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Globalization and Pollution

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Synonyms

Food contamination; Greenhouse gas emissions; Health impacts; Limits to growth; Nuclear weapons testing; Risk society; Toxic waste trade

When the Club of Rome's influential report, *The Limits to Growth* (*LTG*) (Meadows et al. 1972), was first published, it provoked widespread criticism and, indeed, ridicule, on the part of many "pro-growth" advocates and technological optimists for both its methodology and unduly pessimistic conclusions about the trajectory of the world economic system and what the authors saw as the inevitable, environmental consequences. Focusing on five key elements, the document highlighted the ongoing exponential growth in *global population*, *resource depletion*, *food production*, *industrialization*, and *pollution*.

While this offering concentrates on the last item (defined, narrowly, in *LTG* as atmospheric carbon dioxide concentration), it is important to recognize that all five elements are intimately related and generate constantly changing and complex, nonlinear, feedback loops. Population growth, food production, and industrialization, for example, fuel accelerating resource depletion which then creates externalities in the form of pollution. This, in its turn, can often have serious negative consequences for productivity, population health, and growth, especially in low- and middle-income countries subject to runaway pollution from multiple sources.

For the purposes of the initial Club of Rome (*LTG*) exercise, a computer simulation model (World3) varied the metrics of the five variables noted above to produce three alternative scenarios – or "futures" – of the earth/economic system. Of these, two pointed to a dystopian future characterized by "overshoot and collapse" by the mid-twenty-first century. Controversially, the report's authors cast considerable doubt on the capacity of technological innovation ("clean coal," geoengineering for climate change, genetically modified crops, etc.) to address current trends and halt a coming ecological collapse.

Pollution, Population, and the Anthropocene

In the intervening years since the report's release, much has happened to vindicate many of the core findings. Without precedent in human history, world population growth progressed rapidly through the two, three, four, five, and six billion thresholds in the twentieth century. It now stands at 7.2 billion and is projected to exceed nine billion by 2050. Inevitably, this has spawned vastly increased – and

A. Farazmand (ed.), *Global Encyclopedia of Public Administration, Public Policy, and Governance*,
DOI 10.1007/978-3-319-31816-5_1311-1

ultimately unsustainable – consumption levels of energy, food, water, and natural resources of all kinds as well as associated waste production. Rapidly rising standards of living in some of the world's most populous nations (India, China, Indonesia, Brazil, etc.) are compounding the pressures. Each year the Global Footprint Network calculates what has become known as "World Overshoot Day." This is the precise date in that year by which the world has consumed a full 12 months' quota of renewable resources. For 2016, that day was August 8. In 1990, it was December 7 (www.footprintnetwork.org).

The concepts of "peak oil," "peak water," and "planetary boundaries" are now commonly invoked and widely accepted in many academic and policy circles (Hayha et al. 2016). In acknowledgment of the enormous power of human actions over the long term to bring about fundamental environmental changes, a working group of scientists is currently engaged in the process of deciding whether or not the current geological era should officially be named the "Anthropocene" (Casagrande et al. 2017).

One inescapable fact is that, following some 10,000 years of relative earth-system stability in the Holocene, we now appear to be in a phase of uncharted instability. Largely as a consequence of the large-scale (anthropogenic) mining and burning of fossil fuels, carbon dioxide levels in the atmosphere, for example, have been rising steeply in recent decades. In 1958, the level of concentration was 316 parts per million (ppm). But in 2016, the symbolic 400 ppm threshold was breached. The last time the earth had a concentration of this magnitude was three million years ago, and it translated into the hottest year on record since detailed readings were initiated in 1880. What is especially disturbing is that the increase in CO2 is now accelerating at around 2.1 ppm per year (Gaffney and Steffen 2017).

The Intergovernmental Panel on Climate Change (IPCC) represents arguably the most inclusive and successful enterprise in international collaboration and consensus building among scientists that the world has ever seen. If unchecked, under a business-as-usual (BAU) scenario, the alarming prognosis of the fifth and most recent (AR5) report of the IPCC (2014) is that the year 2250 could witness an elevated concentration level of the order of 2000 ppm. This would see a global temperature rise of some 9 °C above pre-industrial levels, with catastrophic consequences for sea-level rise, extreme weather events, crop production, the spread of diseases, and water scarcity. The IPCC's (2014: 8) assessment could not be more blunt. A continuation of the present growth trend in emissions, they note, will generate "severe, pervasive, and irreversible impacts for people and ecosystems." Indeed, all over the world – from the Arctic to sub-Saharan Africa and low-lying Pacific Island nations – we are already witnessing ominous signs of an unfolding, global "unliveability" scenario. What this highlights above all is the total inadequacy and outmoded nature of both the hegemonic narrative of progress and current global institutional arrangements (e.g., climate agreements struck in Kyoto (1997) and Paris (2015); numerous, aspirational UN environmental conventions; and the Green Climate Fund) to even start to deal with such serious global issues.

Turner's (2014) detailed analysis of the reliability of the Club of Rome scenarios finds that we are well on track to fulfilling many of the more pessimistic conclusions including impending, dramatic population decline. Building into his argument consideration of the recent, global financial crisis, a coming energy crunch, and the ongoing problem of unsustainable debt, he highlights the absurdity of economies constantly seeking to "grow" themselves out of the financial abyss. Short-term electoral cycles are a major, contributing factor. He concludes (p. 14) "...a relatively rapid fall in economic conditions and the population could be imminent."

