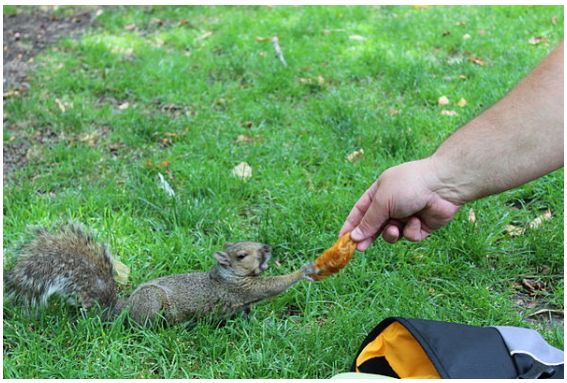
Human impact on the environment



The ecosystem of public parks often includes humans feeding the wildlife.

Human impact on the environment or **anthropogenic impact on the environment** includes impacts on biophysical environments, biodiversity, and other resources.[1][2] The term *anthropogenic* designates an effect or object resulting from human activity. The term was first used in the technical sense by Russian geologist Alexey Pavlov, and was first used in English by British ecologist Arthur Tansley in reference to human influences on climax plant communities.[3] The atmospheric scientist Paul Crutzen introduced the term "Anthropocene" in the mid-1970s.[4] The term is sometimes used in the context of pollution emissions that are produced as a result of human activities but applies broadly to all major human impacts on the environment.[5]

1 Causes

1.1 Technology

The applications of technology often result in unavoidable and unexpected environmental impacts, which according to the I = PAT equation is measured as resource use or pollution generated per unit GDP. Environmental impacts caused by the application of technology are often perceived as unavoidable for several reasons. First, given that the purpose of many technologies is to exploit, control, or otherwise "improve" upon nature for the perceived benefit of humanity while at the same time the myriad of processes in nature have been optimized and are continually adjusted by evolution, any disturbance of these natural processes by technology is likely to result in negative environmental consequences.[6] Second, the conservation of mass principle and the first law of thermodynamics (i.e., conservation of energy) dictate that whenever material resources or energy are moved around or manipulated by technology, environmental consequences are inescapable. Third, according to the second law of thermodynamics, order can be increased within a system (such as the human economy) only by increasing disorder or entropy outside the system (i.e., the environment). Thus, technologies can create "order" in the human economy (i.e., order as manifested in buildings, factories, transportation networks, communication systems, etc.) only at the expense of increasing "disorder" in the environment. According to a number of studies, increased entropy is likely to be correlated to negative environmental impacts.[7][8][9][10]

1.2 Agriculture

Main article: Environmental impact of agriculture

The environmental impact of agriculture varies based on the wide variety of agricultural practices employed around the world. Ultimately, the environmental impact depends on the production practices of the system used by farmers. The connection between emissions into the environment and the farming system is indirect, as it also depends on other climate variables such as rainfall and temperature.

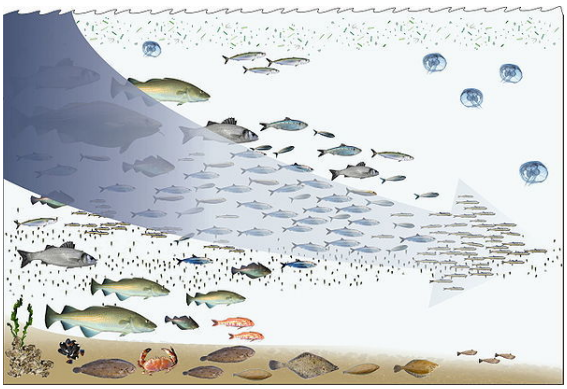
There are two types of indicators of environmental impact: "means-based", which is based on the farmer's production methods, and "effect-based", which is the impact that farming methods have on the farming system or on emissions to the environment. An example of a means-based indicator would be the quality of groundwater, that is effected by the amount of nitrogen applied to the soil. An indicator reflecting the loss of nitrate to groundwater would be effect-based.[11]

The environmental impact of agriculture involves a variety of factors from the soil, to water, the air, animal and soil diversity, plants, and the food itself. Some of the environmental issues that are related to agriculture are climate change, deforestation, genetic engineering, irrigation problems, pollutants, soil degradation, and waste.

1.2.1 Fishing

Main article: Environmental impact of fishing

The environmental impact of fishing can be divided into issues that involve the availability of fish to be caught,



Fishing down the foodweb.

such as overfishing, sustainable fisheries, and fisheries management; and issues that involve the impact of fishing on other elements of the environment, such as by-catch and destruction of habitat such as coral reefs.[12]

These conservation issues are part of marine conservation, and are addressed in fisheries science programs. There is a growing gap between how many fish are available to be caught and humanity's desire to catch them, a problem that gets worse as the world population grows.

