

GLOSSARY

General Terms on Environmental Health

African sleeping sickness. Trypanosomiasis. Spread through the bite of the blood-sucking tsetse fly (*Glossina*), which lives and breeds in woody vegetation along rivers and forests.

Amebiasis. Infection by amoebas, spread mainly hand-to-mouth. Parasitic in humans, most commonly known for amoebic dysentery or bloody (rather than watery) diarrhea.

Bioaccumulation. Biological accumulation. Concentration of substances in living organisms from breathing, eating, or drinking at a rate greater than the substances can be metabolized or excreted. Can accumulate to toxic doses. (Sometimes used, however, to refer to intake of toxic chemicals from environmental factors other than food and water.) Refers to the process within an organism, as opposed to “biomagnification,” which emphasizes the overall process in the aquatic food chain and *bioamplification*, which emphasizes given impurities.

Bioamplification. Biological amplification. Concentration of a persistent substance by an organism in the food chain, for example, 0.001 parts per million (ppm) in earthworms of a pesticide can be amplified to 1 ppm in birds. *Bioamplification* emphasizes a given substance as opposed to *biomagnification*, which emphasizes the overall process in the aquatic food chain and *bioaccumulation*, which emphasizes given organisms.

Biocide. General term for substances toxic to living organisms. Pesticide. Also used as a general term on killing pests. *Herbicides* attack weeds. *Fungicides* attack fungi and molds.

Biodegradation. Biological degradation. General term covering the process of breakdown by microorganisms, in which organic matter becomes less toxic or harmful to humans and the natural environment. Sometimes misused in that biodegradation is not necessarily total and materials remain harmful. Should not be confused with disintegration, in which the physical form changes, but not the biochemical content; for example, many “biodegradable” plastics with additives cause the plastic simply to dissolve or fragment, so that it is less unsightly.

Biomagnification. Biological magnification. Concentration of impurities in water as they pass through the food chain. Concentrations occur in tissues or organs, which are consumed by larger organisms and humans, as they move up the food chain, for example, 0.001 micrograms of mercury in water can magnify to 50 micrograms in fish. Contrast with *bioaccumulation*, which emphasizes the overall process in the aquatic food chain and *bioamplification*, which emphasizes given impurities.

Biological oxygen demand. A common water quality standard that measures the amount of dissolved oxygen “demanded” by organic material in biological degradation for 5 days. An indicator of the degree of organic pollution. Does not indicate pathogenicity of organic material. Used primarily as an indicator of the healthiness of water bodies to support flora and fauna or, conversely, the propensity to stagnate or eutrophy due to lack of oxygen. Compare with *chemical oxygen demand* (COD), which emphasizes inorganic chemical pollution levels.

BOD. (a) See *biological oxygen demand* or (b) *burden of disease*.

Burden of disease. As used in health analyses, a comprehensive, internally consistent, and comparable set of estimates of current patterns of mortality and disability from disease and injury for all regions of the world. See also *global burden of disease*.

Carbon monoxide (CO). Odorless, colorless gas. The product of incomplete combustion. CO reacts with blood in the lungs and reduces overall capacity of blood to carry oxygen. At moderate concentrations, can affect the central nervous system, diminishing perception and performance of fine movements. CO also paralyzes the cilia (tiny hairs) of the respiratory tract, which predisposes people to respiratory infection. Main sources are vehicular traffic and tobacco smoke. Major indoor sources are heating, lighting, and cooking fuels.

Carcinogen. Substances that produce cancer. Related terms include *metastasis*, cancer spreading to other organs, “mutagen,” a change in DNA, which is passed on to other generations, and “teratogen,” a change in utero or birth defect.

Carrier. An infected individual that can spread a disease without necessarily becoming sick or showing symptoms.

Chagas’ disease. American *trypanosomiasis* or sleeping sickness that is spread by the bite of a nocturnal, blood-sucking, cone-nosed bug that lives in cracks and crevices of walls and roofing in the day, hence, sometimes called bedbugs. Tends to be associated with poor housing, particularly in rural areas. See also *African sleeping sickness*.

Chemical oxygen demand (COD). A common water quality standard that measures the amount of dissolved oxygen “demanded” by inorganic material in chemical breakdown for 5 days. An indicator of the degree of inorganic pollution. Does not indicate toxicity of inorganic material. See also *biological oxygen demand*, which, in comparison, emphasizes the capacity of a water body to support life, rather than pollution, which can jeopardize it.

Cholera. Diarrheal disease that is important, because it frequently occurs in epidemics and can spread rapidly. Due primarily to a combination of deficient sanitation and poor hygiene. Interpersonal contact is a major means of transmission, thus, considerations of crowding, even in rural areas, are important. Also important, because once introduced, it can be difficult to eliminate in areas of poor sanitation; historically, it has taken up to 50 years. Can be fatal if untreated, because it strikes rapidly, that is, major consequences are due to rapid dehydration and subsequent depletion of essential body chemicals from water loss. Can be effectively treated with oral rehydration therapy (ORT), which replaces lost fluids and essential chemicals.

CO. See *carbon monoxide*.

COD. See *chemical oxygen demand*.

Coliforms. Groups of bacteria that live in human and animal intestines, commonly used as an indicator of fecal contamination of water supply. “Coliform count” is a common standard of water quality.

DALY. Disability-adjusted life years. A socioeconomic measure of human suffering that weighs morbidity against mortality by combining years lived with a disability, disease, and/or injury with the death rate from the same conditions.