A key point to emphasize at the outset is that there is no direct line of causation between absolute population numbers and pollution metrics. Individuals, as well as regions and nation-states, vary enormously in terms of their resource consumption, waste generation levels, and ecological footprint. In addition, the worldwide, military/industrial complex has much to answer for in this regard.

Risk Society: Chernobyl and Fukushima

Fourteen years after the release of *The Limits to Growth*, sociologist Ulrich Beck's best-selling book, *Risikogesellschaft*, was published in Germany. It later (Beck 1992) appeared in English as *Risk Society*. Building on the increasingly vociferous, and well-articulated, arguments of the global environmental movement over the previous decade, Beck's central argument was that in preindustrial epochs, people were overwhelmingly vulnerable to the dangers (pollution) posed by natural disasters, such as volcanoes, fires, floods, epidemics, and earthquakes, but that in modern times, we have become much more vulnerable to broadly defined "technological" risks (food contamination, nuclear power- and chemical-plant accidents, toxic oil spills, etc.). Invariably, these transcend national boundaries, cannot be insured against, and have proven almost impossible to regulate. Moreover, he argued the "new" environmental risks with their global reach are not merely a minor – and "manageable" – by-product of modernity but are its *central product*. Coincidentally – as if on cue – his book appeared in the same year (1986) as the catastrophic meltdown at the Chernobyl nuclear power plant in the Ukraine and only 2 years after the massive Bhopal pesticide plant industrial accident in India.

What Chernobyl underscored was that not only do technological disasters of this kind produce far-ranging impacts, but they also do not discriminate between victims on the basis of class, income, or nationality. The explosion at the plant contaminated an estimated area of 100,000 km^2 across Russia, Ukraine, and Western Europe with radioactive fallout. The effects are still being felt today in terms of ongoing health, cleanup, and infrastructure containment costs. Radioactive elements will remain in the soil, groundwater, and food for thousands of years. Plutonium, for example, a by-product of nuclear power generation, retains its radioactivity for some 250,000 years. One estimate is that, by now, at least one million premature deaths from various cancers, endocrine disorders, and child deformities can be directly attributed to the Chernobyl accident (Nesterenko et al. 2009).

The International Nuclear Event Scale (INES) ranks incidents on a scale of 0–7, where 7 is the most serious ("widespread health and environmental effects"). Chernobyl scored a 7 rating as did the March 2011 Fukushima Daiichi nuclear power station disaster in Japan. Interestingly, Fukushima provides an example where both uncontrollable "natural" forces (earthquake and tsunami) and a litany of major, human-induced, technological, and regulatory failures came together at the same time. Such a fatal combination is almost certain to erupt at some stage elsewhere in the world in the future. Over 150,000 people were evacuated immediately, and ongoing cleanup costs have so far amounted to USD 13 billion.

Every indication is that the caesium-137 and iodine-131 releases from Fukushima (where three reactors melted by comparison with only one in the Ukraine) have been far higher than from Chernobyl. Radioactive dust rose quickly to 5 km above the nuclear plant where the jet stream then moved it rapidly around the globe. Dust was identified over the western United States and British Columbia only 3 days later and in Europe a week after that (Chossudovsky 2012). The sea, too, has been seriously contaminated, with major repercussions for the fishing industry and public health. One "globalizing" consequence has been heightened anxiety about the dangers of nuclear power generation and expansion plans in such countries as the UK, Germany, France, and Italy. Fears of radioactive contamination have also had a serious impact on Japanese trade. Nissan's engine plant at Iwaki is only 40 km from Fukushima. As a consequence, following the accident, Japanese automobiles and car parts destined for the Russian market were confiscated at the port of Vladivostok because of almost certain irradiation.

Air Pollution/Haze

In Southeast Asia, serious haze pollution episodes have been a common occurrence in recent years. Originating largely from slash-and-burn forest

clearing on a massive scale in Indonesia, the resulting haze has frequently produced widespread health and economic impacts on some 75 million people in neighboring Singapore, Brunei, Malaysia, and Thailand and has severely strained relations between these countries and Indonesia. For Singapore alone, the especially serious 1997 haze event has been calculated to have totaled somewhere between USD 163.5 million and 286.2 million in health costs, lost productivity, and tourism revenue. Poor visibility in that year has also been blamed as the cause of Indonesia's worst airline disaster when 234 people died (Islam et al. 2016). Paradoxically, much of the slash-and-burn clearing is carried out by Malaysian and Singaporean companies with close ties to the Indonesian government.

As a rule more affluent countries have considerably higher average levels of resource consumption, but they also often display much stricter environmental regulatory standards. This means, for example, that the air quality in cities such as Paris or New York, while still not perfect, is generally far better than in the large metropolitan centers of China, Indonesia, or India. Needless to add, prior to concerted cleanup policies, cities in the "developed" world also experienced serious photochemical smog (or haze) episodes resulting in thousands of deaths. This was the case in Los Angeles in the 1940s and London in 1952. In the latter city, as many as 12,000 have been estimated to have died as a result of serious air pollution in December of that year.