Similar to other environmental issues, there can be conflict between the fishermen who depend on fishing for their livelihoods and fishery scientists who realize that if future fish populations are to be sustainable then some fisheries must reduce or even close.[13]

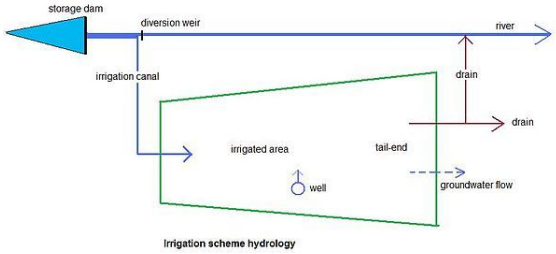
The journal *Science* published a four-year study in November 2006, which predicted that, at prevailing trends, the world would run out of wild-caught seafood in 2048. The scientists stated that the decline was a result of overfishing, pollution and other environmental factors that were reducing the population of fisheries at the same time as their ecosystems were being degraded. Yet again the analysis has met criticism as being fundamentally flawed, and many fishery management officials, industry representatives and scientists challenge the findings, although the debate continues. Many countries, such as Tonga, the United States, Australia and New Zealand, and international management bodies have taken steps to appropriately manage marine resources.[14][15]

1.2.2 Irrigation

Main article: Environmental impact of irrigation

The environmental impact of irrigation includes the changes in quantity and quality of soil and water as a result of irrigation and the ensuing effects on natural and social conditions at the tail-end and downstream of the irrigation scheme.

The impacts stem from the changed hydrological conditions owing to the installation and operation of the scheme.



An irrigation scheme often draws water from the river and distributes it over the irrigated area. As a hydrological result it is found that:

- the downstream river discharge is reduced
- the evaporation in the scheme is increased
- the groundwater recharge in the scheme is increased
- the level of the water table rises
- the drainage flow is increased.

These may be called direct effects.

Effects on soil and water quality are indirect and complex, and subsequent impacts on natural, ecological and socio-economic conditions are intricate. In some, but not all instances, water logging and soil salinization can result. However, irrigation can also be used, together with soil drainage, to overcome soil salinization by leaching excess salts from the vicinity of the root zone.[16][17]

Irrigation can also be done extracting groundwater by (tube)wells. As a hydrological result it is found that the level of the water descends. The effects may be water mining, land/soil subsidence, and, along the coast, saltwater intrusion.

Irrigation projects can have large benefits, but the negative side effects are often overlooked.[18][19] Agricultural irrigation technologies such as high powered water pumps, dams, and pipelines are responsible for the large-scale depletion of fresh water resources such as aquifers, lakes, and rivers. As a result of this massive diversion of freshwater, lakes, rivers, and creeks are running dry, severely altering or stressing surrounding ecosystems, and contributing to the extinction of many aquatic species.[20]

1.2.3 Agricultural land loss and soil erosion

Lal and Stewart estimated global loss of agricultural land by degradation and abandonment at 12 million hectares per year.[21] In contrast, according to Scherr, GLASOD (Global Assessment of Human-Induced Soil Degradation, under the UN Environment Programme) estimated that 6 million hectares of agricultural land per year had

been lost to soil degradation since the mid-1940s, and she noted that this magnitude is similar to earlier estimates by Dudal and by Rozanov et al.[22] Such losses are attributable not only to soil erosion, but also to salinization, loss of nutrients and organic matter, acidification, compaction, water logging and subsidence.[23] Human-induced land degradation tends to be particularly serious in dry regions. Focusing on soil properties, Oldeman estimated that about 19 million square kilometers of global land area had been degraded; Dregne and Chou, who included degradation of vegetation cover as well as soil, estimated about 36 million square kilometers degraded in the world's dry regions.[24] Despite estimated losses of agricultural land, the amount of arable land used in crop production globally increased by about 9% from 1961 to 2012, and is estimated to have been 1.396 billion hectares in 2012.[25]

Global average soil erosion rates are thought to be high, and erosion rates on conventional cropland generally exceed estimates of soil production rates, usually by more than an order of magnitude.[26] In the US, sampling for erosion estimates by the US NRCS (Natural Resources Conservation Service) is statistically based, and estimation uses the Universal Soil Loss Equation and Wind Erosion Equation. For 2010, annual average soil loss by sheet, rill and wind erosion on non-federal US land was estimated to be 10.7 t/ha on cropland and 1.9 t/ha on pasture land; the average soil erosion rate on US cropland had been reduced by about 34% since 1982.[27] No-till and low-till practices have become increasingly common on North American cropland used for production of grains such as wheat and barley. On uncultivated cropland, the recent average total soil loss has been 2.2 t/ha per year.[27] In comparison with agriculture using conventional cultivation, it has been suggested that, because no-till agriculture produces erosion rates much closer to soil production rates, it could provide a foundation for sustainable agriculture.[26]