Dengue. Also known as dengue fever, breakbone fever, and dengue hemorrhagic fever. Febrile illness spread by the aedes mosquito, which breeds in clean water. Appears to be increasing. Epidemics noted in Latin America. Causes for epidemic spread not yet fully understood, but might involve habitat change from global warming or urbanization.

Diarrheas and diarrheal diseases. Broad category of diseases symptomatic of many illnesses. Main effect is loss of body fluids, which can include essential chemicals and blood (e.g., in dysentery).

Dose-response. Relationship indicating degree of exposure, for example, of a pathogen, radiation, or pollutant, to evoke a physiological response. Sometimes considered controversial, because it can overstate relationships for which exposure has been measured, but understate potential risks because of inadequate data.

Endocrine disrupters. Group of pesticides and byproducts that, when absorbed by the body, can mimic hormone activity leading to negative consequences, such as birth defects or breast cancer, in humans and animals. Those causing breast cancers are also called “estrogen mimickers.”

Filariasis. Parasitic worm infection spread by culex mosquito, which tends to breed in organically polluted water, thus, a direct risk in dealing with sanitation and drainage.

Giardiasis. Intestinal infection by *Giardia*, spread mainly hand to mouth. Important in water management, because chlorine concentrations sufficient to kill most pathogens do not kill giardia cysts. Can also be passed on to humans from some animals.

Global burden of disease. Concept developed to convey various socioeconomic factors beyond traditional morbidity and mortality rates. Consists of a combination of years lived with disability and death rates.

Gray water. Wastewater that does not contain fecal material. Also called *sullage*. See *sanitation*.

Guinea worm. Primarily rural worm infection of the lower extremities, causing an ulcer, from which the 60–100-centimeter-long female discharges eggs. The eggs develop into tiny “water fleas” that people drink. Eggs are spread when infected individuals immerse their legs or feet, when fetching water from ponds and other sources or to relieve itching from the sore. The only disease spread exclusively by drinking water. On the verge of eradication in Africa.

H₂SO₄. Sulfuric acid. See *sulfur oxides*.

Helminthes and helminthic worms. See *intestinal worms*.

Hepatitis. General term for several forms of liver infection that are commonly designated viral hepatitis and differentiated by the main mode of transmission: ingestion of feces for hepatitis A and E, or contaminated blood or exchange of body fluids for hepatitis B, C, and D. Debilitating illness causing severe fatigue and lasting up to several months. Improved sanitation is important for A and E.

Herbicides. See “biocides.”

Host. Human or animal that harbors an infectious agent. The host does not always get the infection or even show symptoms. Sometimes also called *reservoir*.

Infective dose. Level of infection from a pathogen that causes sickness. See also *dose-response*.

Insecticides. See *biocides*.

Intestinal worms. Helminthes are parasitic worms (nematodes or trematodes) that are spread by deficient sanitation. Most commonly known from epidemiologically important intestinal infections, such as hookworm, ascariasis, tapeworm, and liver fluke. Can cause a wide array of problems and infect body organs.

Lead (Pb). Lead poisoning can cause a wide array of problems even in low doses. Most common problems are irreversible neurological damage and stunted mental growth (to which aggressive behavior has also been linked), stomach pain, colic, high blood pressure, kidney problems, and bone loss. Can adversely affect normal functions of other vital organs. Lead can accumulate in the body, causing paralysis, blindness, and death. Major sources are lead smelting and lead in gasoline. Important sources not related to commerce and industry are cosmetics, household remedies for diarrhea and stomach ailments, and poultices for sealing infant umbilical cords. Other sources that could be important hotspots include battery manufacturing, brass foundries, lead-glazed pottery and cloisonné, radiator repair, and art restoration. Exposure standards vary, for example, the U.S. OSHA (Occupational Safety and Health Administration) standard of from 50 micrograms/8 hours permissible exposure for workers to the USEPA standards of 1.5 microns/cubic meter for ambient air, 30 micrograms or more/30 days per year maximum atmospheric exposure, and 0.15 milligrams/cubic meter threshold limit value for fumes and dust. Generally, about 40 percent of the lead deposited in the lungs is absorbed into the bloodstream. Despite the general importance of lead, the role of vehicular emissions is sometimes overstated relative to other issues, because lead in ambient air is commonly measured and, thus, data are available for analysis and discussion, whereas other sources are only irregularly measured.

Malaria. Common parasitic infection spread by the anopheles mosquito, which breeds in pure, slow-moving salt or fresh water. Once on the decline, because of vigorous prevention programs, malaria has been staging a comeback, because of resistance to prophylactic drug measures (spraying and medication), as well as prolongation of its breeding season through year-round cropping and extension of its habitat through water supply and irrigation. In addition to water management, control strategies should also consider drainage, because breeding occurs in natural marshes and backwaters. Four basic forms of malaria exist, characterized by different symptoms and relative seriousness.

Micron (μ). 1/1,000,000th of a meter or about 1/25,000th of an inch.

Night soil. Human (or animal) excreta (feces and urine). Term normally in the context of its collection, for example, in latrines using buckets or its being carted away or reused.