More recently, there has been a serious deterioration of air quality in the UK generated by large-scale nitrogen dioxide emissions from diesel motors. This has prompted the European Union to order Britain and four other member countries to radically reduce their automobile emissions or risk prosecution in the European Court of Justice (de Freytas-Tamura 2017). With over 90% of the world's population now living in areas deemed to have a serious air pollution problem, and causing around three million deaths a year, the World Health Organization (2016) has recently identified ambient (outdoor) air pollution as the single most important risk to global health. (As an aside, this is already impacting on the willingness of many potential expatriate corporate employees to relocate their families for periods of employment in several Asian cities (Holliday 2014).)

Mongolia's capital, Ulaanbaatar, illustrates the clear connection between poverty and extreme air pollution levels. In the often severe winters, the tens of thousands of residents living in the city's poor slum districts turn to whatever heat source they can to keep warm. In addition to coal and wood, this often involves trash of all kinds, much of it contaminated. As a consequence the city experiences winter toxic smog that is among the worst in the world. The most harmful particles are known as PM2.5, and according to the WHO, an acceptable standard is 20–25 micrograms per cubic meter. Commonly, Ulaanbaatar experiences levels of between 800 and 1000. While Tianjin and Beijing do not reach levels of this severity, pollution in all major northern Chinese cities is becoming worse because of changing weather patterns caused by increased carbon dioxide levels in the atmosphere. In particular, average wind speeds have dropped dramatically over the last 50 years meaning that the haze now takes much longer to disperse (Li et al. 2016).

Interestingly, recent years have demonstrated the potential "reputational power" of such high-profile international sports' institutions as the Olympic Games' movement to initiate dramatic air and water quality improvements in normally highly polluted cities. In 2007 – caused, in large measure, by unregulated emissions from large numbers of aging coal-fired power stations – China had the dubious record of recording 16 cities on the list of the 20 most polluted places on earth. But then came the lure and prestige associated with hosting the world's most high-profile sporting event. In environmental terms, the 2008 XXIX Beijing Olympiad example is legendary and shows what can be achieved by an authoritarian regime in a very short period. Using temporary industrial plant closures and upgrades, as well as robust emission and traffic controls, an estimated US$10 billion budget was allocated to clean up the city's atmosphere in time for the Games. This has been described as "arguably the largest natural experiment in air cleaning" (Chen et al. 2011: 2). Unfortunately, the improvement was only short

lived. Within a year the air quality had deteriorated to its pre-2008 state.

Transparency and the Global PR Machine

The Beijing case highlights an important feature of pollution, and that is its *highly political* nature. Historically – facing international outrage, embarrassment, or even potentially massive compensation payouts – both corporations and nation-states have often gone to great lengths to deny, cover up, or downplay the seriousness of pollution and related industrial accidents. Increasingly, this has involved the generous financial support of conservative think tanks, lobbyists, and global PR companies such as Burson-Marsteller (Miller and Dinan 2008). The extraordinary reach and power of a relatively small number of transnational corporations are a defining feature of our times. Operating across the globe in the resources, agrifood, energy, and chemical sectors, these conglomerates can and do exert disproportionate influence over individual nation-states, research institutes, and universities, as well as in the formulation or weakening of environmental standards, regulations, laws, and agreements (Starobin 2013).

Coal is Australia's leading export commodity. As, currently, in Germany, Bangladesh, and Thailand, it is also the focus of growing opposition from the renewable energy sector and environmental NGOs because of its unacceptable contribution to greenhouse gas emissions and climate change. But through the well-endowed Minerals Council's "COAL21" campaign, the industry is fighting back with a concerted PR and advertising push that saw it contributing AUD 2.5 million to the generation of a suite of "clean coal" advertisements in the lead-up to the 2016 federal election. In Australia, expenditure of over $13,000 on electoral matters by "third parties" must be declared to the Electoral Commission (Aston 2017).

Large corporations, too, are often greatly assisted by invoking the powers that exist under public law, investor-state dispute settlement (ISDS) legal regimes. When countries have entered into free trade pacts, ISDS grants corporations the right to sue individual states if regulatory controls are deemed to be negatively impacting on their commercial operations. There have been several instances of companies successfully suing countries for "excessive" environmental regulation. This is currently a highly contentious issue as the Comprehensive Economic and Trade Agreement (CETA) between Canada and the European Union edges closer to full ratification. Amid widespread public demonstrations in Europe, one of many concerns is that Canadian mining companies operating in places like Arctic Finland potentially could flout exacting European standards with regard to the disposal and treatment of mine wastes but be legally protected by ISDS. Canadian tar sand developments in Alberta are some of the most polluted places on earth.

Through constant mergers, transnational corporations are becoming larger and ever more powerful as they secure tight control of webs of global supply chains. Shortly, we shall be discussing some of the recent activities of BHP Billiton, now the world's largest mining company. That corporate giant, with total assets of over USD 130 billion, was born in 2001 through the marriage of Australia's Broken Hill Proprietary Company and the Anglo-Dutch company, Billiton. And at the time of writing, negotiations are well under way for another proposed merger between Bayer and Monsanto. This would create an agribusiness and chemical megacorporation that would effectively control the majority of the inputs (seeds, fertilizers, pesticides) into the global food system. Monsanto-patented GE seeds now account for 90% of corn and 94% of soybeans grown in the United States. The implications for food security and farmers' rights in developing countries are profound.