1.2.4 Meat production

Main article: Environmental impact of meat production

Environmental impacts associated with meat production include use of fossil energy, water and land resources, greenhouse gas emissions, and in some instances, rainforest clearing, water pollution and species endangerment, among other adverse effects.[28] [29] Steinfeld et al. of the FAO estimated that 18% of global anthropogenic GHG (greenhouse gas) emissions (estimated as 100-year carbon dioxide equivalents) are associated in some way with livestock production.[28] A more recent FAO analysis estimated that all agriculture, including the livestock sector, in 2011 accounted for 12% of global anthropogenic GHG emissions expressed as 100-year carbon dioxide equivalents.[30] Similarly, the Intergovernmental Panel on Climate Change has estimated that about 10 to 12% of global anthropogenic GHG emissions (expressed as 100-year carbon dioxide equivalents) were assignable to all of agriculture, including the livestock sector, in 2005[31] and again in 2010.[32] The percentage assignable to livestock would be some fraction of the percentage for agriculture. The amount assignable to meat production would be some fraction of that assigned to livestock. FAO data indicate that meat accounted for 26% of global livestock product tonnage in 2011. However, many estimates use different sectoral assignment of some emissions. [25] Environmental specialists Jeff Anhang and Robert Goodland with the IFC and World Bank, have put the GHG associated with livestock at 51%, pointing out the FAO report failed to account for the 8,769 metric tons of respiratory CO_2 produced each year, undercounted methane production and land use associated with livestock, and failed to properly categorize emissions related to the slaughtering, processing, packaging, storing and transporting of animals and animal products. [33] [34]

Globally, enteric fermentation (mostly in ruminant livestock) accounts for about 27% of anthropogenic methane emissions,[35] Despite methane's 100-year global warming potential, recently estimated at 28 without and 34 with climate carbon feedbacks,[35] methane emission is currently contributing relatively little to global warming. Over the decade 2000 through 2009, atmospheric methane content increased by an average of only 6 Tg per year (because nearly all natural and anthropogenic methane emission was offset by degradation), while atmospheric carbon dioxide increased by nearly 15,000 Tg per year.[35] At the currently estimated rate of methane degradation, slight reduction of anthropogenic methane emissions, to about 98% of that decade's average, would be expected to result in no further increase of atmospheric methane content. Although reduction of methane emissions would have a rapid effect on warming, the expected effect would be small.[36] Other anthropogenic GHG emissions associated with livestock production include carbon dioxide from fossil fuel consumption (mostly for production, harvesting and transport of feed), and nitrous oxide emissions associated with use of nitrogenous fertilizers, growing of nitrogen-fixing legume vegetation and manure management. Management practices that can mitigate GHG emissions from production of livestock and feed have been identified.[37][38][39][40][41]

Livestock production, including feed production and grazing, uses about 30% of the earth's ice-free terrestrial surface: about 26% for grazing and about 4% for other feed production.[28] The intensity and duration of grazing use vary greatly[42] and these, together with terrain, vegetation and climate, influence the nature and importance of grazing's environmental impact, which can range from severe to negligible, and in some cases (as noted below) beneficial. Excessive use of vegetation by grazing can be especially conducive to land degradation in dry areas.[43]

Considerable water use is associated with meat production, mostly because of water used in production of veg-

etation that provides feed. There are several published estimates of water use associated with livestock and meat production, but the amount of water use assignable to such production is seldom estimated. For example, "green water" use is evapotranspirational use of soil water that has been provided directly by precipitation; and "green water" has been estimated to account for 94% of global beef cattle production's "water footprint",[44] and on rangeland, as much as 99.5% of the water use associated with beef production is "green water". However, it would be misleading simply to assign that associated rangeland green water use to beef production, partly because that evapotranspirational use occurs even in the absence of cattle. Even when cattle are present, most of that associated water use can be considered assignable to production of terrestrial environmental values, because it produces root and residue biomass important for erosion control, stabilization of soil structure, nutrient cycling, carbon sequestration, support of numerous primary consumers, many of which support higher trophic levels, etc. Withdrawn water (from surface and groundwater sources) is used for livestock watering, and in some cases is also used for irrigation of forage and feed crops. Whereas all irrigation in the US (including loss in conveyance) is estimated to account for about 38% of US withdrawn freshwater use,[45] irrigation water for production of livestock feed and forage has been estimated to account for about 9%;[46] other withdrawn freshwater use for the livestock sector (for drinking, washdown of facilities, etc.) is estimated at about 0.7%.[45] Because of the preponderance of non-meat products from the livestock sector[25] only some fraction of this water use is assignable to meat production.