Nitrates. Class of chemicals that are commonly discussed as water pollutants in groundwater and rural surface water, mainly from fertilizers and human and livestock waste. (Nitrates also derive from nitric acid, which is discussed as an air pollutant under *nitrogen oxides*.) Nitrites and *N-nitroso* compounds (nitrosamines) are frequently cited derivatives of nitrates transformed in the digestive tract. Nitrates and nitrites contain antimicrobial agents and are, thus, used in food processing; an excess, however, can be toxic to humans. From a health perspective, nitrosamines are important as a group, because they can cause blue baby syndrome (methemoglobinemia) in humans and animals and possibly gastric cancer (drinking water

standards are based on the risk of methemoglobinemia). Methemoglobinemia is normally a temporary condition, occurring in the first six months of life, until the infant's digestive system develops. Can also come from nitrites used in meat and fish curing and food preservation and storage of certain green vegetables, for example, spinach, which form nitrite and *N-nitroso* compounds. The latter occur also in tanneries, cosmetics, and rubber and iron foundries. Wells more than 30 meters deep are likely to be safe. USEPA standards for drinking water are 10 ppm.

Nitric acid (HNO₃). Corrosive, colorless acid that is toxic to humans when inhaled and caustic to skin and mucous membranes. Public health importance stems from the possibility of the virtually ubiquitous NO_x reacting with water vapor and other chemicals in the air to form acid aerosol of nitric acid. Commonly used in industry, for example, in manufacturing fertilizers, herbicides, insecticides, explosives, etching glass and steel, wood pulping, reprocessing nuclear fuel, meat processing, ceramics, pharmaceuticals, chemicals, and dyes. A common laboratory reagent. OSHA limit is 232 ppm in air or 30 milligrams/cubic meter.

Nitrites. See *nitrites*.

N-nitroso compounds. See *nitrites*.

Nitrogen dioxide (NO₂). See *nitrogen oxides*.

NO₂. See *nitrogen oxides*.

Nitrogen oxides (NO_x). A general term for compounds containing nitrogen and oxygen, the most common of which is nitrogen dioxide (NO₂). Principal sources of NO₂ are combustion of coal, oil, natural gas, and motor vehicle fuel from transportation, energy, industry, solid waste disposal, and miscellaneous activities, such as fires. Also used in manufacture of chemicals, fertilizers, paints, and propellants. Because transportation and industrial activity are concentrated in urban areas, NO₂ tends to be more significant as an urban pollutant, but can be important in rural or periurban pockets. NO₂ is also an ingredient of tobacco smoke. NO_x can compromise the body's ability to kill bacteria in the respiratory tract and reduce the body's resistance to disease. It is not very soluble in water and, thus, is not readily filtered out in the upper respiratory tract, causing difficulty in breathing or asphyxiation, and can penetrate into the lungs, causing other problems, including respiratory and cardiovascular diseases. NO₂ is believed to be particularly harmful in the presence of automobile exhaust. When nitrogen in the air reacts with a burning flame in a furnace or combustion engine, it forms nitric oxide (NO), a relatively harmless pollutant. Combustion and cooling temperatures are important. When this involves venting and rapid cooling, it becomes significant to public health, thus, idling cars produce less of a health hazard than rapidly moving ones. Can react with water vapor to form acid rain, acid aerosol (nitric acid), and poor visibility.

NO_x. See *nitrogen oxides*.

O₃. See *ozone*.

Onchocerciasis. "River blindness." Spread through bite of the black fly (*Simulium*), which needs highly oxygenated water for breeding, that is, fast-moving streams or other water. Predominantly rural. On the decline from effective programs of Onchocerciasis Control Programme of Western Africa.

Organochlorides. Group of chemicals characterized by their solubility in fat, epidemiologically important because they can be absorbed and accumulate in the body to toxic doses (as opposed to water-soluble chemicals which, generally, are either metabolized or flushed) and because they are common in the food chain, because they are widely used in pesticides. PCBs (see below) are also organochlorides. See also "pesticides."

Organophosphates. Class of insecticides highly toxic to the nervous system of humans and mammals, but nonpersistent in the environment.

Oxides of nitrogen (NO_x). See *nitrogen oxides*.

Oxides of sulfur (SO_x). See *sulfur oxides*.

Ozone (O₃). A secondary pollutant, caused by the reaction of oxygen with carbon monoxide or unburned oxygen from vehicle fuels. The main component of smog. Economic activities that generate ozone include high voltage electrical equipment, for example, x-ray machines, electrical insulators, motor brushes, and some ultraviolet lights. Also used to purify water, sugar, and industrial waste and helps extend the shelf life of produce in cold storage by controlling the growth of bacteria and fungi. Irritant to eyes and respiratory tract. Can compromise the body's ability to kill bacteria in the respiratory tract and reduce the body's resistance to disease. Like SO₂, O₃ reacts mainly with the respiratory tract itself, thus, generally does not get

absorbed by the blood. Portion of O₃ not destroyed in the upper respiratory tract can cause thickening of the respiratory arteries, leading to chronic lung disease, emphysema, and sometimes heart failure. It can also react with nerve endings, interfering with normal oxygen and carbon dioxide exchange in breathing. OSHA ceiling is 0.1 ppm in air or 0.2 milligrams/cubic meter.

PAH. See *polyaromatic hydrocarbons*.

Pathogens. Organisms, mostly microscopic in size, that cause disease. In this discussion paper, pathogens collectively refer to bacteria, viruses, and parasites.

Pb. See *lead*.

PCB. Polychlorinated biphenyl. Class of industrial chemicals once widely used in transformers, vacuum pumps, (liquid) insulators, adhesives, and plastifiers. One of their most important uses was as fire retardants. Now discontinued in many countries because of toxicity, negative effects, and persistence in the environment. See also *organochlorides*.

