environments.<sup>2,3</sup> (See the preceding chapter for a more complete discussion of the environmental and health effects of nuclear weapons production and testing.)

In addition to the nuclear weapons complex, there are thousands of military bases and installations throughout the United States, which include more than two-thirds of the sites classified by the U.S. Envi-

ronmental Protection Agency as highly toxic and dangerous.<sup>4</sup> Technologies for mitigating the dangers of the toxic chemical contamination created by these military sites are not well developed; the environmental (as well as social) costs of continuing to live with these toxicities and/or trying to contain them will undoubtedly be very high.

---

---

## Aerial Bombardment

Bombardment of the human environment displaces the survivors, resulting in clusters of refugee populations in situations conducive to the spread of disease, to malnutrition and starvation, and to marked psychological stress. In World War II, air power became for the first time a major determining technology of military campaigns. During the 6 years of the war, the combatants expended approximately 6–9 million tons of air munitions on targets defined in broad terms of military usefulness.<sup>5</sup> These harbors, ports, overland rail and road routes, and industrial sites were also located near or within areas of dense human habitation. Hundreds of thousands of people died as a direct effect of these bombings. The indirect consequences brought on by the destruction of these human environments were also devastating: It is estimated that by the end of World War II approximately 40–50 million people in Europe alone were considered refugees—victims of a war so sweeping that it left people not only without homes but without countries.<sup>6,7</sup> The cumulative impact of this vast social dislocation on the subsequent course of world history has not been described.

During the years of active U.S. engagement in Southeast Asia, it is estimated that massive U.S. bombardment of Vietnam, Laos, and Cambodia forced approximately 17 million people to become refugees.<sup>8</sup> Thirty years later, with far more precision and efficiency, the Allied forces in the Gulf War relied on highly accurate and powerful aerial bombardment to destroy the urban human environment in Baghdad and several other major Iraqi cities. In a matter of weeks, water works, transportation systems, communications networks, and electrical power grids were selectively demolished. In a relatively urbanized country such as Iraq, this targeted destruction trapped the majority of the civilian population in a downward spiral of confusion, helplessness, hunger, and

disease.<sup>9-11</sup> Iraqi military casualties have been estimated at 100,000 dead and 300,000 wounded.<sup>12</sup> According to a controversial U.S. Census Bureau analysis, Iraqi deaths arising from the direct and indirect effects of the ruin of the major cities may have totaled 100,000.<sup>13</sup>

---

---

## Land Mines

Land mines were strewn across Europe and Africa during World War II, and in Vietnam and Cambodia during the Vietnam War to dissuade enemy movement across the mined terrain. For civilian populations who try to live on this land or to travel on mined waters once the war is over, unexploded mines and other munitions cast a long shadow across space and time. In Europe, in North Africa, and throughout Southeast Asia, intense efforts (often resulting in loss of life) have been required to clear and deactivate mines and other buried remnant munitions from arable land and pasture, and even after decades of such work



Figure 1 A victim of a land mine at the Thailand-Cambodia border. Courtesy of Rae McGrath, Mines Advisory Group.

millions of hectares remain under interdiction.<sup>14</sup> In Vietnam, Laos, and Cambodia, civilians are still frequently maimed or killed walking across territory thought to be free of such threats.<sup>8,15</sup> In Afghanistan, thousands of tons of mines and unexploded munitions litter the plains and the mountains, endangering the lives of farmers and herdsman, their families, and their livestock for decades and greatly complicating the country's path toward peace.

---

---

### Despoliation, Defoliation, and Toxic Pollution

Isolated instances of deliberately damaging the environment in time of war to inflict severe harm on the enemy can be traced back to antiquity. The primary means of doing this were to use fire or water to destroy supplies, ruin farmland, or block access routes.<sup>16</sup> During World War II there were two well-known examples of such efforts: the detonation of the Huayuankow dike across the Yellow River in China in 1938, whereby the Kuomintang hoped to block the advance of the Japanese but succeeded primarily in flooding several million hectares of farm land and drowning several hundred thousand Chinese,<sup>17</sup> and the opening of key dikes in the Netherlands in 1944, whereby the Germans intentionally flooded with salt water approximately 200,000 hectares of agricultural land.<sup>18</sup> Less widely known is the extent to which the German occupation forces, retreating under Russian attack in October 1944, devastated the human ecosystem of the northernmost settlements in Norway, slaughtering all the domestic animals, burning all the buildings, laying waste to all bridges, roads, and fishing boats, destroying all communications and utilities, and strewing the terrain and the harbors with mines.<sup>19</sup> During the Korean War, in May 1953, the U.S. deliberately bombed five irrigation dams in North Korea, all critical to rice production, in the hope of forcing the North Koreans to an armistice agreement.<sup>20</sup>