Impairment of water quality by manure and other substances in runoff and infiltrating water is a concern, especially where intensive livestock production is carried out. In the US, in a comparison of 32 industries, the livestock industry was found to have a relatively good record of compliance with environmental regulations pursuant to the Clean Water Act and Clean Air Act,[47] but pollution issues from large livestock operations can sometimes be serious where violations occur. Various measures have been suggested by the US Environmental Protection Agency, among others, which can help reduce livestock damage to streamwater quality and riparian environments.[48]

Data of a USDA study indicate that, in 2002, about 0.6% of non-solar energy use in the United States was accounted for by production of meat-producing livestock and poultry.[49] This estimate included embodied energy used in production, such as energy used in manufacture and transport of fertilizer for feed production. (Non-solar energy is specified, because solar energy is used in such processes as photosynthesis and hay-drying.)

Changes in livestock production practices influence the environmental impact of meat production, as illustrated by some beef data. In the US beef production system, practices prevailing in 2007 are estimated to have involved 8.6% less fossil fuel use, 16.3% less greenhouse gas emissions (estimated as 100-year carbon dioxide equivalents), 12.1% less withdrawn water use and 33.0% less land use, per unit mass of beef produced, than in 1977.[50] From 1980 to 2012 in the US, while population increased by 38%, the small ruminant inventory decreased by 42%, the cattle-and-calves inventory decreased by 17%, and methane emissions from livestock decreased by 18%;[25] yet despite the reduction in cattle numbers, US beef production increased over that period.[51]

Some impacts of meat-producing livestock may be considered environmentally beneficial. These include waste reduction by conversion of human-inedible crop residues to food, use of livestock as an alternative to herbicides for control of invasive and noxious weeds and other vegetation management,[52] use of animal manure as fertilizer as a substitute for those synthetic fertilizers that require considerable fossil fuel use for manufacture, grazing use for wildlife habitat enhancement,[53] and carbon sequestration in response to grazing practices,[54][55] among others. Conversely, according to some studies appearing in peer-reviewed journals the growing demand for meat is contributing to significant biodiversity loss as it is a significant driver of deforestation and habitat destruction.[56][57][58]

1.2.5 Palm oil

Main article: Social and environmental impact of palm oil

Palm oil, produced from the oil palm, is a basic source

*A village palm oil press "*malaxeur*" in Bandundu, Democratic Republic of the Congo*

of income for many farmers in Southeast Asia, Central and West Africa, and Central America. It is locally used as a cooking oil, exported for use in many commercial food and personal care products and is converted into biofuel. It produces up to 10 times more oil per unit area as soyabeans, rapeseed or sunflowers. Oil palms pro-

duce 38% of vegetable oil output on 5% of the world's vegetable-oil farmland.[59] Palm oil is under increasing scrutiny in relation to its effects on the environment.

1.3 Introductions and invasive species

Introductions of species, particularly plants into new areas, by whatever means and for whatever reasons have brought about major and permanent changes to the environment over large areas. Examples include the introduction of Caulerpa taxifolia into the Mediterranean, the introduction of oat species into the California grasslands, and the introduction of privet, kudzu, and purple loosestrife to North America. Rats, cats, and goats have radically altered biodiversity in many islands. Additionally, introductions have resulted in genetic changes to native fauna where interbreeding has taken place, as with buffalo with domestic cattle, and wolves with domestic dogs.

1.4 Energy industry

Main article: Environmental impact of the energy industry

The environmental impact of energy harvesting and consumption is diverse. In recent years there has been a trend towards the increased commercialization of various renewable energy sources.

In the real world, consumption of fossil fuel resources leads to global warming and climate change. However, little change is being made in many parts of the world. If the peak oil theory proves true, more explorations of viable alternative energy sources, could be more friendly to the environment.

Rapidly advancing technologies can achieve a transition of energy generation, water and waste management, and food production towards better environmental and energy usage practices using methods of systems ecology and industrial ecology.[60][61]

1.4.1 Biodiesel

Main article: Environmental impact of biodiesel

The environmental impact of biodiesel includes energy use, greenhouse gas emissions and some other kinds of pollution. A joint life cycle analysis by the US Department of Agriculture and the US Department of Energy found that substituting 100% biodiesel for petroleum diesel in buses reduced life cycle consumption of petroleum by 95%. Biodiesel reduced net emissions of carbon dioxide by 78.45%, compared with petroleum diesel. In urban buses, biodiesel reduced particulate emissions 32 percent, carbon monoxide emissions 35 percent, and emissions of sulfur oxides 8%, relative to life cycle emissions associated with use of petroleum diesel. Life cycle emissions of hydrocarbons were 35% higher and emission of various nitrogen oxides (NOx) were 13.5% higher with biodiesel.[62] Life cycle analyses by the Argonne National Laboratory have indicated reduced fossil energy use and reduced greenhouse gas emissions with biodiesel, compared with petroleum diesel use.[63] Biodiesel derived from various vegetable oils (e.g. canola or soybean oil), is readily biodegradable in the environment compared with petroleum diesel.[64]

1.4.2 Coal mining and burning

Main article: Environmental impact of coal mining and burning

The environmental impact of coal mining and -burning is diverse.[65] Legislation passed by the US Congress in 1990 required the United States Environmental Protection Agency (EPA) to issue a plan to alleviate toxic air pollution from coal-fired power plants. After delay and litigation, the EPA now has a court-imposed deadline of March 16, 2011, to issue its report.

