بسم الله الرحمن الرحیم

دوره آموزش تخصصی ارزیابی اثرات زیست محیطی EIA
بسته آموزشی دوم
شناخت وضعیت محیط زیست موجود
(محیط فیزیکو شیمیایی)

موضوع آموزش : شناخت وضعیت موجود محیط فیزیکو شیمیایی

هدف از موضوع آموزش : آشنائی دانشپذیران با نحوه مستندسازی وضعیت موجود محیط فیزیکو شیمیایی، شامل شناخت پارامترهای اقلیم ، هوا ، صدا وارتعاش ، منابع آب و موقعیت آنها ، کیفیت آب ، زمین شناسی ـ تکتونیک و لرزه خیزی ، خاک و توپوگرافی مواد زائد جامد

جزوه درسی شناخت وضعیت موجود محیط فیزیکو شیمیایی

تعریف اقلیم

ریشه کلمه آب وهواکه درزبان عربی اقلیم گفته می شودکلمه یونانی کلیما (Klima) است که تقریبا درتمام زبانها ازهمین ریشه اقتباس شده است.

درلغت نامه دهخدا اقلیم به معنی خمیدگی ؛ انحنا و انحراف واصطلاحا به معنی تمایل وانحراف ناحیه ای اززمین نسبت به آفتاب توضیح داده شده است، درفرهنگ عمید نیز اقلیم کلمه ایست یونانی به معنی مملکت، کشور، ناحیه و قطعه ای است ازعالم که ازلحاظ آب و هوا و سایراوضاع و احوال طبیعی ازمنطقه وقطعه دیگرجداشده باشد،پیشینیان کلیه خشکی های عالم را به هفت قسمت تقسیم نموده وهرقسمت رااقلیم نامیده اند. کلمه شهر در زمان فارسی همان اقلیم را می رساند و اصطلاحاتی مانند هفت شهر و هفت اقلیم در ادبیات ما متاثر از طبقه بندی اقلیمی یونانیها می باشد.

درحقیقت اقلیم حالت متوسط کمیت های مشخص کننده وضع هواصرف نظرازلحظه وقوع آنهاست وبه عبارت دیگراقلیم تابع مکان است ولی به زمان بستگی ندارد. برطبق فرهنگ هواشناسی بین المللی هرگاه ازاقلیم یک ناحیه سخن گفته می شودمنظورمجموعه شرایط جوی درمنطقه است که تغییرشرایط جوی مشخصه هرناحیه همراه با تغییرات زمانی، اقلیم آن ناحیه راتشکیل می دهد.

لزوم استفاده از داده های اقلیمی

بسیاری از طرحها و حتی برخی از سازه ها بر اساس معیارهای هوا شناسی و برخی دیگر بر مبنای معیارهای اقلیم شناسی طراحی میشوند. مثلاً احداث یک سد مخزنی برای ذخیره آب را در نظر بگیرید. حجم مخزن باید طوری باشد که رواناب سالانه را در خود جای دهد. بنابراین طراحی آن باید بر اساس مقدار آبی باشد که معمولاً هر سال در رودخانه جاری میشود. لذا این حجم بر اساس یک معیار آب و هوایی یا اقلیمی تعیین می گردد. گرچه حجم آب سالانه میتواند متغیر باشد اما آنچه در طراحی حجم مخزن مهم است متوسط مقدار آبی است که در درازمدت در عمر اقتصادی سد میتوان در هر سال انتظار آن را داشت.

اما مثلاً طراحی سرریز اضطراری سد باید بر اساس حداکثر دبی های لحظه ای که در اثر ریزش بارانهای شدید اتفاق می افتد صورت گیرد. بنابراین؛ معیار طراحی برای سرریز ؛ بارشهایی است که ممکن است به دلیل وضعیت هوا در یک زمان خاص اتفاق افتد. چنین بارانی را نمیتوان یک عنصر اقلیمی دانست بلکه یک پارامتر هواشناسی می باشد. از این جهت یک نفر متخضض هیدرولوژی هم باید از وضعیت هواشناسی منطقه و هم تا اندازه ای از وضعیت اقلیمی آن منطقه اطلاعات داشته باشد.

طبقه بندی اقلیمی

منطقه‌ای از سطح زمین که اثرات ترکیب شده فاکتورهای اقلیمی بر آن ، موجب برقراری شرایط اقلیمی نسبتا همگنی می‌گردند، یعنی یک نوع اقلیم ، اصطلاحا منطقه اقلیمی نامیده می‌شود. بطور کلی یک سیستم طبقه بندی اقلیمی ؛ مجموعه قواعدی است که به کار گرفتن آنها مناطقی را که از نقطه نظرهایی شباهت دارند و

دارای ویژگیهای مشترکی هستند را از دیگر مناطق مجزا می کند و در یک طبقه قرار می دهد. در طبقه بندی اقلیمی دو مسئله را باید مد نظر داشت:

۱- تعیین معیارهای لازم جهت طبقه بندی

۲- تعیین مرز بین دو گروه یا دو ناحیه آب و هوایی

اولین طبقه بندی اقلیمی توسط یونانیان انجام شده که با استفاده از مدارهای مهم از قبیل استوا ؛ راس السرطان و مدار قطبی که کره زمین را به سه منطقه آب و هوایی یعنی استوایی ؛ معتدله و قطبی تقسیم نمودند. جغرافیدانان اسلامی به پیروی از دانشمندان یونانی اقلیم جهان آن روزگار را به هفت اقلیم تقسیم بندی نمودند.

ضرایب و فرمولهای اقلیمی:

فرمولهای اقلیمی توابعی هستند که در آنها دو یا چند عنصر اقلیمی بکار رفته و بر حسب مقادیر عددی که برای یک منطقه بدست می آید نوع آب و هوای آن منطقه مشخص می شود.

مقادیر بدست آمده را ضرایب اقلیمی گویند. در جدول صفحه بعد نام محققان و هدف و اساس تقسیم بندی آنها آورده شده است.

نام محقق	سال	هدف تقسیم بندی	اساس تقسیم بندی
دمارتن	1909	ناحیه بندی سطح زمین	نه گروه اصلی براساس دما وبارش
پنک	1910	نواحی آب وهوایی	سه ناحیه اصلی براساس تفاوت درنوع فرسایش وهوازدگی
کوپن	1918	اقلیم جهان	براساس دما وبارش ماهانه وسالانه
واهل	1919	نواحی آب وهوایی وارتباط باپوشش گیاهی	پنج گروه آب وهوایی براساس سردترین وگرمترین ماههای سال
پاسارژ	1924	رابطه بین پوشش گیاهی وآب وهوا	پنج ناحیه اصلی براساس پراکندگی پوشش گیاهی
فدروف	1927	استفاده ازآماروزانه	براساس وضع بادغالب،دما،بارش وویژگیهای دیگر
میلر	1931	ناحیه بندی آب وهوایی	پنج ناحیه اصلی براساس دما وبااستفاده ازپوشش گیاهی
فیلیپسون	1933	تقسیم بندی آب وهوایی	پنج منطقه اصلی براساس سردترین وگرمترین ماههای سال وبارش
بلیر	1942	توصیف آب وهوای جهان	پنج کمربنداصلی آب وهوایی براساس دما،بارش وپوشش گیاهی
گورزینسکی	1945	سیستم دیسیمال	پنج کمربندآب وهوایی وتاکیدبرآب وهوای قاره ای واقیانوسی
فون وسیمن	1948	پراکندگی آب وهوایی درارتباط باپوشش گیاهی	بااستفاده ازروش کوپن وبراساس دماوبارش وتقسیم آن به واحدهای کوچکتر
تورنت وایت	1948	تععین آب وهوابراساس نیازآب منطقه	بااستفاده ازتبخیروتعرق بالقوه وواقعی
کرتیزبرگ	1950	رابطه آب وهواباپوشش گیاهی	تقسیم بندی براساس تعدادماههای مرطوب وتعدادروزهای پوشیده ازبرف
گایگرپول	1953	نقشه تیپ های آب وهوایی	تقسیم بندی کوپن باکمی تغییرات
تراورتا	1954	توصیف مرتب آب	تقسیم بندی کوپن باکمی تغییرات
برازول	1954	کمربندراحتی انسان	وضعیت هرماه ازنظرراحتی انسان بااستفاده ازدمای خشک وتر
آمبرژه	1955	رابطه آب وهواباشرایط زیست شناختی	تعیین دونوع آب وهوای بیابانی وغیربیابانی براساس نوسان سالانه دما ودوام تابش روزانه خورشید
باکنولزوگوسن	1957	آب وهوای بیولوژیک	تعیین ۱۲ناحیه آب وهوایی براساس ضریب خشکی دمای سردترین ماه وآماربرف ویخبندان
بودیکو	1958	پراکندگی انرژی درارتباط بابیلان آب	تعیین نواحی براساس نسبت انرژی تابشی برای انرژی لازم جهت تبخیرورطوبت
پونتام	1960	تععین شرایط نواحی ساحلی جهان	براساس میانگین دمای حداقلها،میانگین دمای حداکثرها وفراوانی ماهانه وسالانه بارش
پگی	1961	نواحی آب وهوایی	با استفاده ازیک نمودارمثلثی شکل وبراساس آماردما وبارش سالانه
ترول	1963	رابطه آب وهوا وسیستمهای حیات	براساس نوسان روزانه وسالانه دما ونسبت ماههای مرطوب به ماههای خشک
پاپاداکیس	1966	توان کشاورزی نواحی آب وهوایی	براساس پتانسیل هرنقطه ازنظرتولیدمحصولات کشاورزی
کارتر	1966	تعیین محیطهای زیستی	سیستم تورنت وایت با کمی تغییرات
ترجونگ	1968	تاثیرآب وهوا برراحتی انسان	براساس درجه حرارت