The war in Vietnam and parts of Laos and Cambodia, however, marked the first time a nation had used deliberate and direct destruction of the environment as a central and sustained facet of its war-fighting strategy.<sup>8</sup> The destruction of rice paddies in Vietnam was defended as necessary to deny the enemy its source of food; the destruction of rural

areas in general was explained as needed to obliterate the enemy's protective cover.<sup>8</sup>

In the years 1965–1971, the U.S. sprayed 3,640 square kilometers of South Vietnam's cropland with herbicides, using a total estimated amount of 55 million kilograms.<sup>8</sup> The consequences of this onslaught on the ecosystem of Southeast Asia are only just beginning to be discerned. Little is known about the effects of this toxic exposure on the human population in this region, since ongoing war, civil strife, and diplomatic isolation have prevented internal or international epidemiological evaluations. An indication of potential morbidity for the Vietnamese population comes from the claims of U.S. veterans exposed to Agent Orange.<sup>21</sup>

The Gulf War, waged during January and February 1991, is remarkable for the extent of the environmental damage wrought in such a brief time frame. Early in the war, Iraqi forces released approximately 10 million barrels of Kuwaiti oil into the Persian Gulf,<sup>22</sup> which was already gravely polluted after decades of accumulating pollution from previous oil spills (particularly those from the Iraq-Iran war of 1980–88), from industrial wastes, and from heavy freighter traffic. The oil spill threatened Saudi desalination plants on the western shoreline, killed thousands of sea birds, and caused potential, as yet unquantified damage to seagrass beds and to a range of aquatic and migratory birds.

The Iraqi forces also set fire to 732 Kuwaiti oil wells,<sup>23</sup> filling the air for miles with dense black smoke that covered every surface with a sooty residue. The burning wells—not capped until November 1991—poured approximately 50,000 tons of sulfur dioxide and 100,000 tons of soot into the atmosphere per day.<sup>25</sup> Scientific assessments of the short- and long-term effects of this smoke have been filled with controversy and incomplete data,<sup>26–29</sup> but some preliminary measurements raise significant concerns about the potential health consequences for those downwind.<sup>30,31</sup> It has also been postulated that the short-term fluctuations in temperature and winds caused by the lofting smoke increased the intensity of the typhoon in Bangladesh.<sup>27</sup>

The military rationale for the Iraqi degradations of the local and regional environment seemed slim in Allied assessments, since the oil slick did not significantly impede Allied attack plans and the smoke from



Figure 2 Toxic cloud from a burning oil well, Kuwait, 1992. Source: International Committee of the Red Cross.

the Kuwaiti oil fires had no effect on the air or the ground war. An aspect of “eco-terrorism” has been alleged, in that Iraq is said to have sought to cause generalized psychological harm by manipulating the world’s attachment to the environment.<sup>30</sup> The Iraqis, in turn, have charged the Allies with deliberately destroying their urban infrastructure in order to cause death and injury to the civilian population.

---

---

### Major Issues in Estimating the Human Health Consequences of War-Induced Environmental Damage

Four main issues must be addressed in future work on this topic.