Interestingly one of the first acts of the new, Trump administration in the United States was to back the Bayer/Monsanto merger proposal and also ban the publication of Environmental Protection Agency (EPA) data until it had been thoroughly vetted by political appointees (Strom 2017). This is an agency that, critics point out,

already has far too limited powers under the weak *Toxic Substances Control Act* (1976) to effectively regulate and adjudicate upon the safety of literally thousands of chemicals that are already widely used.

Monitoring and "Naming and Shaming"

However, in this age of high-resolution satellite imagery and a range of other technologically advanced tools, hiding or distorting evidence of environmental harm is becoming much more of a challenge. The Chen et al. (2011) study, for example, did not blindly accept official Chinese government figures for Beijing's air pollution index (API) but compared these with high-quality aerosol optimal depth (AOD) data collected by NASA satellites. In addition, independent environmental monitoring by citizens, investigative journalists (e.g., the US-based Center for Public Integrity), environmental activists, and well-resourced NGOs is now commonplace. *Corporate Watch*, *Banktrack*, and *Carbon Underground 200* are but three of literally dozens of organizations that now forensically monitor and report upon the activities of corporate entities and nation-states. The last of these provides detailed and constantly updated information on the top 200 public companies that are investing in fossil fuel enterprises (www.fossilfreeindexes.com).

Two other non-state actor initiatives that are worthy of note are the online *Environmental Justice Atlas* (www.ejatlas.org) and *Pure Earth* (www.pureeart.org). The latter's mission is to "identify and clean up the poorest communities throughout the developing world where high concentrations of toxins have devastating health effects." Needless to add, the information gathered by such organizations and projects can now be transmitted around the world through social media platforms almost instantaneously. "Naming and shaming" is becoming an increasingly common feature of NGO environmental activism. In 2015, the oil multinational, Chevron, was a recipient of the *Lifetime Award* by a consortium of non-state agencies known as the "Public Eye on Davos" for its role in dumping toxic waste into the Amazon in Ecuador. Four years earlier – in a class action that had dragged on for almost a decade – Amazonian indigenous residents had been awarded USD 8.6 billion in the Ecuadorian courts in compensation for the environmental and health impacts of the company's operations. Invoking ISDS rights, Chevron has countersued.

BHP Billiton, Adani, and the Polluter-Pays Principle

BHP Billiton has a similar history of textbook, environmental desecration in developing countries. Each year, between 1984 and 2013, for example, almost 100 million tonnes of untreated tailings from the company's Ok Tedi mine in western Papua New Guinea were discharged into the Fly River. The highly toxic contaminants killed valuable fish stocks, native forest, and food plantations over a 2000 km^2 area. The company was subsequently the target of an unprecedented global campaign on the part of environmental NGOs which – as in the Chevron/Ecuadorian case – eventually resulted in an out-of-court settlement to communities along the Fly River of almost USD 30 million. More recently – since November 2015 – the same company has again been embroiled in ongoing, legal action concerning its role in Brazil's most serious pollution event associated with mining activity. Two tailings dams collapsed at its joint venture, Samarco iron-ore mine, in southeastern Brazil on 5 November. The ensuing, massive mudslide killed 19 people and caused extensive damage in a downstream town, as well as seriously contaminating the Doce River and offshore waters in the Atlantic. At the time of writing, a class action against BHP Billiton and its partner Vale has been filed in the courts in New York on behalf of clients holding USD 2.2 billion in investments in banks that funded the doomed venture. Criminal charges are also pending in Brazil against targeted corporate executives (Danchkert 2017).

At the time of writing, another mining giant – India's Adani corporation – is in negotiations with the Queensland and Australian governments over plans to open what would be by far Australia's

largest coal-mining operation when fully operational. This is the proposed, AUD 22 billion, Carmichael mine in the Galilee Basin. The current plan is to access the estimated 2.3 billion tonnes of coal and transport it 400 km by rail to a new port on the Queensland coast whence it would be shipped to India. On the table is a $1 billion concessional loan from the Commonwealth government for the railway connection. Critics have slammed the mine proposal, arguing that granting the project the green light would make a mockery of Australia's commitment to reduce greenhouse gas emissions under the Paris Agreement (McKenzie et al. 2017). Concerns have also been raised about the impact of shipping and dredging on the adjacent Great Barrier Reef, already showing signs of serious deterioration as a result of climate change. However, a legal challenge to the granting of the mining lease on the part of environmental groups was overturned by the Queensland Supreme Court in 2016.

More recently, Environmental Justice Australia (2017) has released a detailed report of Adani's poor environmental law compliance record and illegal dealings overseas. These included a serious pollution offense 20 nautical miles off the coast of Mumbai in 2011 when an Adani-chartered coal vessel sank. The resulting pollution from 60,000MT of coal, as well as the ship's oil fuel, had a devastating impact on coastal ecosystems and commercial activities. Adani Enterprises took no responsibility for a cleanup and in August 2016 was fined AUD 975,000 by India's National Green Tribunal.