ضریب خشکی دومارتن (De Martonne):

در این تحقیق به شرح فرمول ضریب خشکی دومارتن می پردازیم:
دومارتن معتقداست که مقدارتبخیر با میانگین درجه حرارت سالانه متناسب است و بااستفاده ازمحاسبه ضریب خشکی که ازرابطه $I = P / (T+10)$ محاسبه می شود می توان اقلیمهای مختلف رامشخص نمود. لازم به ذکراست که این روش مورداستقبال دانشمندان جغرافی قرارگرفت ولی زیست شناسان استقبال چندانی از آن نکردند.

$$I = P /(T+10)$$

I= ضـــریب خـشکی
P= بارندگی سالانه(mm)
T= دمای سالانه (C)

بر اساس فرمول دومارتن ۶ نوع آب و هوا به شرح زیر طبقه بندی شده اند:

نوع اقلیم	خشک	نیمه خشک	مدیترانه ای	نیمه مرطوب	مرطوب	بسیارمرطوب
ضریب خشکی	I<10	۱۹,۹10<I<	۲۳,۹20<I<	24<I<27.9	28<I<34.9	I>35

برای آنکه تصویری ار چگونگی تغییرات ضریب خشکی دومارتن در ایران در ذهن داشته باشید بر اساس داده های موجود ضرایب خشکی شهرهایی مانند بندرانزلی ؛ رامسر؛ سنندج و آبادان به ترتیب ۶۸(خیلی مرطوب) ؛ ۳۰ (مرطوب)؛ ۲۰ (مدیترانه ای) و ۵ (خشک) بدست می آیند.
و یا باتوجه به اینکه بارندگی سالانه شهربوشهر ۲۶۹/۱ میلی مترومتوسط دمای سالانه آن ۲۴/۵ درجه سانتیگراداست،ضریب خشکی شهربوشهر ۷/۸ است بنابراین اقلیم بوشهرخشک می باشد.

$$I=269.1/(24.5+10)=7.8$$

اگر دمای متوسط هوا در یک منطقه بسیار سرد مثلا ۱۰- درجه سلسیوس باشد ضریب خشکی دومارتن بسمت بینهایت میل میکند که نشان دهنده یک منطقه بسیار مرطوب است حال آنکه ممکن است آن منطقه چنین شرایطی نداشته باشد. بنابراین همانند سایر فرمولها بر روش دومارتن نیز ایرادهایی وارد است. بهمین دلیل اگر متوسط دمای هوا از صفر کمتر باشد معمولا از فرمول دومارتن استفاده نمیشود. در عمل مختصات هر نقطه از نظر دما و بارندگی روی یک دستگاه مختصات که خطوط مربوط به مرزهای اقلیمی بر اساس فرمولهای دومارتن روی آن رسم شده است آورده میشود تا مشخص گردد که یک منطقه در کدامیک از دامنه های آب و هوایی قرار دارد.چنین دستگاه مختصاتی را اقلیم نمای دومارتن گویند. مثلا (مطابق نمودار) چنانچه مختصات یک حوضه آبریز از نظر دمای سالانه ۲۰ درجه سلسیوس و بارندگی سالانه ۴۰۰ میلیمتر باشد مختصات این نقطه در دامنه خشک قرار میگیرد.

Air Pollution

History

The primary air pollutants found in most urban areas are carbon monoxide, nitrogen oxides, sulfur oxides, hydrocarbons, and particulate matter (both solid and liquid). These pollutants are dispersed throughout the world's atmosphere in concentrations high enough to gradually cause serious health problems. Serious health problems can occur quickly when air pollutants are concentrated, such as when massive injections of sulfur dioxide and suspended particulate matter are emitted by a large volcanic eruption.

Sources of Pollutants

The two main sources of pollutants in urban areas are transportation (predominantly automobiles) and fuel combustion in stationary sources, including residential, commercial, and industrial heating and cooling and coal-burning power plants. Motor vehicles produce high levels of carbon monoxides (CO) and a major source of hydrocarbons (HC) and nitrogen oxides (NOx). Whereas, fuel combustion in stationary sources is the dominant source of sulfur dioxide (SO2).

Carbon Dioxide

Carbon dioxide (CO_2) is one of the major pollutants in the atmosphere. Major sources of CO_2 are fossil fuels burning and deforestation. "The concentrations of CO_2 in the air around 1860 before the effects of industrialization were felt, is assumed to have been about 290 parts per million (ppm). In the hundred years and more since then, the concentration has increased by about 30 to 35 ppm that is by 10 percent".

CO_2 is a good transmitter of sunlight, but partially restricts infrared radiation going back from the earth into space. This produces the so-called greenhouse effect that prevents a drastic cooling of the Earth during the night. Increasing the amount of CO_2 in the atmosphere reinforces this effect and is expected to result in a warming of the Earth's surface. Currently carbon dioxide is responsible for 57% of the global warming trend. Nitrogen oxides contribute most of the atmospheric contaminants.

$N0_X$ - Nitric oxide (NO) and Nitrogen dioxide (NO2)

- Natural component of the Earth's atmosphere.
- Important in the formation of both acid precipitation and photochemical smog (ozone), and causes nitrogen loading.
- Comes from the burning of biomass and fossil fuels.
- 30 to 50 million tons per year from human activities, and natural 10 to 20 million tons per year.
- Average residence time in the atmosphere is days.
- Has a role in reducing stratospheric ozone.

N_2O - Nitrous oxide

- Natural component of the Earth's atmosphere.
- Important in the greenhouse effect and causes nitrogen loading.
- Human inputs 6 million tons per year, and 19 million tons per year by nature.
- Residence time in the atmosphere about 170 years.
- 1700 (285 parts per billion), 1990 (310 parts per billion), 2030 (340 parts per billion).
- Comes from nitrogen based fertilizers, deforestation, and biomass burning.

Sulfur and chlorofluorocarbons (CFCs)
Sulfur dioxide is produced by combustion of sulfur-containing fuels, such as coal and fuel oils. Also,in the process of producing sulfuric acid and in metallurgical process involving ores that contain sulfur. Sulfur oxides can injure man, plants and materials. At sufficiently high concentrations, sulfur dioxide irritates the upper respiratory tract of human beings because potential effect of sulfur dioxide is to make breathing more difficult by causing the finer air tubes of the lung to constrict. "Power plants and factories emit 90% to 95% of the sulfur dioxide and 57% of the nitrogen oxides in the United States. Almost 60% of the SO_2 emissions are released by tall smoke stakes, enabling the emissions to travel long distances". As emissions of sulfur dioxide and nitric oxide from stationary sources are transported long distances by winds, they form secondary pollutants such as nitrogen dioxide, nitric acid vapor, and droplets containing solutions of sulfuric acid, sulfate, and nitrate salts. These chemicals descend to the earth's surface in wet form as rain or snow and in dry form as a gases fog, dew, or solid particles. This is known as acid deposition or acid rain.