1.4.3 Electricity generation

Main article: Environmental impact of electricity generation

The environmental impact of electricity generation is significant because modern society uses large amounts of electrical power. This power is normally generated at power plants that convert some other kind of energy into electricity. Each such system has advantages and disadvantages, but many of them pose environmental concerns.

1.4.4 Nuclear power

Main article: Environmental impact of nuclear power

The environmental impact of nuclear power results from the nuclear fuel cycle processes including mining, processing, transporting and storing fuel and radioactive fuel waste. Released radioisotopes pose a health danger to human populations, animals and plants as radioactive particles enter organisms through various transmission routes.

Radiation is a carcinogen and causes numerous effects on living organisms and systems. The environmental impacts of nuclear power plant disasters such as the Chernobyl disaster, the Fukushima Daiichi nuclear disaster and the Three Mile Island accident, among others, persist indefinitely, though several other factors contributed to these events including improper management

of fail safe systems and natural disasters putting uncommon stress on the generators. The radioactive decay rate of particles varies greatly, dependent upon the nuclear properties of a particular isotope. Radioactive Plutonium-244 has a half-life of 80.8 million years, which indicates the time duration required for half of a given sample to decay, though very little plutonium-244 is produced in the nuclear fuel cycle and lower half-life materials have lower activity thus giving off less dangerous radiation.[66]

1.4.5 Oil shale industry

Main article: Environmental impact of the oil shale industry

The environmental impact of the oil shale industry in-

Kiviõli Oil Shale Processing & Chemicals Plant in ida-Virumaa, Estonia

cludes the consideration of issues such as land use, waste management, and water and air pollution caused by the extraction and processing of oil shale. Surface mining of oil shale deposits causes the usual environmental impacts of open-pit mining. In addition, the combustion and thermal processing generate waste material, which must be disposed of, and harmful atmospheric emissions, including carbon dioxide, a major greenhouse gas. Experimental in-situ conversion processes and carbon capture and storage technologies may reduce some of these concerns in future, but may raise others, such as the pollution of groundwater.[67]

1.4.6 Petroleum

Main article: Environmental impact of petroleum

The environmental impact of petroleum is often negative because it is toxic to almost all forms of life. Climate change exists. Petroleum, commonly referred to as oil, is closely linked to virtually all aspects of present society, especially for transportation and heating for both homes and for commercial activities.

1.4.7 Reservoirs

Main article: Environmental impact of reservoirs

The environmental impact of reservoirs is coming under

The Wachusett Dam in Clinton, Massachusetts.

ever increasing scrutiny as the world demand for water and energy increases and the number and size of reservoirs increases.

Dams and the reservoirs can be used to supply drinking water, generate hydroelectric power, increasing the water supply for irrigation, provide recreational opportunities and flood control. However, adverse environmental and sociological impacts have also been identified during and after many reservoir constructions. Although the impact varies greatly between different dams and reservoirs, common criticisms include preventing sea-run fish from reaching their historical mating grounds, less access to water downstream, and a smaller catch for fishing communities in the area. Advances in technology have provided solutions to many negative impacts of dams but these advances are often not viewed as worth investing in if not required by law or under the threat of fines. Whether reservoir projects are ultimately beneficial or detrimental—to both the environment and surrounding human populations— has been debated since the 1960s and probably long before that. In 1960 the construction of Llyn Celyn and the flooding of Capel Celyn provoked political uproar which continues to this day. More recently, the construction of Three Gorges Dam and other similar projects throughout Asia, Africa and Latin America have generated considerable environmental and political debate.

1.4.8 Wind power

Main article: Environmental impact of wind power

Compared to the environmental impact of traditional energy sources, the environmental impact of wind power is relatively minor. Wind powered electricity generation consumes no fuel, and emits no air pollution, unlike fossil fuel power sources. The energy consumed to manu-

Wind turbines in an agricultural setting.

facture and transport the materials used to build a wind power plant is equal to the new energy produced by the plant within a few months. While a wind farm may cover a large area of land, many land uses such as agriculture are compatible, with only small areas of turbine foundations and infrastructure made unavailable for use.[68]