The BHP Billiton and Adani examples – widely separated in time and space yet sharing so many common characteristics – highlight the legal (and moral) complexity surrounding the definition of corporate and environmental "responsibility." The oft quoted "polluter-pays principle" for OECD countries makes it clear that the "mining entity" is always the one ultimately accountable for environmental damage and reparation (OECD 2001). Yet there are widely differing interpretations of "entity." Apart from the company director, does it also include shareholders and investment banks, for example? Adani's structure in Australia, for example, comprises 25 separate legal entities. And how, precisely, does one define "accountability" and assess "corporate responsibility?" (Johnson 2017). The latter may well entail the rights of future generations, plants and animals, and/or traditional spiritual connections to land and water. As well, complicating matters, in the Ok Tedi case, over time, there were numerous legal changes to details of the ownership structure and related responsibilities in the mining operation (Marychurch and Stoiannoff 2006). The PNG government assumed complete control of the mine in 2013. Its Parliament also repealed the legislation granting the right to sue BHP Billiton for the damage it had caused. That damage could last for hundreds of years, and mining still continues.

In stark contrast, New Zealand may well be setting a new international standard for such issues in the future. The *Te Urewera Act* (2014) and the soon to be legislated *Te Awa Tupua Bill* completely overturn the presumption of human sovereignty over the natural world and grant the powerful status of "legal personality" to rivers and their catchments. The wide diffusion of this entirely new legal construct around the world has the potential to seriously impact the environmentally and culturally damaging activities of global mining, agribusiness, and chemical companies in such places as South America and Canada.

The Global Commission on Pollution and Health

The recently constituted, high-level, Global Commission on Pollution and Health (www.commissiononpollution.org) has as its aim the raising of global public awareness of the critical linkage between pollution and health and the surging health costs associated with pollution of all kinds. Its findings are due to be published in *The Lancet* in 2017. It will be interesting to see if the Commission casts its net widely to include the abovementioned corporate activities, as well as the hugely under-researched, lasting environmental effects of over 500 atmospheric nuclear

weapons' tests and armed conflicts around the world (Simon and Bouville 2015).

The latter is a key focus of the international Toxic Remnants of War Project (www.trwn.org). We have, for example, recently passed the 25th anniversary of the end of the first Gulf War. The deliberate ignition of over 700 Kuwaiti oil wells by Iraqi troops at that time created by far the most extensive oil spill ever recorded (1.5 billion barrels). The subsequent fires burnt for over 9 months and covered a 1000 km^2 area. Following the conflict, a United Nations Compensation Commission (UNCC) was hastily established to evaluate 170 so-called F4 claims from 12 states. These related to "environmental damage and depletion of natural resources." As a result of scientific uncertainty and evidentiary problems in apportioning cost and blame, a mere 6% of claims received compensation. The "Legacies of War" project, too, continues to highlight the ongoing problem of unexploded ordnance (UXO) in Laos, following the Vietnam War. That country has the distinction of being the most heavily bombed country in the world. The legacy is an estimated 75 million still unexploded bombs in 10 out of 18 of the provinces, resulting in one-third of the land area being classified as "severely contaminated" (www.legaciesofwar.org).

"Natural" and "Unnatural" Contaminants

As would be clear by now, the umbrella term "pollution" is open to extremely wide interpretation. At one level it covers contaminants from both point and nonpoint sources and also encompasses a wide range of both naturally occurring and synthetic substances now routinely occurring (and persisting) in the soil, water, oceans, and the atmosphere, as well as energy in the form of heat and light. A complication is that many so-called contaminants do not pose a problem in small quantities; the damaging effects (as with asbestos) may take decades to make their mark, and that opinion is sharply divided on whether or not certain things should be classified as pollutants at all.

In industry circles, genetically engineered (GE or GM) crops and seeds, for example, are frequently heralded as "miracle" products promising to solve the problem of developing world malnutrition. For organic farmers the very same products are classed as pollutants with the capacity to cross-pollinate and seriously damage the legitimacy of their brand. GM maize (MON810) was first introduced into Spain in 1998 and has subsequently expanded rapidly in the northeast of the country, in particular. Because of the actual and potential contamination threat, the area sown to organic maize in Aragon fell dramatically by 75% between 2003 and 2007 (Herrero et al. 2017).

Some jurisdictions – most notably in many parts of Europe – have invoked the precautionary principle; a conscious decision has been made that we still do not have enough scientific evidence about the safety or possible harmful effects of GE crops and that, accordingly, they should either be disallowed altogether or subject to very strict controls and transparency about their field locations (Robin 2012). However, by a slender, five to four margin, in the high-profile Supreme Court of Canada case of *Monsanto Canada Inc. v Schmeiser* (2004), the court ruled that Monsanto had not accidentally "contaminated" Mr. Schmeiser's canola crop in Saskatchewan with its patented canola seed. This was a substantial victory for the principle of seed patenting by the chemical giant that, as we have seen, is currently in discussions with Bayer about a possible merger.

The case highlighted the absurdity of the "coexistence" model, the assumption that seeds could not routinely be transmitted over large distances by wind, and also challenged the fundamentals of the "patent rights versus property rights" debate. The *International Treaty on Plant Genetic Resources for Food and Agriculture* came into force in 2004 and currently has 139 contracting parties. The aim of the treaty is to guarantee farmer's rights and to recognize nonpatented seeds as the common property of mankind. The treaty has the potential to be one of the finest examples of collaborative global governance, but its weakness is that different countries

have widely varying interpretations of the concept of "farmer's rights."