- Insufficient information exists about the effects of war on natural ecosystems, both in the immediate aftermath of war and over the long term. Until these effects are analyzed, assessments of the human impacts resulting from this environmental damage will continue to be fragmentary. Examples of the environmental effects of war, now accessible as case studies throughout the world, are not being studied in systematic or comprehensive ways. In many cases (such as the long-term effects of multiple craters or of disruption of desert terrain) there is a lack of clarity about what questions to ask or what data to gather. Public health experts, demographers, environmental scientists, meteorologists, agricultural experts, anthropologists, and military weapons experts have to begin to develop integrated analytic models to address these issues.
- The escalating numbers of weapons and the diverse technologies of destruction and delivery now available to virtually any country that wishes to pay the price place the local, regional, and global environments in greater jeopardy than ever before. Chemical and biological weapons, cluster bombs, fuel-air explosives, and herbicides are capable of inflicting massive and lasting damage on natural ecosystems and thus threatening the survival of entire human populations. Any war between forces equipped with these modern systems carries the potential of creating as much environmental destruction as the Gulf War.
- Burdened by rapid population growth in many parts of the world, by unrestrained settlement, and by economic exploitation, the global ecosystem is increasingly threatened and stressed, even in the absence





Figure 3 Nagasaki after the atomic bombing. Source: U.S. Air Force.

of war.<sup>31</sup> In view of the impact of World War II, another massive war in the near future (even one waged only with conventional weapons) would push into oblivion many natural systems that are now surviving marginally. The world's population has doubled since 1940, from 2.5 billion to over 5 billion. The rain forests have been reduced by more than 55% as of 1989 and are disappearing at a rate of 1.8% per year.<sup>32</sup> Global species extinction is occurring at such a pace that in 50 years one-fourth or more of the world's plants and animals could have disappeared.<sup>33</sup> Pollution of coastal oceans and seas is causing entire aquatic life chains to crash.<sup>34</sup> Air and ground pollution from industrial activity poses a serious health threat to many urban areas in developed and developing societies.<sup>35</sup> Since the end of the last world war, in times of relative peace, societies have approached the limits of global sustainability. A large-scale war occurring now, at this stage of environmental jeopardy, could plunge the world into ecological catastrophe.

- Future wars carry the risk that one party or more might use nuclear weapons. The environmental and human impacts of the use of nu-

clear weapons have been more carefully explored, on a theoretical basis, than have the impacts of the actual use of conventional weapons. Most assessments assume large-scale and widespread nuclear explosions, based as they are on strategic escalation scenarios. Even “limited” nuclear war, as envisioned during the depths of the Cold War for Europe (171 nuclear weapons, averaging 200 kilotons each, in the hypothetical scenario), would entail sweeping destruction of the environment from the North Sea to the Mediterranean and from England to the Urals, the death of approximately 10 million people in Germany alone, and enduring radioactive contamination.<sup>36</sup>

Global nuclear war would substantially destroy many life forms, particularly ocean plankton (from increased ultraviolet B radiation), deciduous trees and conifers (because of radiation sensitivity), and large mammals, including humans (again because of radiation sensitivity).<sup>37,38</sup> Longer-term effects of the war would include obliteration of most global agricultural production (through loss of human cultivators, destruction of seed, absence of petroleum and production facilities for fertilizer and mechanized equipment, radiation effects on crops that are planted, and global climate change precipitated by possible nuclear winter effects) (table 1). Such potentially profound alterations of the environment, described on the basis of well-

Table 1 Damage to biota from a nuclear bomb exploded at the surface. Source: reference 18.

Type of damage	Bomb size:	Area suffering the given type of damage (hectares)		
		18 kt	0.91 Mt	9.1 Mt
Craterization by blast wave		1	12	57
Trees blown down by blast wave		362	9,040	52,500
Trees killed by nuclear radiation		148	12,800	63,800
All vegetation killed by nuclear radiation		43	2,830	12,100
Dry vegetation ignited by thermal radiation		749	21,300	117,000
Vertebrates killed by blast wave		24	332	1,540
Vertebrates killed by nuclear radiation		674	36,400	177,000
Vertebrates killed by thermal radiation		1,000	26,900	150,000

grounded speculation, would cause from 1 billion to 4 billion human deaths from famine and disease.<sup>39</sup> Such assessments have served to caution the world community and to bolster efforts at arms control and disarmament. It is important to keep high on the agenda of world leadership the enormity of risk these weapons still entail.