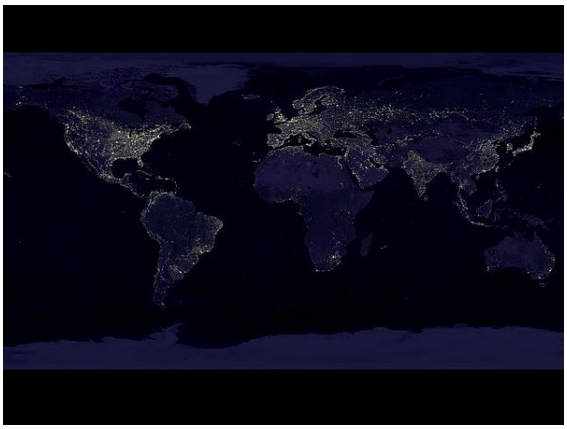
There are reports of bird and bat mortality at wind turbines, as there are around other artificial structures. The scale of the ecological impact may[69] or may not[70] be significant, depending on specific circumstances. Prevention and mitigation of wildlife fatalities, and protection of peat bogs,[71] affect the siting and operation of wind turbines.

There are conflicting reports about the effects of noise on people who live very close to a wind turbine.

1.5 Light pollution

Main article: Ecological light pollution

Artificial light at night is one of the most obvious physical changes that humans have made to the biosphere, and is the easiest form of pollution to observe from space.[72] The main environmental impacts of artificial light are due to light's use as an information source (rather than an energy source). The hunting efficiency of visual predators generally increases under artificial light, changing predator prey interactions. Artificial light also affects dispersal, orientation, migration, and hormone levels, resulting in disrupted circadian rhythms.[73]



A composite image of artificial light emissions from Earth at night

1.6 Manufactured products

1.6.1 Cleaning agents

Main article: Environmental impact of cleaning agents

The environmental impact of cleaning agents is diverse. In recent years, measures have been taken to reduce these effects.

1.6.2 Nanotechnology

Main article: Environmental impact of nanotechnology

Nanotechnology's environmental impact can be split into two aspects: the potential for nanotechnological innovations to help improve the environment, and the possibly novel type of pollution that nanotechnological materials might cause if released into the environment. As nanotechnology is an emerging field, there is great debate regarding to what extent industrial and commercial use of nanomaterials will affect organisms and ecosystems.

1.6.3 Leather

Main article: Environmental impact of leather

1.6.4 Paint

Main article: Environmental impact of paint

The environmental impact of paint is diverse. Traditional painting materials and processes can have harmful effects on the environment, including those from the use of lead and other additives. Measures can be taken to reduce environmental impact, including accurately estimating paint quantities so that wastage is minimized, use of paints, coatings, painting accessories and techniques that are environmentally preferred. The United States Environmental Protection Agency guidelines and Green Star ratings are some of the standards that can be applied.

1.6.5 Paper

Main article: Environmental impact of paper

The environmental impact of paper is significant, which

A pulp and paper mill in New Brunswick, Canada. Although pulp and paper manufacturing requires large amounts of energy, a portion of it comes from burning wood waste.

has led to changes in industry and behaviour at both business and personal levels. With the use of modern technology such as the printing press and the highly mechanised harvesting of wood, paper has become a cheap commodity. This has led to a high level of consumption and waste. With the rise in environmental awareness due to the lobbying by environmental organizations and with increased government regulation there is now a trend towards sustainability in the pulp and paper industry.

1.6.6 Pesticides

Main article: Environmental impact of pesticides

The environmental impact of pesticides is often greater than what is intended by those who use them. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water, bottom sediments, and food.[74] Pesticide contaminates land and water when it escapes from production sites and storage tanks, when it runs off from fields, when it is discarded, when it is sprayed aerially, and when it is sprayed into water to kill algae.[75]

The amount of pesticide that migrates from the intended application area is influenced by the particular chemical's properties: its propensity for binding to soil, its vapor pressure, its water solubility, and its resistance to being broken down over time.[76] Factors in the soil, such as its texture, its ability to retain water, and the amount of organic matter contained in it, also affect the amount of pesticide that will leave the area.[76] Some pesticides contribute to global warming and the depletion of the ozone layer.[77]

1.6.7 Pharmaceuticals and personal care products

Main article: Environmental impact of pharmaceuticals and personal care products

The environmental impact of pharmaceuticals and personal care products (PPCPs) is largely speculative. PPCPs are substances used by individuals for personal health or cosmetic reasons and the products used by agribusiness to boost growth or health of livestock. PPCPs have been detected in water bodies throughout the world. The effects of these chemicals on humans and the environment are not yet known, but to date there is no scientific evidence that they affect human health.[78]

1.7 Mining

Main article: Environmental impact of mining

The environmental impact of mining includes erosion,

Acid mine drainage in the Rio Tinto River.

formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to increase the available room for the storage of the created debris and soil.[79] Besides creating environmental damage, the contamination resulting from leakage of chemicals also affect the health of the local population.[80] Mining companies in some countries are required to follow environmental and rehabilitation codes, ensuring the area mined is returned to close to its original state. Some mining methods may have significant environmental and public health effects.