There is also a strong argument for including exotic plants, animals, and certain diseases (e.g., Ebola, foot and mouth disease) as "pollutants." Often – as with the introduction of rabbits and cane toads into Australia – this was carried out deliberately with the very best of intentions but without any real understanding of the untold ecological damage that would eventually unfold. But more commonly the plant and animal "invaders" make their way around the world in ship or air cargo and ballast water or are transported on the wind and by birds and ocean currents. If not quickly contained, the economic costs can be enormous. As a result, protectionism in the form of biosecurity is now an important concern for national governments everywhere though unfortunately states vary greatly in terms of their resources, openness to external scrutiny of threats, and commitment to action. To take one example of the damage that can be done, the cost estimate for dealing with exotic weeds that had already taken a strong hold in Australia in the 1990s was AUD 3.3 billion a year. This included lost production and eradication programs (Low 1999).

The serious BSE outbreak in the UK in 1986 and the SARS (severe acute respiratory syndrome) epidemic of 2002/2003 provide two other tragic cases of cross-contamination with widespread health and transboundary impacts. Bovine spongiform encephalopathy ("mad cow disease") first appeared in cattle eating contaminated feed. It also spread to humans and eventually caused 229 deaths in the UK and elsewhere. The subsequent eradication campaign involved the slaughter of 4.4 million cattle in the UK and a crippling 10-year ban on the import of British beef into the EU.

Like Ebola, and the earliest phase of HIV, SARS too is a zoonotic disease. In this case, it started in Guandong, southern China, in November 2002, when the SARS coronavirus was transmitted to humans via wild animals sold in local markets. Early failures of diagnosis, treatment, and notification to the World Health Organization on the part of the Chinese authorities meant that the disease quickly spread to Hong Kong, Taiwan, and elsewhere in China and then appeared in Toronto, Canada, in February of the following year. Largely through rapid transmission by air transport, an estimated 774 people in over 30 countries eventually succumbed to the disease before it was finally contained by a well-coordinated, though belated, global effort (Keil 2014).

Persistent Organic Pollutants (POPS)

Clearly unanticipated at the time of their early deployment, many relatively recently developed toxic substances such as asbestos, the constituents of plastics, pesticides like dieldrin, the insecticide chlordane, and flame-retardant PCBs (polychlorinated biphenyls) stubbornly persist in the soil, oceans, atmosphere, and food chain for generations. The long-term impacts of the use of such products are truly global in scope. The herbicide 2,4-D/2,4,5-T ("Agent Orange"), used with such devastating effect by the US military in its "defoliation" campaign over some four million acres in Vietnam between 1965 and 1971, continues to this day to produce adverse health impacts (e.g., cancers, diabetes, and birth defects) among countless American veterans and Vietnamese civilians, as well as in populations of agricultural workers and rural communities, across both the so-called developed and developing worlds.

One of the components of "Agent Orange" was the highly toxic TCDD (or 2,3,7,8-*tetrachlorodibenzo para dioxin*) chemical. This is one of the dioxins that make up the "dirty dozen" group of so-called POPs or persistent organic pollutants. The insecticides aldrin, dieldrin, and DDT are also on the list. The latter was widely used by the US military during the Second World War as a defense against mosquito-transmitted malaria and dengue fever, but its serious health impacts were drawn to the public's attention by the publication of Rachel Carson's best-selling book, *Silent Spring*, in 1962. Subsequently it was banned for most purposes in the United States in 1973. It continued to be used in the UK for another decade and is still widely used in India.

This is despite the UN's Stockholm Convention on Persistent Organic Pollutants coming into force in 2004 in an attempt to stop the use and spread of POPs.

Dioxins are particularly dangerous by-products of many industries, including the production of pesticides and herbicides (widely used in industrial-scale agriculture), metal smelting, and paper bleaching. High-temperature incineration is the only effective method of dealing with these products that are often found in waste oil. But this an expensive exercise, well out of the reach of many poorer countries. Long-term storage in deteriorating containers, followed by leakage into the soil and waterways, is an all too common occurrence. PCBs were produced in large quantities (around 1.3 million tonnes) from the 1930s till the 1970s. By that time there was indisputable evidence of their harmful effects right through the food chain. Of this total approximately 35% is believed to be in or near the open oceans. A recent study found high concentrations of PCBs at depths of between 7000 and 10,000 m in Kermadec and Mariana trenches. It is thought that this may be related to the relative proximity to the North Pacific Subtropical Gyre, more commonly known as the "Great Pacific Garbage Patch" (Jamieson et al. 2017).

As global reserves of conventional oil rapidly approach exhaustion, the major multinational energy corporations such as ExxonMobil, Shell, and Statoil are diversifying into the exploitation of so-called unconventional oil deposits like shale oil and tar sands. Sometimes referred to as "extreme energy," for decades these were deemed to be too expensive and technically difficult to develop (www.extremenergy.org). They require enormous amounts of energy to extract and process, thereby adding considerably to carbon dioxide emissions and global warming. But in addition, hydraulic fracturing fluids and wastewater have been found to harbor scores of dangerous toxins (Elliott et al. 2017). These include benzene, arsenic, and mercury, the latter infamous for its link with Minamata disease, first identified in Japan in 1956. Minamata is contracted by eating contaminated seafood, and the victims are believed to number up to 200,000 so far. One positive outcome has been that – under the aegis of UNEP's Global Mercury Partnership – the Japanese government has taken on a strong global leadership role in terms of "mercury management" so that other countries can learn from the mistakes made over 60 years ago. A UN "Minamata Convention" is currently in the early stages of formulation (Ministry of the Environment, Japan 2013).