Chlorofluorocarbons (CFCs)
CFCs are lowering the average concentration of ozone in the stratosphere. "Since 1978 the use of CFCs in aerosol cans has been banned in the United States, Canada, and most Scandinavian countries. Aerosols are still the largest use, accounting for 25% of global CFC use". (Miller 448) Spray cans, discarded or leaking refrigeration and air conditioning equipment, and the burning plastic foam products release the CFCs into the atmosphere. Depending on the type, CFCs stay in the atmosphere from 22 to 111 years. Chlorofluorocarbons move up to the stratosphere gradually over several decades. Under high energy ultra violet (UV) radiation, they break down and release chlorine atoms, which speed up the breakdown of ozone (O_3) into oxygen gas (O_2).

Chlorofluorocarbons, also known as Freons, are greenhouse gases that contribute to global warming. Photochemical air pollution is commonly referred to as "smog". Smog, a contraction of the words smoke and fog, has been caused throughout recorded history by water condensing on smoke particles, usually from burning coal. With the introduction of petroleum to replace coal economies in countries, photochemical smog has become predominant in many cities, which are located in sunny, warm, and dry climates with many motor vehicles. The worst episodes of photochemical smog tend to occur in summer.

Smog

Photochemical smog is also appearing in regions of the tropics and subtropics where savanna grasses are periodically burned. Smog's unpleasant properties result from the irradiation by sunlight of hydrocarbons caused primarily by unburned gasoline emitted by automobiles and other combustion sources. The products of photochemical reactions includes organic particles, ozone, aldehydes, ketones, peroxyacetyl nitrate, organic acids, and other oxidants. Ozone is a gas created by nitrogen dioxide or nitric oxide when exposed to sunlight. Ozone causes eye irritation, impaired lung function, and damage to trees and crops. Another form of smog is called industrial smog.

Effects

The major concern with air pollution relates to its effects on humans. Since most people spend most of their time indoors, there has been increased interest in air-pollution concentrations in homes, workplaces, and shopping areas. Much of the early information on health effects came from occupational health studies completed prior to the implementation of general air-quality standards.

Damage to vegetation by air pollution is of many kinds. Sulfur dioxide may damage field crops such as alfalfa and trees such as pines, especially during the growing season. Both hydrogen fluoride (HF) and nitrogen dioxide (NO_2) in high concentrations have been shown to be harmful to citrus trees and ornamental plants, which are of economic, importance in central Florida. Ozone and ethylene are other contaminants that cause damage to certain kinds of vegetation.

Air pollution can affect the dynamics of the atmosphere through changes in long wave and shortwave radiation processes. Particles can absorb or reflect incoming short-wave solar radiation, keeping it from the Earth's surface during the day. Greenhouse gases can absorb long-wave radiation emitted by the Earth's surface and atmosphere.

Carbon dioxide, methane, fluorocarbons, nitrous oxides, ozone, and water vapor are important greenhouse gases. These represent a class of gases that selectively absorb long-wave radiation. This effect warms the temperature of the Earth's atmosphere and surface higher than would be found in the absence of an atmosphere (the greenhouse effect).

Chemistry

Air pollution can be divided into primary and secondary compounds, where primary pollutants are emitted directly from sources (for example, carbon monoxide, sulfur dioxide) and secondary pollutants are produced by chemical reactions between other pollutants and atmospheric gases and particles (for example, sulfates, ozone). Most of the chemical transformations are best described as oxidation processes. In many cases these secondary pollutants can have significant environmental effects, such as acid rain and smog.

Smog is the best-known example of secondary pollutants formed by photochemical processes, as a result of primary emissions of nitric oxide (NO) and reactive hydrocarbons from anthropogenic sources such as transportation and industry as well as natural sources. Energy from the Sun causes the formation of nitrogen dioxide, ozone (O_3), and peroxyacetalnitrate, which cause eye irritation and plant damage.

Pollutants

There are many substances in the air which may impair the health of plants and animals (including humans), or reduce visibility. These arise both from natural processes and human activity. Substances not naturally found in the air or at greater concentrations or in different locations from usual are referred to as 'pollutants'.

Pollutants can be classified as either primary or secondary. Primary pollutants are substances directly emitted from a process, such as ash from a volcanic eruption or the carbon monoxide gas from a motor vehicle exhaust.

Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. An important example of a secondary pollutant is ground level ozone - one of the many secondary pollutants that make up photochemical smog.

Note that some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

Major primary pollutants produced by human activity include:

- Sulfur oxides (SO_x) especially sulfur dioxide are emitted from burning of coal and oil.

- Nitrogen oxides (NO_x) especially nitrogen dioxide are emitted from high temperature combustion. Can be seen as the brown haze dome above or plume downwind of cities.
- Carbon monoxide is colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.
- Carbon dioxide (CO_2), a greenhouse gas emitted from combustion and respiration.
- Volatile organic compounds (VOC), such as hydrocarbon fuel vapors and solvents.
- Particulate matter (PM), measured as smoke and dust. PM_{10} is the fraction of suspended particles 10 micrometers in diameter and smaller that will enter the nasal cavity. $PM_{2.5}$ has a maximum particle size of 2.5 µm and will enter the bronchies and lungs.
- Toxic metals, such as lead, cadmium and copper.
- Chlorofluorocarbons (CFCs), harmful to the ozone layer emitted from products currently banned from use.
- Ammonia (NH_3) emitted from agricultural processes.
- Odors, such as from garbage, sewage, and industrial processes
- Radioactive pollutants produced by nuclear explosions and war explosives, and natural processes such as radon.

Secondary pollutants include:

- Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog, such as nitrogen dioxide.
- Ground level ozone (O_3) formed from NOx and VOCs.
- Peroxyacetyl nitrate (PAN) similarly formed from NOx and VOCs.

Minor air pollutants include:

- A large number of minor hazardous air pollutants. Some of these are regulated in USA under the Clean Air Act and in Europe under the Air Framework Directive.
- A variety of persistent organic pollutants, which can attach to particulate matter.

Sources of air pollution

Anthropogenic sources (human activity) related to burning different kinds of fuel

- "Stationary Sources" as smoke stacks of power plants, manufacturing facilities, municipal waste incinerators
- "Mobile Sources" as motor vehicles, aircraft etc.
- Combustion-fired power plants
- Controlled burn practices used in agriculture and forestry management
- Motor vehicles generating air pollution emissions.
- Marine vessels, such as container ships or cruise ships, and related port air pollution.
- Burning wood, fireplaces, stoves, furnaces and incinerators

Other anthropogenic sources

- Oil refining, power plant operation and industrial activity in general.
- Chemicals, dust and crop waste burning in farming, (see Dust Bowl).
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents.
- Waste deposition in landfills, which generate methane.
- Military uses, such as nuclear weapons, toxic gases, germ warfare and rocketry.

Natural sources

- Dust from natural sources, usually large areas of land with little or no vegetation.
- Methane, emitted by the digestion of food by animals, for example cattle.
- Radon gas from radioactive decay within the Earth's crust.
- Smoke and carbon monoxide from wildfires.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

Indoor air quality (IAQ)

The lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon (Rn) gas, a carcinogen, is exuded from the Earth in certain locations and trapped inside houses. Researchers have found that radon gas is responsible for over 1,800 deaths annually in the United Kingdom.[*citation needed*] Building materials including carpeting and plywood emit formaldehyde (H_2CO) gas. Paint and solvents give off volatile organic compounds (VOCs) as they dry. Lead paint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners, incense, and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation.

Carbon monoxide (CO) poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors. 56,000 Americans died from CO in the period 1979-1988.[*citation needed*] Chronic carbon monoxide poisoning can result even from poorly adjusted pilot lights. Traps are built into all domestic plumbing to keep sewer gas, hydrogen sulfide, out of interiors. Clothing emits tetrachloroethylene, or other dry cleaning fluids, for days after dry cleaning.

Though its use has now been banned in many countries, the extensive use of asbestos in industrial and domestic environments in the past has left a potentially very dangerous material in many localities. Asbestosis is a chronic inflammatory medical condition affecting the tissue of the lungs. It occurs after long-term, heavy exposure to asbestos from asbestos-containing materials in structures. Sufferers have severe dyspnea (shortness of breath) and are at an increased risk regarding several different types of lung cancer. As clear explanations are not always stressed in non-technical literature, care should be taken to distinguish between several forms of relevant diseases. According to the World Health Organisation (WHO), these may defined as; asbestosis, *lung cancer*, and *mesothelioma* (generally a very rare form of cancer, when more widespread it is almost always associated with prolonged exposure to asbestos).