---

---

### International Law of War and the Environment<sup>40-42</sup>

The intense concern about the environmental effects of the Gulf War has been conducive to proposals to strengthen international law with regard to protection of the environment during time of war. International law has attempted to limit the use of weapons that carry high risk of damaging the environment and to prohibit the direct manipulation and destruction of the environment as an act of war. Of particular relevance to these efforts are the several existing treaties and arms control agreements that forbid the specific use of certain classes of weapons or certain methodologies: the 1925 Geneva Protocol on Chemical Weapons, the 1972 Biological Weapons Convention, the 1977 Protocols to the Geneva Conventions, the 1977 Convention on the Production of Military or any other Hostile Use of Environmental Modification Technologies (the “En-Mod Convention”), and the 1981 Convention on Excessively Injurious Conventional Weapons.<sup>43</sup>

Although these agreements mark important advances in the international rules of war as applied to the environment, they contain many loopholes and inadequacies. The challenge to the international community is to act, in the present favorable climate, to rectify some of the recognized insufficiencies in the current status of the law, and, in so doing, to introduce some new strictures. Experts in the field of arms control in relation to the environment have proposed the following<sup>44</sup>:

- ruling out military action if environmental consequences are assessed to be severe
- holding responsible each party that has caused environmental damage during armed conflict
- forbidding destruction or damage of facilities that could release radioactive or poisonous substances to the environment

- classifying natural parks and reserves and other sites of special ecological importance as demilitarized zones
- banning the use of all weapons of mass destruction.

Other proposals would not only increase our understanding of the environmental effects of war but would also raise public consciousness of the dangers of any specific impending armed conflict and support mitigating interventions. Among these proposals<sup>25</sup> are that the United Nations establish an international environmental database listing and quantifying the details of vulnerable ecosystems, set up an environmental crisis management system that would preposition response equipment (such as oil-spill rigs) and could dispatch teams of experts to gather data and employ tactics to reduce environmental damage during and immediately after a war, and require consideration of the environmental impact of a potential conflict as part of international decision-making during times of crisis.

---

---

## Conclusion

Although societies have waged war for millennia, the effects of this enterprise on the environment and the pervasive consequences for human health have received relatively little sustained scientific attention. The surge in interest after the Gulf War may reflect the recent overall expansion of public awareness that the world's ecosystems are fragile, even in times of peace, and that the fate of human beings is inextricably bound to the fate of the earth. Such recognition has arrived late, only as the environmental and social consequences of world population growth and industrial activity have become too bleak to ignore.

To limit the environmental effects of war requires action at the international level. The actions to take must spring from the tension that pervades all international law with regard to war: bind all parties to agreements that severely limit damage to the environment in the event of war, and create norms, procedures, and alternatives that continue to constrain the use of war as an option. Because the means of waging war are increasingly outstripping the means of controlling its effects once launched, the task for the United Nations in the 21st century is not only to strengthen the laws regulating outright military action but also to make possible and powerful all means to settle conflict short of war.

---

---

## References

1. Fuller, J. F. C. *The Conduct of War 1789–1961*. Methuen, 1979.
2. Renner, M. G. Assessing the military's war on the environment. In *State of the World 1991*, ed. L. Brown. Norton, 1991.
3. Finger, M. The military, the nation state, and the environment. *Ecologist* 21 (1991): 220–224.
4. Environmental Progress and Challenges: EPA's Update. Environmental Protection Agency report GAO/RCED-88-44, 1988.
5. Westing, A. H. Misspent energy: Munition expenditures past and future. *Bulletin of Peace Proposals* 16 (1986), no. 1: 9–10.
6. Laquer, W. *Europe since Hitler*. Penguin, 1984.
7. Proudfoot, M. J. *European Refugees 1939–1952: A Study in Forced Population Movement*. Northwestern University Press, 1956.
8. Westing, A. H. *Warfare in a Fragile World: Military Impact on the Human Environment*. Taylor & Francis, 1980.
9. Arkin, W. M., Durran, D., and Cherni, M. *On Impact: Modern Warfare and the Environment; A Case Study of the Gulf War*. Greenpeace, 1991.
10. *Iraq Situation Report for Save the Children*, U.K. Save the Children Fund, 1991.
11. Renner, M. G. Military victory, ecological defeat. *World Watch*, July/August 1991: 27–33.
12. Tyler, P. E. Iraq's war toll estimated by U.S. *New York Times*, June 5, 1991.
13. Andrews, E. L. Census Bureau to dismiss analyst who estimated Iraqi casualties. *New York Times*, March 7, 1992.
14. Westing, A. H., ed. *Explosive Remnants of War: Mitigating the Environmental Effects*. Taylor & Francis, 1985.
15. Stover, E. *Land Mines in Cambodia: The Coward's War*. Physicians for Human Rights and Asia Watch, 1991.
16. Jones, A. *The Art of War in the Western World*. Oxford University Press, 1987.
17. Westing, A. H., ed. *Environmental Hazards of War: Releasing Dangerous Forces in an Industrialized World*. Sage, 1990.
18. Westing, A. H. *Weapons of Mass Destruction and the Environment*. Taylor & Francis, 1977.
19. Lund, D. H. The revival of northern Norway. *Geographical Journal* 109 (1947): 185–197.
20. The attack on the irrigation dams in North Korea. *Air University Quarterly Review* 6 (1954): 40–61.