Pesticides. Substances that kill or repel pests (i.e., fungicides, rodenticides, herbicides, and insecticides), including defoliant and desiccants. See also *biocides*.

Phenols. Toxic organic chemicals released from oil-based compounds during chemical breakdown. Significant, because of the predominance of oil-based compounds (e.g., gasoline, motor oil, coal, and others) currently used in the transportation, energy, and infrastructure sectors.

PM₁₀ and PM₅. Particulate matter less than 10 or 5 microns in diameter (less than 1/1,000,000 meter). See *suspended particulate matter*.

Polyaromatic hydrocarbons (PAH). Polycyclic or polynuclear aromatic hydrocarbons. Class of chemicals that are significant as air pollutants. Produced by incomplete combustion of coal, oil, gas, garbage, and hazardous waste. Common constituents are cigarette smoke and coal tar. Toxic to humans and can cause lung cancer. The OSHA permissible exposure limit is 0.2 milligrams/cubic meter.

Respirable fraction. Refers to that fraction of air pollutants that are not filtered out in the nasal passage and are small enough in particle size (generally less than 10 microns in diameter) to penetrate into the lungs where oxygen exchange occurs.

Quality adjusted life year (QALY). An outcome measure that *expresses years life gained* (opposite of DALYs) from an intervention, that is, the quantity and quality of the extra life in years provided by an intervention. It is the arithmetic product of the life expectancy and the quality of the remaining years. One QALY is one gained year of healthy life.

Reservoir. Any human, animal, plant, or other substance in which an infectious agent can live and multiply, until it can find a “host” to infect. A human or animal reservoir does not necessarily become infested while serving as a reservoir, in which case they are often referred to as a “carrier.”

Roundworms. See *intestinal worms*.

Salmonellosis. Common, acute gastrointestinal infections with salmonella, causing sudden onset of diarrhea, headache pain, and nausea. Frequently associated with food poisoning. Spread mainly through animal feces, so food preparation is a major preventive measure. Spread also by deficient sanitation. Typhoid and paratyphoid are classified as salmonellosis, but are not spread through animal feces and are characterized mostly by fever.

Sanitation. General term covering waste management. Used irregularly to refer to sewers and other water conveyance systems, for example, high- and medium-tech sewerage; on-site systems, for example, latrines and other low-tech systems; and solid waste removal.

Septage. Human waste that does not pass through a *sewage* system. See *sanitation*.

Sewage. Contents of sewers.

Sewerage. General term referring to the system of conveyance for wastewater containing human and animal excreta. Consists of (a) sewers, that is, a network of pipes, (b) treatment plants, which produce water and sludge, and (c) the means of final disposal, for example, sewage outfalls discharging treated or untreated wastewater into rivers or oceans, or a sanitary landfill that accepts the sludge. Technically speaking, the sewerage system is different from the “drainage system,” which conveys storm water not requiring treatment for pathogen removal. Some systems carry a combination of sewage and storm water. “Sewer-

age” and “sewerage system” are inconsistently used and defined, even in technical dictionaries. The important point is to distinguish among component parts (collection, transmission, and disposal), drainage systems, and the institutions that manage the system.

Sludge. Residue from sewage treatment plant, consisting of the accumulation of settled solids and other material that results from different treatment stages. Eventually needs proper disposal. Depending on the thoroughness of treatment and type of effluent coming into the system, can be biologically pathogenic and chemically toxic.

SO₂. Sulfur dioxide. See *sulfur oxides*.

SO_x. See *sulfur oxides*.

SPM. See *suspended particulate matter*.

Sulfur dioxide (SO₂). A mild respiratory irritant, most of which is absorbed in the upper respiratory tract, because it is soluble in water. Can be converted to sulfuric acid, a more serious pollutant to the lungs. SO₂ is implicated in chronic bronchitis, asthma, eye, and nasal irritations. See *sulfur oxides*.

Sulfuric acid (H₂SO₄). Mainly a secondary pollutant caused by reactions with sulfur dioxide. See *sulfur oxides*.

Sulfur oxides (SO_x). General term used to refer to compounds containing sulfur and oxygen, the most common of which are *sulfur dioxide (SO₂)* and *sulfuric acid (H₂SO₄)*. Most SO₂ is generated in the combustion of coal, petroleum products and wood and as a byproduct primarily of space heating, cooking, and production of electricity. SO_x is also generated in refineries, smelters (e.g., copper, lead, and zinc), manufacturing of paper, and incineration of refuse. Most SO_x consists of particles less than 2 microns, which makes it a contributor to poor visibility and also small enough to penetrate into the lungs. SO_x is a major component of tobacco smoke, which probably constitutes a more serious health problem than respiration of SO_x in ambient air.

Sullage. Wastewater that does not contain fecal material. Also called *gray water*. See *sanitation*.

Suspended particulate matter (SPM). Small particles of solids or liquids suspended in air. When used in measuring air pollution, figures also include *PM₁₀* or *PM₅* to refer to particles less than 10 or 5 microns in diameter, which are significant because they can penetrate deep into the lung cavity where the blood is oxygenated. Compare with *TSP* and *respirable fraction*.

Tetanus. An infection of the musculature causing painful contractions, hence, the name lockjaw. Tetanus is commonly spread through puncture wounds contaminated with human or animal feces in soil and street dust. It is an important occupational disease for agriculture and animal husbandry, because of frequent handling of animal feces.