Biological sources of air pollution are also found indoors, as gases and airborne particulates. Pets produce dander, people produce dust from minute skin flakes and decomposed hair, dust mites in bedding, carpeting and furniture produce enzymes and micron-sized fecal droppings, inhabitants emit methane, mold forms in walls and generates mycotoxins and spores, air conditioning systems can incubate Legionnaires' disease and mold, and houseplants, soil and surrounding gardens can produce pollen, dust, and mold. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature.

Water resources

Water resources are sources of water that are useful or potentially useful to humans. Uses of water include agricultural, industrial, household, recreational and environmental activities. Virtually all of these human uses require fresh water. 97.5% of water on the Earth is salt water, leaving only 2.5% as fresh water of which over two thirds is frozen in glaciers and polar ice caps. The remaining unfrozen freshwater is mainly found as groundwater, with only a small fraction present above ground or in the air.[1] Fresh water is a renewable resource, yet the world's supply of clean, fresh water is steadily decreasing. Water demand already exceeds supply in many parts of the world, and as world population continues to rise at an unprecedented rate, many more areas are expected to experience this imbalance in the near future.[*citation needed*] The framework for allocating water resources to water users (where such a framework exists) is known as water rights.

Surface water

Surface water is water in a river, lake or fresh water wetland Surface water is naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, and sub-surface seepage.

Although the only natural input to any surface water system is precipitation within its watershed, the total quantity of water in that system at any given time is also dependent on many other factors. These factors include storage capacity in lakes, wetlands and artificial reservoirs, the permeability of the soil beneath these storage bodies, the runoff characteristics of the land in the watershed, the timing of the precipitation and local evaporation rates. All of these factors also affect the proportions of water lost.

Human activities can have a large impact on these factors. Humans often increase storage capacity by constructing reservoirs and decrease it by draining wetlands. Humans often increase runoff quantities and velocities by paving areas and channelizing stream flow.

The total quantity of water available at any given time is an important consideration. Some human water users have an intermittent need for water. For example, many farms require large quantities of water in the spring, and no water at all in the winter. To supply such a farm with water, a surface water system may require a large storage capacity to collect water throughout the year and release it in a short period of time. Other users have a continuous need for water, such as a power plant that requires water for cooling. To supply such a power plant with water, a surface water system only needs enough storage capacity to fill in when average stream flow is below the power plant's need.

Sub-surface water

Sub-surface water, or groundwater, is fresh water located in the pore space of soil and rocks. It is also water that is flowing within aquifers below the water table. Sometimes it is useful to make a distinction between sub-surface water that is closely associated with surface water and deep sub-surface water in an aquifer (sometimes called "fossil water").

Sub-surface water can be thought of in the same terms as surface water: inputs, outputs and storage. The critical difference is that due to its slow rate of turnover, sub-surface water storage is generally much larger compared to inputs than it is for surface water. This difference makes it easy for humans to use sub-surface water unsustainably for a long time without severe consequences. Nevertheless, over the long term the average rate of seepage above a sub-surface water source is the upper bound for average consumption of water from that source.

The natural input to sub-surface water is seepage from surface water. The natural outputs from sub-surface water are springs and seepage to the oceans.

If the surface water source is also subject to substantial evaporation, a sub-surface water source may become saline. This situation can occur naturally under endorheic bodies of water, or artificially under irrigated farmland. In coastal areas, human use of a sub-surface water source may cause the direction of seepage to ocean to reverse which can also cause soil salinization. Humans can also cause sub-surface water to be "lost" (i.e. become unusable) through pollution. Humans can increase the input to a sub-surface water source by building reservoirs or detention ponds.

Desalination

Desalination is an artificial process by which saline water (generally sea water) is converted to fresh water. The most common desalination processes are distillation and reverse osmosis. Desalination is currently expensive compared to most alternative sources of water, and only a very small fraction of total human use is satisfied by desalination. It is only economically practical for high-valued uses (such as household and industrial uses) in arid areas. The most extensive use is in the Persian Gulf.

Frozen water

Several schemes have been proposed to make use of icebergs as a water source, however to date this has only been done for novelty purposes. Glacier runoff is considered to be surface water.

Uses of fresh water

Uses of fresh water can be categorized as consumptive and non-consumptive (sometimes called "renewable"). A use of water is consumptive if that water is not immediately available for another use. Losses to sub-surface seepage and evaporation are considered consumptive, as is water incorporated into a product (such as farm produce). Water that can be treated and returned as surface water, such as sewage, is generally considered non-consumptive if that water can be put to additional use.

Agricultural

It is estimated that 69% of world-wide water use is for irrigation, with 15-35% of irrigation withdrawals being unsustainable

In some areas of the world irrigation is necessary to grow any crop at all, in other areas it permits more profitable crops to be grown or enhances crop yield. Various irrigation methods involve different trade-offs between crop yield, water consumption and capital cost of equipment and structures. Irrigation methods such as most furrow and overhead sprinkler irrigation are usually less expensive but also less efficient, because much of the water evaporates or runs off. More efficient irrigation methods include drip or trickle irrigation, surge irrigation, and some types of sprinkler systems where the sprinklers are operated near ground level. These types of systems, while more expensive, can minimize runoff and evaporation. Any system that is improperly managed can be wasteful. Another trade-off that is often insufficiently considered is salinization of sub-surface water.

Aquaculture is a small but growing agricultural use of water. Freshwater commercial fisheries may also be considered as agricultural uses of water, but have generally been assigned a lower priority than irrigation (see Aral Sea and Pyramid Lake).

Industrial

It is estimated that 15% of world-wide water use is industrial. Major industrial users include power plants, which use water for cooling or as a power source (i.e. hydroelectric plants), ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent.

The portion of industrial water usage that is consumptive varies widely, but as a whole is lower than agricultural use.

Household

It is estimated that 15% of world-wide water use is for household purposes. These include drinking water, bathing, cooking, sanitation, and gardening. Basic household water requirements have been estimated by Peter Gleick at around 50 liters per person per day, excluding water for gardens.

Recreation

Recreational water use is usually a very small but growing percentage of total water use. Recreational water use is mostly tied to reservoirs. If a reservoir is kept fuller than it would otherwise be for recreation, then the water retained could be categorized as recreational usage. Release of water from a few reservoirs is also timed to enhance whitewater boating, which also could be considered a recreational usage. Other examples are anglers, water skiers, nature enthusiasts and swimmers.

Recreational usage is usually non-consumptive. Golf courses are often targeted as using excessive amounts of water, especially in drier regions. It is, however, unclear whether recreational irrigation (which would include private gardens) has a noticeable effect on water resources. This is largely due to the unavailability of reliable data. Some governments, including the Californian Government, have labelled golf course usage as agricultural in order to deflect environmentalists' charges of wasting water. However, using the above figures as a basis, the actual statistical effect of this reassignment is close to zero.

Environmental

Explicit environmental water use is also a very small but growing percentage of total water use. Environmental water usage includes artificial wetlands, artificial lakes intended to create wildlife habitat, fish ladders around dams, and water releases from reservoirs timed to help fish spawn.

Like recreational usage, environmental usage is non-consumptive but may reduce the availability of water for other users at specific times and places. For example, water release from a reservoir to help fish spawn may not be available to farms upstream.

Pollution and water protection

Water pollution is one of the main concerns of the world today. The governments of many countries have striven to find solutions to reduce this problem. Many pollutants threaten water supplies, but the most widespread, especially in underdeveloped countries, is the discharge of raw sewage into natural waters; this method of sewage disposal is the most common method in underdeveloped countries, but also is prevalent in quasi-developed countries such as China, India and Iran.

Sewage, sludge, garbage, and even toxic pollutants are all dumped into the water. Even if sewage is treated, problems still arise. Treated sewage forms sludge, which may be placed in landfills, spread out on land, incinerated or dumped at sea. In addition to sewage, non-point source pollution such as agricultural runoff is a significant source of pollution in some parts of the world, along with urban storm water runoff and chemical wastes dumped by industries and governments.

Water quality

Water quality is the physical, chemical and biological characteristics of water in relationship to a set of standards. In the United States, Water Quality Standards are created by state agencies for different types of water bodies and water body locations per desired uses. The primary uses considered for such characterization are parameters which relate to drinking water, safety of human contact, and for health of ecosystems. The methods of hydrometric are used to quantify water characteristics.