21. Harris, R., and Paxman, J. *A Higher Form of Killing: The Secret Story of Gas and Germ Warfare*. Chatto & Windus, 1982.
22. Introductory report of the Executive Director: Environmental Consequences of the Armed Conflict between Iraq and Kuwait. United Nations Environment Programme report UNEP/GC.16/4/Add.1, 1991.
23. Carothers, A. After Desert Storm: The deluge. *Greenpeace*, October–December 1991: 14–17.
24. *The Gulf, 1990–1991: From Crisis to Conflict*. International Committee of the Red Cross, 1991.
25. Toukan, A. Humanity at war: The environmental price. *Physicians for Social Responsibility Quarterly* 1 (1991): 214–220.
26. Horgan, J. Up in flames. *Scientific American* 264 (1991), May: 17–24.
27. Horgan, J. Burning questions. *Scientific American* 265 (1991), July: 17–24.
28. Wald, M. L. Experts worried by Kuwait fires. *New York Times*, August 14, 1991.
29. Stone, R. Kuwait quits smoking. *Science* 255 (1992): 1357.
30. Environmental Consequences of the Armed Conflict between Iraq and Kuwait: Introductory Report of the Executive Director. United Nations Environment Programme report UNEP/GC 16/4/Add. 1, 1991.
31. Third National Toxics Campaign Fund Report on Kuwait Air Quality: Laboratory Test Results. National Toxins Campaign, 1991.
32. Ehrlich, P. R., and Wilson, E. O. Biodiversity studies: Science and policy. *Science* 253 (1991): 758–762.
33. Wilson, E. O. Threats to biodiversity. *Scientific American* 261 (1989), September: 108–116.
34. Ryan, J. C. Life Support: Conserving Biological Diversity. Paper 108, Worldwatch Institute, 1992.
35. Report of the WHO Commission on Health and the Environment: Summary. World Health Organization, 1992.
36. Arkin, W., von Hippel, F., and Levi, B. G. The consequences of a “limited” nuclear war in East and West Germany. In *The Aftermath: The Human and Ecological Consequences of Nuclear War*, ed. J. Peterson. Pantheon, 1983.
37. Pittock, A. B., et al. *Environmental Consequences of Nuclear War*, volume 1: *Physical and Atmospheric Effects*. Wiley, 1986.
38. Harwell, M. A., and Hutchinson, T. C. *Environmental Consequences of Nuclear War*, volume 2: *Ecological and Agricultural Effects*. Wiley, 1986.
39. Harwell, M. A., and Harwell, C. C. Nuclear famine: The indirect effects of nuclear war. In *The Medical Consequences of Nuclear War*, ed. F. Solomon and R. Q. Marston. National Academy Press, 1986.

40. DeLupis, I. D. *The Law of War*. Cambridge University Press, 1987.
41. *The Geneva Conventions of August 12, 1949*. International Committee of the Red Cross, 1989.
42. *Protocols Additional to the Geneva Conventions of August 12, 1949*. International Committee of the Red Cross, 1977.
43. Bouvier, A. Protection of the natural environment in time of armed conflict. *International Review of the Red Cross* 285 (1991): 567–578.
44. Barnaby, F. The environmental impact of the Gulf War. *Ecologist* 21 (1991): 166–172.