1.8 Transport

Main article: Environmental impact of transport

The environmental impact of transport is significant because it is a major user of energy, and burns most of the world's petroleum. This creates air pollution, including nitrous oxides and particulates, and is a significant contributor to global warming through emission of carbon dioxide,[81] for which transport is the fastest-growing emission sector.[82] By subsector, road transport

Interstate 10 and Interstate 45 near downtown Houston, Texas in the United States.

is the largest contributor to global warming.[81]

Environmental regulations in developed countries have reduced the individual vehicles emission; however, this has been offset by an increase in the number of vehicles, and more use of each vehicle.[81] Some pathways to reduce the carbon emissions of road vehicles considerably have been studied.[83] Energy use and emissions vary largely between modes, causing environmentalists to call for a transition from air and road to rail and human-powered transport, and increase transport electrification and energy efficiency.

Other environmental impacts of transport systems include traffic congestion and automobile-oriented urban sprawl, which can consume natural habitat and agricultural lands. By reducing transportation emissions globally, it is predicted that there will be significant positive effects on Earth's air quality, acid rain, smog and climate change.[84]

The health impact of transport emissions is also of concern. A recent survey of the studies on the effect of traffic emissions on pregnancy outcomes has linked exposure to emissions to adverse effects on gestational duration and possibly also intrauterine growth.[85]

1.8.1 Aviation

Main article: Environmental impact of aviation

The environmental impact of aviation occurs because aircraft engines emit noise, particulates, and gases which contribute to climate change[86][87] and global dimming.[88] Despite emission reductions from automobiles and more fuel-efficient and less polluting turbofan and turboprop engines, the rapid growth of air travel in recent years contributes to an increase in total pollution attributable to aviation. In the EU, greenhouse gas emissions from aviation increased by 87% between 1990 and 2006.[89] Among other factors leading to this phenomenon are the increasing number of hypermobile travellers[90] and social factors that are making air travel commonplace, such as frequent flyer programs.[90]

There is an ongoing debate about possible taxation of air travel and the inclusion of aviation in an emissions trading scheme, with a view to ensuring that the total external costs of aviation are taken into account.[91]

1.8.2 Roads

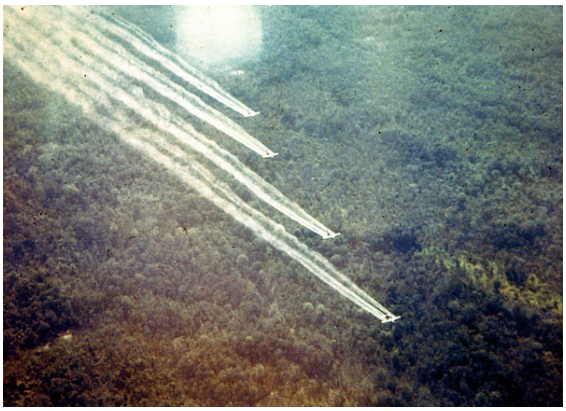
Main article: Environmental impact of roads

The environmental impact of roads includes the local effects of highways (public roads) such as on noise, light pollution, water pollution, habitat destruction/disturbance and local air quality; and the wider effects including climate change from vehicle emissions. The design, construction and management of roads, parking and other related facilities as well as the design and regulation of vehicles can change the impacts to varying degrees.

1.8.3 Shipping

Main article: Environmental impact of shipping

The environmental impact of shipping includes



An Agent Orange spray run, part of Operation Ranch Hand, during the Vietnam War by UC-123B Provider aircraft.

greenhouse gas emissions and oil pollution. In 2007, carbon dioxide emissions from shipping were estimated at 4 to 5% of the global total, and estimated by the International Maritime Organisation (IMO) to rise by up to 72% by 2020 if no action is taken.[92] There is also a potential for introducing invasive species into new areas through shipping, usually by attaching themselves to the ship's hull.

The First Intersessional Meeting of the IMO Working Group on Greenhouse Gas Emissions[93] from Ships took place in Oslo, Norway on 23–27 June 2008. It was tasked with developing the technical basis for the reduction mechanisms that may form part of a future IMO

regime to control greenhouse gas emissions from international shipping, and a draft of the actual reduction mechanisms themselves, for further consideration by IMO's Marine Environment Protection Committee (MEPC).[94]

1.9 War

Main article: Environmental impact of war

As well as the cost to human life and society, there is a significant environmental impact of war. Scorched earth methods during, or after war have been in use for much of recorded history but with modern technology war can cause a far greater devastation on the environment. Unexploded ordnance can render land unusable for further use or make access across it dangerous or fatal.