In the setting of standards, agencies make political and technical/scientific decisions about how the water will be used.[2] In the case of natural water bodies, they also make some reasonable estimate of pristine conditions. Different uses raise different concerns and therefore different standards are considered. Natural water bodies will vary in response to environmental conditions. Environmental scientists are working to understand the functioning of these systems, which determines sources and fates of contaminants. Environmental lawyers and policy makers are working to define water laws that designate the fore mentioned uses and natural conditions.

Human Consumption

Contaminants that may be in untreated water include microorganisms such as viruses and bacteria; inorganic contaminants such as salts and metals; pesticides and herbicides; organic chemical contaminants from industrial processes and petroleum use; and radioactive contaminants. Water quality depends on the local geology and ecosystem, as well as human uses such as sewage dispersion, industrial pollution, use of water bodies as a heat sink, and overuse (which may lower the level of the water).

In the United States, the U.S. Environmental Protection Agency (EPA) limits the amounts of certain contaminants in tap water provided by public water systems. The Safe Drinking Water Act authorizes EPA to issue two types of standards: *primary standards* regulate substances that potentially affect human health, and *secondary standards* prescribe aesthetic qualities, those that affect taste, odor, or appearance. The U.S. Food and Drug Administration (FDA) regulations establish limits for contaminants in bottled water that must provide the same protection for public health. Drinking water, including bottled water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of these contaminants does not necessarily indicate that the water poses a health risk.

Some people use water purification technology to remove contaminants from the municipal water supply they get in their homes, or from local pumps or bodies of water. For people who get water from a local stream, lake, or aquifer (well), their drinking water is not filtered by the local government.

Environmental Water Quality

Environmental water quality, also called **ambient water quality**, pertains to water bodies such as lakes, rivers, and oceans. Ambient water quality standards vary significantly due to different environmental conditions, ecosystems, and intended human uses. Toxic substances and high populations of certain microorganisms can present a health hazard for non-drinking purposes such as irrigation, swimming, fishing, rafting, boating, and industrial uses. These conditions may also affect wildlife which use the water for drinking or as a habitat. Modern water quality laws general specify protection of fishable/swimmable use and antidegradation of current conditions.

There is some desire among the public to return water bodies to pristine, or pre-industrial conditions. Current environmental laws focus of the designation of uses and therefore allow for some water contamination as long as the particular type of contamination is not harmful to the designated uses. Given the landscape changes in the watersheds of many freshwater bodies, returning to pristine conditions would be a significant challenge. In these cases, environmental scientists focus on achieving goals for maintaining populations of endangered species and protecting human health.

Measurement

The complexity of water quality as a subject is reflected in the many types of measurements of water quality indicators. Some of the simple measurements listed below can be made on-site (temperature, pH, dissolved oxygen, conductivity), in direct contact with the water source in question. More complex measurements that must be made in a lab setting require a water sample to be collected, preserved, and analyzed at another location. Making these complex measurements can be expensive. Because direct measurements of water quality can be expensive, ongoing monitoring programs are typically conducted by government agencies. However, there are local volunteer programs and resources available for some general assessment. Tools available to the general public are on-site test kits commonly used for home fish tanks and biological assessments.

The following is a list of indicators often measured by situational category:

Drinking Water

- Alkalinity
- Color of water
- pH
- Taste and odor (geosmin, 2-methylisoborneol (MIB), etc)
- Dissolved metals and salts (sodium, chloride, potassium, calcium, manganese, magnesium)
- Microorganisms such as fecal coliform bacteria (*Escherichia coli*), Cryptosporidium, and Giardia lamblia
- Dissolved metals and metalloids (lead, mercury, arsenic, etc.)
- Dissolved organics: colored dissolved organic matter (CDOM), dissolved organic carbon (DOC)
- Radon
- Heavy metals
- Pharmaceuticals
- Hormone analogs

Environmental

Chemical Assessment

- pH
- Conductivity (also see salinity)
- Dissolved Oxygen (DO)
- nitrate-N
- orthophosphates
- Chemical oxygen demand (COD)
- Biochemical oxygen demand (BOD)
- Pesticides

Physical Assessment

- Temperature
- Total suspended solids (TSS)
- Turbidity

Biological Assessment

Biological monitoring metrics have been developed in many places, and one widely used measure is the presence and abundance of members of the insect orders Ephemeroptera, Plecoptera and Trichoptera. (Common names are, respectively, Mayfly, Stonefly and Caddisfly.) EPT indexes will naturally vary from region to region, but generally, within a region, the greater the number of taxa from these orders, the better the water quality. EPA and other organizations in the United States offer guidance on developing a monitoring program and identifying members of these and other aquatic insect orders.

Individuals interested in monitoring water quality who cannot afford or manage lab scale analysis can also use biological indicators to get a general reading of water quality. One example is the IOWATER volunteer water monitoring program, which includes a benthic macroinvertebrate indicator key.

Soil

Soil is the naturally occurring, unconsolidated or loose covering on the Earth's surface. Soil is made up of broken rock particles that have been altered by chemical and environmental conditions, affected by processes such as weathering and erosion. Soil is different from its parent rock(s) source(s), altered by interactions between the lithosphere, hydrosphere, atmosphere, and the biosphere. It is a mixture of mineral and organic constituents that are in solid, gaseous and aqueous states. Soil particles pack loosely, forming a soil structure filled with pore spaces. These pores contain soil solution (liquid) and air (gas). Accordingly, soils are often treated as a three state system. Most soils have a density between 1 and 2, and weigh between 60 and 120 pounds per cubic foot. Soil is also known as earth: it is the substance from which our planet takes its name.

Characteristics

Soil color is the first impression one has when viewing soil. Striking colors and contrasting patterns are especially memorable. The Red River in Louisiana carries sediment eroded from extensive reddish soils like Port Silt Loam in Oklahoma. Soil color results from chemical and biological weathering. As the primary minerals in parent material weather, the elements combine into new and colorful compounds. Iron forms secondary minerals with a yellow or red color; organic matter decomposes into brown compounds; and manganese, sulfur and nitrogen can form black mineral deposits. Soil structure is the arrangement of soil particles into aggregates. These may have various shapes, sizes and degrees of development or expression. Soil texture refers to sand, silt and clay composition. Sand and silt are the product of physical weathering while soil is the product of chemical weathering. Soil content is particularly influential on soil behavior due to a high retention capacity for nutrients and water. The electrical receptivity of soil can affect the rate of galvanic corrosion of metallic structures in contact with it. Higher moister content or increased electrolyte concentration can lower the resistivity and thereby increase the rate of corrosion. Soil receptivity values typically range from about 2 to 1000 Ω·m, but more extreme values are not unusual.

Formation

Soil formation, or pedogenesis, is the combined effect of physical, chemical, biological, and anthropogenic processes on soil parent material resulting in the formation of soil horizons. Soil is always changing. The long periods over which change occurs and the multiple influences of change mean that simple soils are rare. While soil can achieve relative stability in properties for extended periods of time, the soil life cycle ultimately ends in soil conditions that leave it vulnerable to erosion. Little of the soil composition of the earth is older than Tertiary and most no older than Pleistocene. Despite the inevitability of soils retrogression and degradation, most soil cycles are long and productive. How the soil "life" cycle proceeds is influenced by at least five classic soil forming factors: regional climate, biotic potential, topography, parent material, and the passage of time. An example of soil development from bare rock occurs on recent lava flows in warm regions under heavy and very frequent rainfall. In such climates plants become established very quickly on basaltic lava, even though there is very little organic material. The plants are supported by the porous rock becoming filled with nutrient bearing water, for example carrying dissolved bird droppings or guano. The developing plant roots themselves gradually break up the porous lava and organic matter soon accumulates. But even before it does, the predominantly porous broken lava in which the plant roots grow can be considered a soil.

Organic matter

Most living things found in soils, including plants, insects, bacteria and fungi, are dependent on organic matter for nutrients and energy. Soils often have varying degrees of organic compounds in different states of decomposition. Many soils, including desert and rocky-gravel soils, have no or little organic matter; while soils, such as peat (Histosols), that are all organic matter are infertile.

Humus

Humus refers to organic matter that has decomposed to a point were it is resistant to further breakdown or alteration. Humus typically forms from plant residues like foliage, stems and roots. After death, these plant residues begin to decay, starting the formation of humus. Humus formation involves changes within the soil and plant residue, there is a reduction of water soluble constituents including cellulose and hemicellulose; as the residues are deposited and break down, lignin and lignin complexes accumulate within the soil; as microorganisms live and feed on the decaying plant matter, an increase in proteins occurs.