Trachoma. A leading cause of preventable blindness, transmitted through person-to-person contact of discharges from the eye of infected individuals. More common in dry areas, hence, exhibits seasonal variation. The main preventive measure is adequate water for personal hygiene.

Trypanosomiasis. See *African sleeping sickness* and *Chagas' disease*.

Total suspended particulate (TSP). Refers to the aggregate of pollutants, regardless of particle size. Compare with *suspended particulate matter* and *respirable fraction*.

TSP. See *total suspended particulate*.

Tuberculosis (TB). Disease of the lungs (although it can infect other body organs) that is spread mainly by interpersonal contact through air-borne droplets; hence, crowded living conditions are a factor (may also be spread through consumption of unpasteurized dairy products). Common complication of HIV infection. Staging a comeback, even in developed countries, where, at the turn of the century, it was considered a scourge of humanity. TB bacillus resists drying, but is susceptible to sunlight, hence, dark, dusty housing aids its spread.

Typhoid. See *salmonellosis*.

Vector. An intermediate agent, such as a fly, mosquito, or rodent, that is capable of transmitting a disease from one organism to another or a susceptible *host*. Infections may be transmitted through a bite or skin penetration (inoculation) (e.g., mosquitoes transmitting malaria or rats carrying plague), mechanical deposi-

tion (e.g., flies carrying bacteria that cause diarrheas), or ingestion (e.g., humans drinking “water fleas” that carry guinea worm disease).

Intermediate vector. Indicates a complicated life cycle with more than one stage. For example, in schistosomiasis, humans excrete worm eggs, which develop into larvae. These infect snails, which, in turn, excrete eggs that develop into larvae able to penetrate human skin.

Virulence. Degree of severity of an infection capable of withstanding body defenses or medical treatment. Often measured by case fatality rates.

Volatile organic compounds (VOC). Organic compounds that readily evaporate and exist as gases in the atmosphere. Commonly used term when referring to air pollutants, for example, benzene.

Terms on Environmental, Health, and Risk Assessments

This section contains various definitions for:

- Environmental health
- Assessment
- Health impact assessment
- Environmental assessment and environmental impact assessment
- Risk assessment.

Because no internationally accepted definitions, practices, or standards for environmental health exist, several are listed here. Sources are noted for those definitions quoted, excerpted, or adapted from other sources. Each bullet indicates a separate source.

Environmental Health

- *Environmental health* is as much a way of thinking as a set of facts or professional discipline. Preventing disease, death, and disability form its core. The field or discipline entails looking at a problem in both its broad and narrow contexts. Broadly speaking, environmental health is intended to reduce exposure to adverse environmental conditions as well as promote behavioral change. More narrowly, it addresses the underlying causes of individual groups of diseases and injuries by looking at the direct and indirect causes and effecting relationships in the short and long term.

Environmental health relates to ecological factors, natural disasters, and human activities (production or consumption) that impact on socioeconomic conditions and environmental life support systems, potentially affecting the well-being of present and future generations,* specifically by increasing human disease, injury, and premature death, especially among vulnerable groups, mainly the poor, women, and children under five.

Environmental health is intended to prevent health risks by controlling human exposure to (a) biological agents, such as bacteria, viruses, and parasites, (b) chemical agents, such as heavy metals, particulate matter, pesticides, and fertilizers, (c) disease vectors, such as mosquitoes and snails, and (d) physical and safety hazards, such as traffic accidents, fire, extremes of heat and cold, noise, and radiation. Human exposure pathways are air, water, land, and food.

Environmental health strives to consider individual problems in as broad a context as possible, within which to set policies and develop reasonably practical and cost-effective preventive and remedial measures. The broad context should include socioeconomic determinants of physical and mental stress, for example, (a) population movements, such as growth, rural-to-urban migration, and resettlement, (b)

* Future generation preferences and possible environment-related human genetic defects cannot be determined or documented beforehand; this chapter will not address this unresolved issue (see also institutional failures).

general lack of access to basic services, such as transport, water, sanitation, and energy, and (c) time spent compensating for this lack, such as fetching water and household fuels, or getting to school, work, and health services. Remedial measures in environmental health complement health care system interventions in order to optimize health benefits. The broad context also allows for more efficient cross-sectoral intervention, such as addressing the risk of STDs/AIDS in infrastructure projects, in which truckers and work crews risk acquiring or spreading the disease. (World Bank, 1996, *Bridging Environmental Health Gaps*, vol. 1, AFTES Working Paper No. 22, Environmentally Sustainable Development Division, Africa Technical Department, Washington, D.C., p. 2)

“Environmental health is the body of knowledge concerned with the prevention of disease through the control of biological, chemical, or physical agents in the air, water, and food, and the control of environmental factors that may have an impact on the well-being of people.” (Frank S. Lisella, ed., 1994, *The VNR Dictionary of Environmental Health and Safety*, New York: Van Nostrand Reinhold, pp. 107–108.)

“Environmental health comprises those aspects of human health, including quality of life, that are determined by physical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations.” (World Health Organization, 1997, *Health and Environment in Sustainable Development*. Geneva)

- What is environmental health?

