Box 1.13 Pollution and Ecosystems

In the last century, a growing and rapidly industrializing world has produced greater quantities of common pollutants like household garbage and sewage, and more toxic and persistent contaminants like pesticides, polychlorinated-biphenyls (PCBs), dioxins, heavy metals, and radioactive wastes. The environmental costs of contemporary society's pollutant load are difficult to quantify, both because there is little comprehensive data on pollution emissions on a global scale and because the effects of pollutants on ecosystems are often hard to measure. But the problem is surely growing.

Pollutants affect ecosystems in a variety of ways. Pesticides and heavy metals may harm exposed orgnisms by being acutely toxic or by accumulating in plant and animal tissue through repeated exposures. Pollutants like acid rain can act at a system-wide level, disrupting soil acidity and water chemistry—both critical environmental factors that affect the nutrition and physical development of plants and aquatic life. Multiple pollutants can create a toxic synergy that weakens organisms and gradually reduces an ecosystem's productivity and resilience. All of these effects on ecosystems are much in evidence.

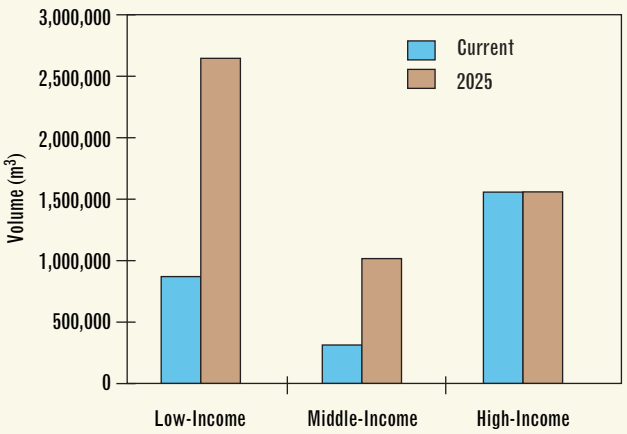
- Although there is greater awareness today of the dangers associated with toxic materials, toxic emissions continue to be significant. For example, the US$37 billion global pesticide market dispenses 2.6 billion kg of active ingredients (pesticides excluding solvents and dilutants) on the world's farms, forests, and household gardens, with a variety of collateral effects on wildlife and human health (Aspelin and Grube 1999:10).

- Accidental releases of toxic substances like mining wastes, or of oil or industrial chemicals, occur routinely and with devastating effect. In January 2000, 99,000 m^3 of cyanide-laden wastes escaped a Romanian gold mine when an earthen tailings dam collapsed; the toxic plume wiped out virtually all aquatic life along a 400-km stretch of the Danube and its tributaries (D'Esposito and Feiler 2000:1,4). In 1997, more than 167,000 tons of oil spilled from pipelines, storage vessels, tankers, and other carriers and sources to contaminate the world's marine and inland environments (Etkin 1998:5)

- Air pollution from sulfur dioxide (SO_2), nitrogen oxides (NO_x) and ground-level ozone still exceeds the "critical load"—the amount an ecosystem can absorb without damage—over wide areas of Europe, North America, and Asia, with documented effects on crops, forests, and freshwater ecosystems from acid rain. For example, the fraction of healthy Norway spruce, one of the most common conifers in European forests, decreased from 47 percent in 1989 to 39 percent in 1995—an indicator of the continued stress air pollution imposes on Europe's forest ecosystems (EEA 1999:144–145).

- Fertilizer runoff, human and animal sewage, and inadequately treated industrial wastes can add nutrients to freshwater and coastal ecosystems, stimulating algal blooms and depleting the water of oxygen—a process called eutrophication. Oxygen-depleted waters can't support aquatic life. Eutrophication is a growing problem worldwide. A roughly 18,000 km^2 "dead zone" of oxygen-depleted waters in the northern Gulf of Mexico stems from a tripling of the nutrient pollution carried to the coast by the Mississippi River over the last 40 years (Rabalais and Scavia 1999; NOAA 2000).

Total Waste Volumes Generated by Low-, Middle-, and High-Income Countries (per day)



Source: Hoornweg and Thomas 1999:11.

Excess Nutrients Translate to Water Pollution

Country	Total Nitrogen Supply from Fertilizer and Manure (1,000 tons)	Nitrogen Uptake by Crops	Residual Nitrogen	Residual Equivalence per Hectare (kg)
Belgium and Luxembourg	580	211	369	240
Denmark	816	287	529	187
Netherlands	1255	285	970	480

Note: Because some nitrogen is lost to the atmosphere, only a part of the residual nitrogen stays in the soil for possible nitrate leaching.
Source: Matthews and Hammond 1999.