Lignin is resistant to breakdown and accumulates within the soil, it also chemically reacts with amino acids which add to its resistance to decomposition, including enzymatic decomposition by microbes. Fats and waxes from plant matter have some resistance to decomposition and persist in soils for a while. Proteins normally decompose readily but when bound to clay particles they become more resistant to decomposition, clay particles also absorb enzymes that would break down proteins, thus clay soils often have higher organic contents that persist longer than soils without clay. The addition of organic matter to clay soils, can render the organic matter and any added nutrients inaccessible to plants and microbes for many years, since they can bind strongly to the clay.

Humus formation is a processes dependent on the amount of plant material added each year and the type of base soil; both are effected by climate and the type of microorganisms present. Soils with humus can vary in nitrogen content but have 3 to 6 percent nitrogen typically; humus as a reserve of nitrogen and phosphorus, is a vital component effecting soil fertility. Humus also adsorbs water, acting as a moisture reserve, that plants can utilize; it also expands and shrinks between dry and wet states, providing pore spaces. Humus is less stable than other soil constituents, because it is effected by microbial decomposition, and over time its concentration decreases without the addition of new organic matter.

Climate and organics

The production and accumulation, or degradation, of organic matter and humus is greatly depended on climate conditions. Temperature and soil moisture are major factors in the formation or degradation of humus and the formation of organic soils. Soils high in organic matter tend to form under wet conditions and/or were there is enough precipitation to sustain thick vegetation.

In nature

Biogeography is the study of special variations in biological communities. Soils are restricting factor as to what plants can grow in which environments. Soil scientists survey soils in the hope of understanding controls as to what vegetation can and will grow in a particular location

Geologists also have a particular interest in the patterns of soil on the surface of the earth. Soil texture, color and chemistry often reflect the underlying geologic parent material and soil types often change at geologic unit boundaries. Buried paleosols mark previous land surfaces and record climatic conditions from previous eras. Geologists use this paleopedological record to understand the ecological relationships in past ecosystems. According to the theory of biorhexistasy, prolonged conditions conducive to forming deep, weathered soils result in increasing ocean salinity and the formation of limestone.

Geologists use soil profile features to establish the duration of surface stability in the context of geologic faults or slope stability. An offset subsoil horizon indicates rupture during soil formation and the degree of subsequent subsoil formation is relied upon to establish time since rupture.

Degradation

Land degradation is a human induced or natural process which impairs the capacity of land to function. Soils are the critical component in land degradation when it involves acidification, contamination, desertification, erosion, or salination.

While soil acidification of alkaline soils is beneficial, it degrades land when soil acidity lowers crop productivity and increases soil vulnerability to contamination and erosion. Soils are often initially acid because their parent materials were acid and initially low in the basic cations (calcium, magnesium, potassium, and sodium). Acidification occurs when these elements are removed from the soil profile by normal rainfall or the harvesting of crops. Soil acidification is accelerated by the use of acid-forming nitrogenous fertilizers and by the effects of acid precipitation.

Soil contamination at low levels are often within soil capacity to treat and assimilate. Many waste treatment processes rely on this treatment capacity. Exceeding treatment capacity can damage soil biota and limit soil function. Derelict soils occur where industrial contamination or other development activity damages the soil to such a degree that the land cannot be used safely or productively. Remediation of derelict soil uses principles of geology, physics, chemistry, and biology to degrade, attenuate, isolate, or remove soil contaminants and to restore soil functions and values. Techniques include leaching, air sparging, chemical amendments, phytoremediation, bioremediation, and natural attenuation.

Desertification is an environmental process of ecosystem degradation in arid and semi-arid regions, or as a result of human activity. It is a common misconception that droughts cause desertification. Droughts are common in arid and semiarid lands. Well-managed lands can recover from drought when the rains return. Soil management tools include maintaining soil nutrient and organic matter levels, reduced tillage and increased cover. These help to control erosion and maintain productivity during periods when moisture is available. Continued land abuse during droughts, however, increases land degradation. Increased population and livestock pressure on marginal lands accelerates desertification.

Soil erosional loss is caused by wind, water, ice, movement in response to gravity. Although the processes may be simultaneous, erosion is distinguished from weathering. Erosion is an intrinsic natural process, but in many places it is increased by human land use. Poor land use practices include deforestation, overgrazing, and improper construction activity. Improved management can limit erosion using techniques like limiting disturbance during construction, avoiding construction during erosion prone periods, intercepting runoff, terrace-building, use of erosion suppressing cover materials and planting trees or other soil binding plants.

Soil piping is a particular form of soil erosion that occurs below the soil surface. It is associated with levee and dam failure as well as sink hole formation. Turbulent flow removes soil starting from the mouth of the seep flow and subsoil erosion advances upgradient. The term sand boil is used to describe the appearance of the discharging end of an active soil pipe.

Soil salination is the accumulation of free salts to such an extent that it leads to degradation of soils and vegetation. Consequences include corrosion damage, reduced plant growth, erosion due to loss of plant cover and soil structure, and water quality problems due to sedimentation. Salination occurs due to a combination of natural and human caused processes. Acidic conditions favor salt accumulation. This is especially apparent when soil parent material is saline. Irrigation of arid lands is especially problematic. All irrigation water has some level of salinity. Irrigation, especially when it involves leakage from canals, often raise the underlying water table. Rapid salination occurs when the land surface is within the capillary fringe of saline groundwater.

Salinity control involves flushing with higher levels of applied water in combination with tile drainage.

Soil type

In terms of soil texture, **soil type** usually refers to the different sizes of mineral particles in a particular sample. Soil is made up in part of finely ground rock particles, grouped according to size as sand, silt and clay. Each size plays a significantly different role.

For example, the largest particles, sand, determine aeration and drainage characteristics, while the tiniest, sub-microscopic clay particles, are chemically active, binding with water and plant nutrients. The ratio of these sizes determines soil type: clay, loam, clay-loam, silt-loam, and so on.

In addition to the mineral composition of soil, humus (organic material) also plays a crucial role in soil characteristics and fertility for plant life. Soil may be mixed with larger aggregate, such as pebbles or gravel. Not all types of soil are permeable, such as pure clay.

There are many recognized soil classifications, both international and national.

Erosion

Erosion is the carrying away or displacement of solids (sediment, soil, rock and other particles) usually by the agents of currents such as, wind, water, or ice by downward or down-slope movement in response to gravity or by living organisms (in the case of bioerosion).
Erosion is distinguished from weathering, which is the process of chemical or physical breakdown of the minerals in the rocks, although the two processes may be concurrent.

Erosion is a noticeable intrinsic natural process but in many places it is increased by human land use. Poor land use practices include deforestation, overgrazing, unmanaged construction activity and road-building. Land that is used for the production of agricultural crops generally experiences a significant greater rate of erosion than that of land under natural vegetation. This is particularly true if tillage is used, which reduces vegetation cover on the surface of the soil and disturbs both soil structure and plant roots that would otherwise hold the soil in place. However, improved land use practices can limit erosion, using techniques such as terrace-building, conservation tillage practices, and tree planting.

A certain amount of erosion is natural and, in fact, healthy for the ecosystem. For example, gravels continuously move downstream in watercourses. Excessive erosion, however, does cause problems, such as receiving water sedimentation, ecosystem damage and outright loss of soil.
The rate of erosion depends on many factors. Climatic factors include the amount and intensity of precipitation, the average temperature, as well as the typical temperature range, and seasonality, the wind speed, storm frequency. The geologic factors include the sediment or rock type, its porosity and permeability, the slope (gradient) of the land, and if the rocks are tilted, faulted, folded, or weathered. The biological factors include ground cover from vegetation or lack thereof, the type of organisms inhabiting the area, and the land use.

In general, given vegetation and ecosystems, you expect areas with high-intensity precipitation, more frequent rainfall, more wind, or more storms to have more erosion. Sediment with high sand or silt contents and areas with steep slopes erode more easily, as do areas with highly fractured or weathered rock. Porosity and permeability of the sediment or rock affect the speed with which the water can percolate into the ground. If the water moves underground, less runoff is generated, reducing the amount of surface erosion. Sediment containing more clay tend to erode less than those with sand or silt. Here, however, the impact of atmospheric sodium on erodibility of clay should be considered.