Evernden (1995: 525) reminds us that, broadly defined, pollution is by no means a modern phenomenon. Throughout history it has been seen by all societies to represent "the defilement of the purity or sanctity of something – but not necessarily only to the physical world." As such, polluting agents (e.g., countries, corporations) invariably are targeted as being "at fault" or – as in the contemporary field of "green criminology" – perpetrators of criminal acts (Lynch et al. 2016). Increasingly, for example, those judged to be responsible for marine oil spills (*Exxon Valdez* (1989); British Petroleum/*Deepwater Horizon* (2010)), the illegal trade in hazardous wastes from affluent to developing countries, or food contamination are the subject of legal prosecution. The latter was a major concern internationally in 2008 when milk, eggs, and infant formula products originating in China were found to have been deliberately adulterated with the chemical melamine by 22 companies. Some 12 countries eventually banned the import of dairy products from China, and subsequent trials in that country resulted in a number of lengthy prison terms and two executions of company officials.

Waste

Pollution is often equated with "waste." This takes many different forms but is usually subdivided into "hazardous" and "nonhazardous" categories. It includes radioactive by-products (a form of *intractable* hazardous waste), decommissioned ships and military bases, food waste (to the tune of US$ 1 trillion a year), plastics and packaging, mining tailings dams, used car tires, and the multiple subproducts of electronic goods. Comprising such items as used televisions, computers, and

mobile phones, the latter (e-waste) was estimated to total 41.8 million metric tonnes in 2014. Involving a long and complex global chain of collection, transport, disassemblage, recycling, and resale, this is an industry estimated to be worth as much as USD 18.8 billion in 2014 (including a sizeable informal and illegal sector) and growing rapidly year by year (United Nations Environment Programme 2015). The United States, for example, discards up to 20 million personal computers annually, and, within a decade, predictions are for a sevenfold increase in mobile phone e-waste in China and more than double that figure for India (Olowu 2012). When broken down individual mobile phones yield small amounts of gold. Yet used electronic products also release large quantities of toxic by-products such as cadmium, arsenic, and mercury that can cause serious contamination problems at the point of end-of-life processing.

The legal and illegal trade in waste products of all kinds are now one of the fastest-growing items in global sea transport. The widespread uptake of containerization has made this possible. To a large extent, the trade is controlled by transnational crime syndicates, and under the terms of the 1992 *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes*, "illegal activity" is defined as a crime. As waste recycling, disposal, and related regulatory costs continue to rise in Western Europe and North America, West African countries, like Ghana, Cote d'Ivoire, and Nigeria, as well as Vietnam, China, and Bangladesh in Asia, have become increasingly favored destinations for wastes of all kinds. Product separation and recovery are usually carried out at the small-scale, informal level with minimal health and environmental controls. As well, there is ample evidence of illegal dumping at sea as well as on land (United Nations Environment Programme 2015).

In the mid-1990s, Canada sought to stop the export of PCBs on environmental grounds. Invoking ISDS and the NAFTA framework, the US company SD Myers Inc. (SDMI) challenged this ruling in 1998, seeking USD 70 million in compensation. SDMI is a waste management processing company that had planned to access Canadian-based PCBs for its American operations. In 2000, the United Nations Commission on International Trade Law (UNCITRAL) found in favor of SDMI and ordered the Canadian government to pay CAD 6 million to the company.

Most of this discussion focuses on human actions that have – and continue to exert – an adverse impact on the atmospheric and marine commons. But it needs to be stressed that "pollution" can also be caused by "natural" phenomena. Major explosive volcanic eruptions and accompanying tsunami events are a clear case in point. The scientific consensus is that, over the long geological timescale, there have been five previous mass extinction events and that we are currently living through the sixth. While the present phase appears to be largely attributable to multiple, accelerating human impacts on a global scale, volcanic eruptions, wildfires, and associated environmental changes over relatively short geological time horizons are now widely accepted as having played a major role in the past (Hance 2015). In other words, as earthlings, our hold on this planet is, at best, tenuous (Eckersley 2014).

"Natural" Pollution: Volcanic Eruptions

When the island of Krakatoa off the coast of Java was so spectacularly annihilated by catastrophic natural forces in August 1883, the resulting toxic volcanic ash cloud reached deep into the stratosphere, by some estimates as high as 160,000 ft. The explosion was heard thousands of kilometers away. Fine particulate matter and sulfur dioxide circled the earth for months, resulting in spectacular sunsets in Europe and North and South America and a worldwide drop in temperature. The ash was eventually widely distributed as acid rain. A forerunner to the far more destructive 2004 Indian Ocean tsunami, the accompanying tidal waves at that time led to the deaths of some 36,000 people and contaminated vital freshwater supplies in low-lying coastal areas, often on the other side of the Indian Ocean, far from the initial eruption site. This particular volcanic episode, which was by no means the largest that the world has experienced, of course occurred in

pre-aviation times. Winchester (2003: 271) notes, "Few in Victorian times had begun to think truly globally...Krakatoa, however, began to change all that."

More recently, the world has experienced two major volcanic episodes, the first at Mount Pinatubo in the Philippines in 1991 and the second in Iceland in 2010. In the twentieth century, only Novarupta in Alaska exceeded the force and level of particulate emissions of Pinatubo, which rivaled those of Krakatoa. A high-level, sulfuric acid haze was generated over a wide area of Southeast Asia and lasted for more than a year. Agricultural production was severely affected, and the major US military bases at Clark and Subic Bay were subsequently abandoned.