The definition of environmental health is still evolving. The conventional list of main health hazards in the household and community environment includes the following:

- *Traditional hazards.* Lack of safe water, inadequate sanitation, and waste disposal, indoor air pollution, and vector-borne diseases (malaria and others).
- *Modern hazards.* Urban air pollution and agroindustrial chemicals and waste.
- Other health hazards may be added—at least partially—to the environmental health category, such as food contamination, occupational safety, and natural disasters. Health and environment nexus is broader than environmental health itself. For example, it may include health care waste management, health impact of land degradation and impoverishment, and the impact of biodiversity loss on medicinal plants. These issues, however, are outside the scope of this note. (WHO web site, <www.who.int>)

Assessment

- The critical analysis, evaluation, or judgment of the status or quality of a particular condition, situation, or other subject of appraisal. (Herman Koren, 1996, *Illustrated Dictionary of Environmental Health and Occupational Safety*, New York: Lewis Publishers, p. 34.)

Environmental Health Impact Assessment

- A statement of the beneficial or adverse health effects or risks due to an environmental exposure or likely to follow an environmental change. Such statements may contain or refer to results of epidemiological and/or toxicological studies of environmental health hazards. (Alan Gilpin, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, 1996, p. 53.)
- An assessment of the effects on the environment and people of aspects of a project recognized as having potentially adverse health effects; the health component is often insufficiently addressed in environmental impact assessments (EIAs). In 1982 the World Health Organization recommended that EHIA [environmental health impact assessment] studies should be conducted for all major development projects. Health assessment embraces the following: risks and hazards (direct and indirect), involving explosion, fire, shock, heat, blast, vibration, and destruction of property beyond the boundaries of the plant; biological factors such as parasites, helminthes, protozoa, bacteria, mycobacteria, rickett-

rickettsia, and viruses; toxic, carcinogenic, or mutagenic chemicals, and heavy metals; ionizing and nonionizing radiation; noise; dust and other irritants; and excessive temperature or humidity. The possible implications for human health may be measured in terms of mortality and morbidity. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p. 53.)

- Environmental health impact assessment offers an appropriate mechanism for maximizing the advantages of such projects, while minimizing possible environmental and health damage. Environmental impact assessment identifies, at an early stage, the impact on both the environment and human health that planned development projects may have. Environmental health impact assessment, thus, puts into action the sound public health principle: prevention is better than cure. In doing so, its overall purpose is to create an environment conducive to achieving physical and social well-being. (Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, p. 1.)
- The combination of environmental and health impact assessment (EHIA) procedures should lead to the identification of alternative development policies or projects less detrimental to health and the environment and/or the provision of mitigation measures to compensate for potential environmental health impacts. (Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, p. 1.)

Health Impact Assessment

- The main steps in health impact assessment are identification of health hazards, interpretation of health risks, and management of health risks. The operational procedures required by a regulating agency to achieve these steps are initial screening of the project for health hazards, initial health examination or rapid appraisal, health impact assessment, and proposals for health risk management. The initial screening process identifies the health hazards normally associated with the kind of development project. The initial health examination (IHE) or rapid appraisal uses existing information to interpret the health hazard as a health risk. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p. 3.)
- A full health impact assessment (HIA) involves detailed field studies and is a more rigorous, expensive, and specific form of assessment. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p.4.)
- The assessment is concerned with the change in exposure associated with the project: identifying the communities that will be exposed and the nature, magnitude, and likelihood of that exposure. The consultant should also establish the capabilities of existing protection agencies, including the health service, to monitor, inform, safeguard, and mitigate health risk. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p. 29.)

(Health impact assessment within an environmental impact assessment)

- The purpose of a health impact assessment within an EIA has been defined as “the creation of an environment conducive to the achievement of physical and social well-being.” (Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, p. 2.)

Environmental Assessment and Environmental Impact Assessment

Environmental Assessment

- A written environmental analysis that is prepared pursuant to the National Environmental Policy Act (NEPA) by a federal agency in anticipation of proposed legislation or federal action. The analysis

briefly provides significant evidence for determining whether to prepare an environmental impact statement or a finding of no significant impact and aids an agency's compliance with NEPA, when no environmental impact statement is necessary. It also includes a brief discussion of the need for the proposal of alternatives and of the environmental impacts of the proposed action and alternatives, as well as a listing of agencies and persons consulted. (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, p. 107.)

Environmental Assessment (Regional)

- An instrument that examines environmental issues and impacts associated with a particular strategy, policy, plan, or program or with a series of projects for a particular region (e.g., an urban area, watershed, or coastal zone), evaluates and compares the impacts with those of alternative options, assesses legal and institutional aspects relevant to the issues and impacts, and recommends broad measures to strengthen environmental management in the region. Regional environmental assessments pay particular attention to potential cumulative impacts of multiple activities. (World Bank OP 4.1 Annex.)

Environmental Assessment (Sectoral)

- An instrument that examines environmental issues and impacts associated with a particular strategy, policy, plan, or program, or with a series of projects for a specific sector (e.g., power, transport, or agriculture), evaluates and compares the impacts against those of alternative options, assesses legal and institutional aspects relevant to the issues and impacts, and recommends broad measures to strengthen environmental management in the sector. Sectoral environmental assessments pay particular attention to potential cumulative impacts of multiple activities. (World Bank OP 4.1 Annex.)

Environmental Impact Assessment

- Insure that environmental amenities and values are given appropriate consideration by preparing detailed statements on the environmental impacts of major federal actions, significantly affecting the quality of the human environment. The detailed statements are called environmental impact statements (EIS). (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, p. 463.)

The EIA process has two principal purposes: integrating environmental considerations into the federal decisionmaking process and encouraging participation by other federal agencies with specialized expertise and by the public in the preparation of environmental analysis and in the eventual decision. (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, pp. 463–4.)