The factor that is most subject to change is the amount and type of ground cover. In an undisturbed forest, the mineral soil is protected by a litter layer and an organic layer. These two layers protect the soil by absorbing the impact of rain drops. These layers and the underlaying soil in a forest is porous and highly permeable to rainfall. Typically only the most severe rainfall and large hailstorm events will lead to overland flow in a forest. If the trees are removed by fire or logging, infiltration rates remain high and erosion low to the degree the forest floor remains intact. Severe fires can lead to significantly increased erosion if followed by heavy rainfall. In the case of construction or road building when the litter layer is removed or compacted the susceptibility of the soil to erosion is greatly increased.

Roads are especially likely to cause increased rates of erosion because, in addition to removing ground cover, they can significantly change drainage patterns especially if an embankment has been made to support the road. A road that has a lot of rock and one that is "hydrologically invisible" (that gets the water off the road as quickly as possible, mimicking natural drainage patterns) has the best chance of not causing increased erosion.

Many human activities remove vegetation from an area, making the soil easily eroded. Logging can cause increased erosion rates due to soil compaction, exposure of mineral soil, for example roads and landings. However it is the removal of or compromise to the forest floor not the removal of the canopy that can lead to erosion. This is because rain drops striking tree leaves coalesce with other rain drops creating larger drops. When these larger drops fall (called throughfall) they again may reach terminal velocity and strike the ground with more energy then had they fallen in the open. Terminal velocity of rain drops is reached in about 8 meters. Because forest canopies are usually higher than this, leaf drop can regain terminal velocity. However, the intact forest floor, with its layers of leaf litter and organic matter, absorbs the impact of the rainfall.

Heavy grazing can reduce vegetation enough to increase erosion. Changes in the kind of vegetation in an area can also affect erosion rates. Different kinds of vegetation lead to different infiltration rates of rain into the soil. Forested areas have higher infiltration rates, so precipitation will result in less surface runoff, which erodes. Instead much of the water will go in subsurface flows, which are generally less erosive. Leaf litter and low shrubs are an important part of the high infiltration rates of forested systems, the removal of which can increase erosion rates. Leaf litter also shelters the soil from the impact of falling raindrops, which is a significant agent of erosion. Vegetation can also change the speed of surface runoff flows, so grasses and shrubs can also be instrumental in this aspect.

One of the main causes of erosive soil loss in the year 2006 is the result of slash and burn treatment of tropical forest. When the total ground surface is stripped of vegetation and then seared of all living organisms, the upper soils are vulnerable to both wind and water erosion. In a number of regions of the earth, entire sectors of a country have been rendered unproductive. For example, on the Madagascar high central plateau, comprising approximately ten percent of that country's land area, virtually the entire landscape is sterile of vegetation, with gully erosive furrows typically in excess of 50 meters deep and one kilometer wide. Shifting cultivation is a farming system which sometimes incorporates the slash and burn method in some regions of the world. This degrades the soil and causes the soil to become less and less fertile.

Effects

Approximately 40% of the world's agricultural land is seriously degraded. According to the UN, an area of fertile soil the size of Ukraine is lost every year because of drought, deforestation and climate change. In Africa, if current trends of soil degradation continue, the continent might be able to feed just 25% of its population by 2025, according to UNU's Ghana-based Institute for Natural Resources in Africa.

When land is overused by animal activities (including humans), there can be mechanical erosion and also removal of vegetation leading to erosion. In the case of the animal kingdom, this effect would become material primarily with very large animal herds stampeding such as the Blue Wildebeest on the Serengeti plain. Even in this case there are broader material benefits to the ecosystem, such as continuing the survival of grasslands, that are indigenous to this region. This effect may be viewed as anomalous or a problem only when there is a significant imbalance or overpopulation of one species.

In the case of human use, the effects are also generally linked to overpopulation. When large number of hikers use trails or extensive off road vehicle use occurs, erosive effects often follow, arising from vegetation removal and furrowing of foot traffic and off road vehicle tires. These effects can also accumulate from a variety of outdoor human activities, again simply arising from too many people using a finite land resource.

Soil contamination

Soil contamination is caused by the presence of man-made chemicals or other alteration in the natural soil environment. This type of contamination typically arises from the rupture of underground storage tanks, application of pesticides, percolation of contaminated surface water to subsurface strata, oil and fuel dumping, leaching of wastes from landfills or direct discharge of industrial wastes to the soil. The most common chemicals involved are petroleum hydrocarbons, solvents, pesticides, lead and other heavy metals. This occurrence of this phenomenon is correlated with the degree of industrialization and intensity of chemical usage.

The concern over soil contamination stems primarily from health risks, both of direct contact and from secondary contamination of water supplies. Mapping of contaminated soil sites and the resulting cleanup are time consuming and expensive tasks, requiring extensive amounts of geology, hydrology, chemistry and computer modeling skills..

Health effects

The major concern is that there are many sensitive land uses where people are in direct contact with soils such as residences, parks, schools and playgrounds. Other contact mechanisms include contamination of drinking water or inhalation of soil contaminants which have vaporized.

There is a very large set of health consequences from exposure to soil contamination depending on pollutant type, pathway of attack and vulnerability of the exposed population[citation needed]. Chromium and obsolete pesticide formulations are carcinogenic to populations[citation needed]. Lead is especially hazardous to young children, in which group there is a high risk of developmental damage to the brain, while to all populations kidney damage is a risk.

Chronic exposure to at sufficient concentrations is known to be associated with higher incidence of leukemia .Obsolete pesticides such as mercury and cyclodienes are known to induce higher incidences of kidney damage, some irreversible; cyclodienes are linked to liver toxicity .Organophosphates and carbamates can induce a chain of responses leading to neuromuscular blockage.

Many chlorinated solvents induce liver changes, kidney changes and depression of the central nervous system. There is an entire spectrum of further health effects such as headache, nausea, fatigue (physical), eye irritation and skin rash for the above cited and other chemicals.

Ecosystem effects

Not unexpectedly, soil contaminants can have significant deleterious consequences for ecosystems [5]. There are radical soil chemistry changes which can arise from the presence of many hazardous chemicals even at low concentration of the contaminant species. These changes can manifest in the alteration of metabolism of endemic microorganisms and arthropods resident in a given soil environment. The result can be virtual eradication of some of the primary food chain, which in turn has major consequences for predator or consumer species. Even if the chemical effect on lower life forms is small, the lower pyramid levels of the food chain may ingest alien chemicals, which normally become more concentrated for each consuming rung of the food chain. Many of these effects are now well known, such as the concentration of persistent DDT materials for avian consumers, leading to weakening of egg shells, increased chick mortality and potentially species extinction.

Effects occur to agricultural lands which have certain types of soil contamination. Contaminants typically alter plant metabolism, most commonly to reduce crop yields. This has a secondary effect upon soil conservation, since the languishing crops cannot shield the earth's soil mantle from erosion phenomena. Some of these chemical contaminants have long half-lives and in other cases derivative chemicals are formed from decay of primary soil contaminants.

Waste

Waste is an unwanted or undesired material or substance. It is also referred to as rubbish, trash, garbage, or junk depending upon the type of material and the regional terminology. In living organisms, waste relates to unwanted substances or toxins that are expelled from them.
Waste management is the human control of the collection, treatment and disposal of different wastes. This is in order to reduce the negative impacts waste has on environment and society.

Waste is directly linked to the human development, both technologically and socially. The composition of different wastes have varied over time and location, with industrial development and innovation being directly linked to waste materials. Examples of this include plastics and nuclear technology. Some components of waste have economical value and can be recycled once correctly recovered.

Biodegradable waste such as food waste or sewage is broken down naturally by microorganisms either aerobically or anaerobically. If the disposal of biodegradable waste is not controlled it can cause a number of wider problems including contributing to the release of greenhouse gases and can impact upon human health via encouragement of pathogens.

It is difficult to define specifically what a waste is. Items that some people discard have value to others. It is widely recognized that waste materials are a valuable resource, whilst there is debate as to how this value is best realized. Governments need to define what waste is in order that it can be safely and legally managed. Different definitions need to be combined in order to ensure the safe and legal disposal of the waste. As a nation, Americans generate more waste than any other nation in the world with 4.5 pounds of municipal solid waste (MSW) per person per day, 55 percent of which is contributed as residential garbage. The remaining 45 percent of waste in the U.S.'s ‘waste stream' comes from manufacturing, retailing, and commercial trade in the U.S. economy.