2 Effects

Life timeline
view • discuss •
−4500 —
–
−4000 —
–
−3500 —
–
−3000 —
–
−2500 —
–
−2000 —
–
−1500 —
–
−1000 —
–
−500 —
–
0 —
water
Single-celled life
photosynthesis
Eukaryotes
Multicellular life
Land life
Dinosaurs
Mammals
Flowers
←
Earliest Earth (−4540)
←
Earliest water
←
Earliest life
←
LHB meteorites
←
Earliest oxygen
←
Atmospheric oxygen
←
Oxygen crisis
←
Earliest sexual reproduction
←
Ediacara biota
←
Cambrian explosion
←
Earliest humans

Phanerozoic

Proterozoic

Archean

Hadean

Pongola

Huronian

Cryogenian

Andean

Karoo

Quaternary

Axis scale: millions of years.
Orange labels: known ***ice ages***.
Also see: *Human timeline* and *Nature timeline*

2.1 Biodiversity

Further information: Biodiversity § Threats

Human impact on biodiversity is significant, humans have caused the extinction of many species, including the dodo and, potentially, large megafaunal species during the last ice age.[95] Though most experts agree that human beings have accelerated the rate of species extinction, the exact degree of this impact is unknown, perhaps 100 to 1000 times the normal background rate of extinction.[96][97] Some scholars have postulated that without human interference the biodiversity of the Earth would continue to grow at an exponential rate.[1]

2.2 Coral reefs

Main article: Human impact on coral reefs

Human impact on coral reefs is significant. Coral reefs are dying around the world.[98] In particular, coral mining, pollution (organic and non-organic), overfishing, blast fishing and the digging of canals and access into islands and bays are serious threats to these ecosystems. Coral reefs also face high dangers from pollution, diseases, destructive fishing practices and warming oceans.[99] In order to find answers for these problems, researchers study the various factors that impact reefs. The list of factors is long, including the ocean's role as a carbon dioxide sink, atmospheric changes, ultraviolet light, ocean acidification, biological virus, impacts of dust storms carrying agents to far flung reefs, pollutants, algal blooms and others. Reefs are threatened well beyond coastal areas.

General estimates show approximately 10% world's coral reefs are already dead.[100][101][102] It is estimated that about 60% of the world's reefs are at risk due to destructive, human-related activities. The threat to the health of reefs is particularly strong in Southeast Asia, where 80% of reefs are endangered.

2.3 Carbon cycle

Global warming is the result of increasing atmospheric carbon dioxide concentrations which is caused primarily by the combustion of fossil energy sources such as petroleum, coal, and natural gas, and to an unknown extent by destruction of forests, increased methane, volcanic activity and cement production. Such massive alteration of the global carbon cycle has only been possible because of the availability and deployment of advanced technologies, ranging in application from fossil fuel exploration, extraction, distribution, refining, and combustion in power plants and automobile engines and advanced farming practices. Livestock contributes to climate change both thru the production of greenhouse gases and thru destruction of carbon sinks such as rainforests. According to the 2006 United Nations/FAO report, 18% of all greenhouse gas emissions found in the atmosphere are due to livestock. The raising of livestock and the land needed to feed them has resulted in the destruction millions of acres of Rainforest and as global demand for meat rises, so too will the demand for land. Ninety-one percent of all rainforest land deforested since 1970 is now used for livestock. [103] Potential negative environmental impacts caused by increasing atmospheric carbon dioxide concentrations are rising global air temperatures, altered hydrogeological cycles resulting in more frequent and severe droughts, storms, and floods, as well as sea level rise and ecosystem disruption.[104]

2.4 Nitrogen cycle

Main article: Human impact on the nitrogen cycle

Human impact on the nitrogen cycle is diverse. Agricultural and industrial nitrogen (N) inputs to the environment currently exceed inputs from natural N fixation.[105][106] As a consequence of anthropogenic inputs, the global nitrogen cycle (Fig. 1) has been significantly altered over the past century. Global atmospheric nitrous oxide (N_2O) mole fractions have increased from a pre-industrial value of ~270 nmol/mol to ~319 nmol/mol in 2005.[107] Human activities account for over one-third of N_2O emissions, most of which are due to the agricultural sector.[107]

2.5 Effects on human health

Further information: Pollution § Human health, and Effects of global warming on human health

3 See also

- Anthropocene
- Attribution of recent climate change
- Biome
- Environmental issue
- Great Pacific garbage patch
- Hemeroby
- Holocene extinction
- Human overpopulation
- Human timeline
- Human–wildlife conflict
- Life timeline
- Nature timeline
- Planetary boundaries
- Sustainability
- *The Sixth Extinction: An Unnatural History*

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- The Garden of Our Neglect: How Humans Shape the Evolution of Other Species July 5, 2012 Scientific American
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5 External links

- The Sixth Extinction on YouTube (PBS Digital Studios, November 17, 2014)
- Human activities that harm the Environment (Energy Physics)
- www.worldometers.info
- Equation: Human Impact on Climate Change (2017) & Yale University

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6.1 Text

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