- A method of analysis that attempts to predict probable repercussions of a proposed development on the social and physical environment of the surrounding area. (Thomas M. Pankratz, 1996, *Concise Dictionary of Environmental Engineering*, New York: Lewis Publishers, p. 107.)
- The principal method of ensuring that environmental considerations are taken into account at the planning stage is to conduct an environmental impact assessment or EIA, which is then embodied in an environmental impact statement (EIS), which is now often required by law before a new project can proceed. Typically, an EIS will embody the following information:
 - A description of the development proposed, comprising information about the site and the design and size or scale of the development
 - The data necessary to identify and assess the main effects that development is likely to have on the environment
 - Description of the likely significant effects, direct and indirect, on the environment of the development, explained by reference to its possible impact on human beings, flora, fauna, soil, water, air, climate, the landscape, the interaction between any of the foregoing material assets, the cultural heritage, employment, transport, education resources, housing, etc.
 - Where significant adverse effects are identified with respect to any of the foregoing, a description of the measures envisaged in order to avoid, reduce, or remedy those effects

- A summary in nontechnical language of the information specified above, where public participation is involved. (Andrew Porteous, 1996, *Dictionary of Environmental Science and Technology*. Second Edition, New York: John Wiley and Sons, pp. 201–2.)
- An interdisciplinary process by which the environmental consequences of proposed actions and various alternatives are presented and considered as an aid to decisionmaking. The process may involve assessment of ecological, sociological, anthropological, economic, geological, and other environmental impacts. In many countries, industrial organizations planning new projects are required by law to conduct such studies and to produce an environmental impact assessment, which can then be examined critically. (W. John Maunder, 1992, *Dictionary of Global Climate Change*,. Compiled under the auspices of the Stockholm Environment Institute, New York: Chapman and Hall, pp. 85–6.)
- The critical appraisal of the likely effects of a policy, program, project, or activity on the environment. To assist the decisionmaking authority, assessments are carried out independently of the proponent, who may have prepared an environmental impact statement (EIS). The decisionmaking authority may be a level of government (local, state, or federal) or a government agency (at local, state, or federal level). Assessments take account of any adverse environmental effects on the community; any environmental impacts on the ecosystems of the locality; any diminution of the aesthetic, recreational, aesthetic, scientific, or other environmental values of a locality; the endangering of any species of fauna or flora; any adverse effects on any place or building having aesthetic, anthropological, archaeological, cultural, historical, scientific, or social significance; any long-term or cumulative effects on the environment; any curtailing of the range of beneficial uses; any environmental problems associated with the disposal of wastes; any implications for natural resources; and the implications for the concept of sustainable development. EIA extends to the entire process from the inception of a proposal to environmental auditing and post-project analysis. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p. 76.)
- The assessment is intended to identify and predict the impact of the project on the biogeographical environment and on people's health and well-being and to interpret and communicate information about the impacts. This book proposes to incorporate health impact assessment within environmental impact assessment. (Dr. M. H. Birley, 1995, *The Health Impact Assessment of Development Projects*, London: HMSO, p. 2.)
- Environmental impact assessment: It provides for adequate assessment of human health and safety impact of development policies and projects or of consumer products. It encourages intersectoral collaboration, especially between environmentalists and public health professionals. It provides for public information and community participation in environmental health issues. (Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, pp. 1–2.)
- There is no general and universally accepted definition of EIA. The great diversity of EIA definitions is illustrated by the following examples:
 - (a) "... an activity designed to identify and predict the impact on the biogeophysical environment and on man's health and well-being of legislative proposals, policies, programs, projects, and operational procedures, and to interpret and communicate information about impacts."
 - (b) "... to identify, predict, and describe in appropriate terms the pros and cons (penalties and benefits) of a proposed development. To be useful, the assessment needs to be communicated in terms understandable by the community and decisionmakers and the pros and cons should be identified on the basis of criteria relevant to the countries affected."
 - (c) "... an assessment of all relevant environmental and resulting social effects that would result from a project."
 - (d) "... assessment consists in establishing quantitative values for selected parameters that indicate the quality of the environment before, during, and after the action."

(e) "... the systematic examination of the environmental consequences of projects, policies, plans, and programs. Its main aim is to provide decisionmakers with an account of the implications of alternative courses of action before a decision is made."

(Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, pp. 4–5.)

Main objectives of an EIA: To identify beneficial and adverse environmental impacts. To suggest mitigation actions that might reduce or prevent adverse impacts. To identify and describe the residual adverse impacts that cannot be mitigated. To identify appropriate monitoring strategies to "tract" impacts and provide an "early warning" system. To incorporate environmental information into the decisionmaking process relating to development projects. To aid selection of the "optimum" alternative, here alternative sites or project designs are being investigated in an EIA study. (Robert G. H. Turnbull, ed. 1992. *Environmental and Health Impact Assessment of Development Projects. A Handbook for Practitioners*. WHO and CEMP, New York, NY: Elsevier Applied Science, p. 13.)