Further – in April 2010 – the widely dispersed ash cloud from the Eyjafjallajokull volcanic eruption in Iceland seriously disrupted airline flights for more than a week across Europe and beyond. Over 100,000 flights, involving around ten million passengers, were subsequently canceled for safety reasons (Bye 2011). Although large, the Eyjafjallajokull event pales into insignificance by comparison with the Laki eruption in the same part of Iceland 227 years earlier. Laki erupted continuously for 8 months and has been estimated to have been around 100 times larger than the 2010 event (Thordarson and Self (2003). At its peak the volcano was forcing 17 Mt of sulfur dioxide into the atmosphere every 3 days. In the summer of 1783, some 20,000 people in Britain alone died as a result of sulfur dioxide poisoning directly linked to the eruption. One can only speculate about the health and climatic impacts as well as the scale of disruption to air traffic and economic activity were such an eruption to occur today.

The Aviation Industry

Air transport can, in many ways, be seen as synonymous with globalization. As it has evolved, it has greatly assisted in the ever-accelerated movement of people, goods, ideas, innovations, and humanitarian aid around the world. These are the indisputable, positive aspects. But as we saw in the example of SARS, aviation also facilitates the rapid transmission of diseases and – of central significance to the present discussion – adds to the total atmospheric load of greenhouse gas pollution on a truly massive scale. As such, the aviation sector can also be viewed as being emblematic of the growth/pollution dilemma and has, for many years, been the target of increasingly strident criticism by environmental campaigners. Put simply, while traveling, aircraft emit extremely large quantities of greenhouse gases, including sulfur dioxide, nitrogen oxide, and hydrocarbons. For example, a return flight from Melbourne, Australia, to London generates approximately 17 t of CO2 per passenger, and it has been estimated that for the period up to 2050, global carbon emissions from air transport could total around 43 Gt (Paradee 2015). This would make the aviation sector the fastest growing contributor to global warming and would come about largely as a consequence of the exponential expansion of airports, aircraft, flights, and passenger numbers. The latter have been projected by IATA to increase from 3.8 billion passengers in 2016 to 7.2 billion in 2035.

Much of the new growth will come from Asia. But this is only a very small part of the picture. One also needs to build into the equation the pollution load created by building and maintaining the aircraft and airports, extracting and transporting the fuel and passengers to and from airports, and so on. When combined, this could lead to the sector eventually contributing as much as 15% of greenhouse gases from all sources. Specifying national contributions to such a globalized industry is immensely challenging and so far has defied all attempts at building a robust global governance framework. Nevertheless, Austria represents an interesting development in this regard. In February 2017, that country's Federal Administrative Court ruled against a proposal to build a third runway at Vienna Airport on the grounds that this would contravene Austria's international commitment to reduce the quantum of its greenhouse gas emissions (The Local/AFP 2017). A similar fight by environmental and resident's action groups against plans to increase the capacity of

London's Heathrow Airport was lost the previous year.

Concluding Remarks

The examples of airport expansion plans at Vienna and London highlight a fundamental conundrum at the heart of this chapter. While Austria, at least for the time being, has taken a bold symbolic stand in favor of reducing greenhouse gas emissions and setting an international example, the UK – as noted – has given the go-ahead for Heathrow to greatly increase its capacity and thus contribute to the already rapidly rising quantum of emissions from the aviation sector around the world. In China, Beijing's latest international airport has seven runways, and the country plans to build 66 new airports over the next 5 years. In short, Austria's laudable actions will have minimal impact on climate change. Given that there is no such entity as a "'World State," the core issue here, of course, in common with so many of the topics covered, is the absence of *enforcement* mechanisms.

The sanction of "naming and shaming" was discussed briefly, above. Barrett (2016: 14519) has recently focused on the potential power of this in the Paris Agreement on climate change, arguing that the real innovation in this treaty "is to embed voluntary contribution making within a framework of 'pledge and review.'" In other words, nation-states set transparent targets to commit to reducing carbon emissions which are then available for all to assess. However, the pledges made relate to the years 2025 and 2030, and there is considerable uncertainty surrounding the effectiveness of naming and shaming to bring about substantive behavioral change.

There are currently approximately 200 nation-states and a similar number of largely voluntary environmental treaties and conventions with limited sanctions attached. There are also "failed"/"fragile" states (approximately 65), as well as many experiencing ongoing armed conflicts. Illegal trade of all kinds is a common feature of these situations and includes toxic waste, banned pesticides, and radioactive material. We also need to add into this mix a weakening of environmental laws and regulations by new administrations in such countries as Canada and the United States. Finally, as we have seen, the world has a relatively small number of immensely wealthy and powerful transnational corporations whose activities are not constrained to any degree by national borders (Hertz 2001). In short, the prospects for effective global governance to resolve past and emerging pollution-related matters are not encouraging. Close scrutiny of all the key environmental indicators gives little cause for optimism.

Cross-References

- ▶ Energy policy
- ▶ Environmental protection policies
- ▶ Globalization and capitalism
- ▶ Globalization and energy
- ▶ Global and International Politics
- ▶ Global governance
- ▶ Natural resources policies
- ▶ Public policy and politics

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