- A document, prepared by a PROPONENT, describing: a proposed activity or development and identifying the possible, probable, or certain effects of the proposal on the ENVIRONMENT; examining the possible alternatives; setting out the mitigation measures to be adopted; proposing a program of environmental management; provisions for monitoring, post-project analysis, or auditing; and plans for decommissioning and rehabilitation. An EIS should be prepared following SCOPING exercises to identify the key issues. It should be objective, thorough, and comprehensive, but without superfluous material. EISs are usually prepared by consultants working for the proponent, presenting what has been described as an ethical dilemma; however, the ultimate test is not pleasing the proponent in the short term, but achieving development consent after rigorous examination by a government agency and the public. This has ensured an increasing degree of integrity in the preparation of EISs. An EIS is often a key document in the EIA process. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, pp. 76–78.)
- A report required by major federal action significantly affecting the quality of the human environment, under the terms of the National Environmental Policy Act (NEPA). This report is, in effect, a detailed study of the proposed action and the environmental consequences of that action. Alternatives must be provided in the statement and a "no action" scenario must be presented. Specifically, the study must describe the environmental impact of the proposed action and adverse environmental effects that cannot be avoided should the proposal be implemented, alternatives to the proposed action, the relationship between the short-term uses of the human environment and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources that would be involved in the implementation of the proposed action. (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, p. 108.)
- An instrument to identify and assess the potential environmental impacts of a proposed project, evaluate alternatives, and design appropriate mitigation, management, and monitoring measures. Projects and subprojects need EIAs to address important issues not covered by any applicable regional or sectoral EA. (World Bank OP 4.1 Annex.)

Risk and Hazard Assessment

Hazard and Risk Assessment

- An essential component of many environmental impact statements, embracing the potentially adverse effects of a project involving fire, heat, blast, explosion, or flood, arising from a manufacturing plant or transportation system. An assessment reveals hazards to life and limb and property and is expressed in the form of risk probability. Safety depends both on the location of a plant and the safety precautions and back-up arrangements adopted, together with the degree of training and alertness in the plant. Buffer zones and correct routing of vehicles are also essential. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p. 107.)

Risk Assessment

- The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemicals. (Ruth A Eblen and William R. Eblen, eds., 1994, *The Encyclopedia of the Environment*, New York: Houghton Mifflin Company, p. 264.)
- The evaluation of short- and long-term risks by hazard identification, dose-response assessment, exposure assessment, and risk characterization; the process of integrating available information in the inherent toxicity of the chemical with information on how much of the chemical may come in contact with the individual. (Herman Koren, 1996, *Illustrated Dictionary of Environmental Health and Occupational Safety*, New York: Lewis Publishers, p. 238.)
- The qualitative and quantitative estimation of the likelihood of adverse effects that may result from exposure to specified health hazards or from the absence of beneficial influences. The process of determining risks to health attributable to environment or other hazards. The process consists of four steps, as follows:
 - *Hazard identification*: Identifying the agent responsible for the health problem, its adverse effects, the target population, and the conditions of exposure.
 - *Risk characterization*: Describing the potential health effects of the hazard, quantifying dose-effect and dose-response relationships.
 - *Exposure assessment*: Quantifying exposure (dose) in a specified population, based on measurement of emissions, environmental levels of toxic substances, biologic monitoring, etc.
 - *Risk estimation*: Combining risk characterization, dose-response relationships, and exposure estimates to quantify the risk level in a specific population. The end result is a qualitative and quantitative statement about the health effects expected and the proportion and number of affected people in a target population, including estimation of the uncertainties involved. The size of the exposed population must be known. (Alan Gilpin, 1996, *Dictionary of Environment and Sustainable Development*, Second Edition, New York: John Wiley and Sons, p.148.)
- An instrument for estimating the probability of harm occurring from the presence of dangerous conditions or materials at a project site. Risk represents the likelihood and significance of a potential hazard being realized; therefore, a hazard assessment often precedes a risk assessment, or the two are conducted as one exercise. Risk assessment is a flexible method of analysis, a systematic approach to organizing and analyzing scientific information about potentially hazardous activities or about substances that might pose risks under specified conditions. The Bank routinely requires risk assessment for projects involving handling, storage, or disposal of hazardous materials and waste, the construction of dams, and major construction works in locations vulnerable to seismic activity or other potentially damaging natural events. For certain projects, the environmental assessment report may consist of the risk assessment alone; in other cases, the risk assessment is part of the environmental assessment documentation. (World Bank OP 4.1 Annex)

Comparative Risk Assessment

- Comparative risk assessment is a technique developed within the last decade to distinguish *actual risk* from *potential exposure*. A strength of this technique is being able to compare and evaluate the effects of two or three pollutants or hazards. A limitation is its reliance on animal studies and focus on limited risks. Because few such epidemiological tools exist, they are often overextended or misapplied. Bearing in mind that many user assessments will probably not have a background in health and environment (and maybe neither), the inherent value of comparative risk assessments, that is, of ranking selected pollutants, can be compromised, if they are inappropriately used as an equal substitute for an environmental health assessment; the difference is one of emphasis and breadth of coverage. (James

Listorti, 1996, *Bridging Environmental Health Gaps*, vol. III, AFTES Working Paper No. 22, Urban Environmental Management Program, Washington, D.C.: World Bank, p. 7.)

Hazard Assessment

- An instrument for identifying, analyzing, and controlling hazards associated with the presence of dangerous materials and conditions at a project site. The Bank requires a hazard assessment for projects involving certain inflammable, explosive, reactive, and toxic materials, when they are present at a site in quantities above a specified threshold level. For certain projects, the environmental assessment report may consist of the hazard assessment alone. In other cases, the hazard assessment is part of the environmental assessment documentation. (World Bank OP 4.1 Annex.)