Environmental impact

Many different types of waste have negative impacts upon the wider environment.
Waste pollution is considered a serious threat by many and can broadly be defined as any pollution associated with waste and waste management practices. Typical materials that are found in household waste which have specific environmental impacts with them include biodegradable wastes, batteries, aerosols, oils, acids and fluorescent tubes. hi Biodegradable waste is of specific concern as breaks down in landfills to form methane, a potent greenhouse gas. If this gas is not prevented from entering the atmosphere, by implication, it contributes to climate change.

Littering can be considered the most visible form of solid waste pollution. The act of littering for the most part constitutes disposing of waste inappropriately, typically in public places. Littering itself may or may not be an intentional action.

Marine debris, also known as marine litter, is human-created waste that has deliberately or accidentally become afloat in a lake, sea, ocean or waterway. Though it was originally assumed that most oceanic marine waste stemmed directly from ocean dumping, it is now thought that around four fifths of the oceanic debris is from rubbish blown seaward from landfills, and washed seaward by storm drains.

Other forms of pollution associated with waste materials include illegal dumping and leaching. Illegal dumping of fly tipping often involves unregulated disposal of materials on private or public land. Remote sites with road access coupled with limited surveillance often provides the perfect opportunity for this form of dumping which often goes unpunished and leaves others (such as the community or developer) to properly dispose of the waste. Leaching is the process by which contaminants from solid waste enter soil and often ground water systems contaminating them.

Composition of waste

Most waste is comprised of the following materials.

- Paper - newspaper*, office paper*, packing materials, cardboard*
- Plastic - beverage containers*, high tech waste*, packing materials
- Metals - cans*, high tech waste*, scrap metals*, appliances*, building materials*
- Glass - windows*, bottles*
- Food waste and organic material - leaves, peelings and scraps, spoiled food, grass clippings
- Human and animal waste - feces,
- Wood - furniture, building materials, pallets*

Most waste ends up here, in a landfill, where it is left to break down.
Although most of this waste is recyclable, very few of it makes it to a recycling facility. Plastics, Metals and Glass can sit in landfills for millions of years before they break down. And when incinerated, they release toxic fumes. In developed area, there are services that will remove these materials, and properly recycle them. But for most people, no service exists. Recycling takes much energy, a lot of labor, and does not leave much of a final product. For most of the world it is a lot easier to just throw it in the garbage than take the hassle of recycling it.

The UK's Environmental Protection Act 1990 indicated waste includes any substance which constitutes a scrap material, an effluent or other unwanted surplus arising from the application of any process or any substance or article which requires to be disposed of which has been broken, worn out, contaminated or otherwise spoiled; this is supplemented with anything which is discarded otherwise dealt with as if it were waste shall be presumed to be waste unless the contrary is proved. This definition was amended by the Waste Management Licensing Regulations 1994 defining waste as:[havok] for ever.

Waste management

Waste management is the collection, transport, processing, recycling or disposal of waste materials. The term usually relates to materials produced by human activity, and is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is also carried out to recover resources from it. Waste management can involve solid, liquid, gaseous or radioactive substances, with different methods and fields of expertise for each.

Waste management practices differ for developed and developing nations, for urban and rural areas, and for residential and industrial, producers. Management for non-hazardous residential and institutional waste in metropolitan areas is usually the responsibility of local government authorities, while management for non-hazardous commercial and industrial waste is usually the responsibility of the generator.

Waste management methods

Waste management methods vary widely between areas for many reasons, including type of waste material, nearby land uses, and the area available.

Disposal methods

Landfill

Disposing of waste in a landfill involves burying waste to dispose it off, and this remains a common practice in most countries. Landfills were often established in abandoned or unused quarries, mining voids or borrow pits. A properly-designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials. Older, poorly-designed or poorly-managed landfills can create a number of adverse environmental impacts such as wind-blown litter, attraction of vermin, and generation of liquid leachate. Another common byproduct of landfills is gas (mostly composed of methane and carbon dioxide), which is produced as organic waste breaks down anaerobically. This gas can create odor problems, kill surface vegetation, and is a greenhouse gas.

A landfill compaction vehicle in action.
Design characteristics of a modern landfill include methods to contain leachate such as clay or plastic lining material. Deposited waste is normally compacted to increase its density and stability, and covered to prevent attracting vermin (such as mice or rats). Many landfills also have landfill gas extraction systems installed to extract the landfill gas. Gas is pumped out of the landfill using perforated pipes and flared off or burnt in a gas engine to generate electricity.

Incineration

Incineration is a disposal method that involves combustion of waste material. Incineration and other high temperature waste treatment systems are sometimes described as "thermal treatment". Incinerators convert waste materials into heat, gas, steam, and ash.

Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials (such as biological medical waste). Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants.

Incineration is common in countries such as Japan where land is scarcer, as these facilities generally do not require as much area as landfills. waste-to-energy (WtE) or energy-from-waste (EfW) are broad terms for facilities that burn waste in a furnace or boiler to generate heat, steam and/or electricity. Combustion in an incinerator is not always perfect and there have been concerns about micro-pollutants in gaseous emissions from incinerator stacks. Particular concern has focused on some very persistent organics such as dioxins which may be created within the incinerator and which may have serious environmental consequences in the area immediately around the incinerator. On the other hand this method produces heat that can be used as energy.

Recycling methods

The process of extracting resources or value from waste is generally referred to as recycling, meaning to recover or reuse the material. There are a number of different methods by which waste material is recycled: the raw materials may be extracted and reprocessed, or the calorific content of the waste may be converted to electricity. New methods of recycling are being developed continuously, and are described briefly below.

Physical reprocessing

The popular meaning of 'recycling' in most developed countries refers to the widespread collection and reuse of everyday waste materials such as empty beverage containers. These are collected and sorted into common types so that the raw materials from which the items are made can be reprocessed into new products. Material for recycling may be collected separately from general waste using dedicated bins and collection vehicles, or sorted directly from mixed waste streams.

The most common consumer products recycled include aluminum beverage cans, steel food and aerosol cans, HDPE and PET bottles, glass bottles and jars, paperboard cartons, newspapers, magazines, and cardboard. Other types of plastic (PVC, LDPE, PP, and PS: see resin identification code) are also recyclable, although these are not as commonly collected. These items are usually composed of a single type of material, making them relatively easy to recycle into new products. The recycling of complex products (such as computers and electronic equipment) is more difficult, due to the additional dismantling and separation required.

Biological reprocessing

Waste materials that are organic in nature, such as plant material, food scraps, and paper products, can be recycled using biological composting and digestion processes to decompose the organic matter. The resulting organic material is then recycled as mulch or compost for agricultural or landscaping purposes. In addition, waste gas from the process (such as methane) can be captured and used for generating electricity. The intention of biological processing in waste management is to control and accelerate the natural process of decomposition of organic matter.

There are a large variety of composting and digestion methods and technologies varying in complexity from simple home compost heaps, to industrial-scale enclosed-vessel digestion of mixed domestic waste (see Mechanical biological treatment). Methods of biological decomposition are differentiated as being aerobic or anaerobic methods, though hybrids of the two methods also exist.

An example of waste management through composting is the Green Bin Program in Toronto, Canada, where household organic waste (such as kitchen scraps and plant cuttings) are collected in a dedicated container and then composted.

Energy recovery

The energy content of waste products can be harnessed directly by using them as a direct combustion fuel, or indirectly by processing them into another type of fuel. Recycling through thermal treatment ranges from using waste as a fuel source for cooking or heating, to fuel for boilers to generate steam and electricity in a turbine. Pyrolysis and gasification are two related forms of thermal treatment where waste materials are heated to high temperatures with limited oxygen availability. The process typically occurs in a sealed vessel under high pressure. Pyrolysis of solid waste converts the material into solid, liquid and gas products. The liquid and gas can be burnt to produce energy or refined into other products. The solid residue (char) can be further refined into products such as activated carbon. Gasification and advanced Plasma arc gasification are used to convert organic materials directly into a synthetic gas (syngas) composed of carbon monoxide and hydrogen. The gas is then burnt to produce electricity and steam.

Avoidance and reduction methods
An important method of waste management is the prevention of waste material being created, also known as waste reduction. Methods of avoidance include reuse of second-hand products, repairing broken items instead of buying new, designing products to be refillable or reusable (such as cotton instead of plastic shopping bags), encouraging consumers to avoid using disposable products (such as disposable cutlery), and designing products that use less material to achieve the same purpose (for example, lightweighting of beverage cans).

Waste handling and transport

Waste collection methods vary widely between different countries and regions. Domestic waste collection services are often provided by local government authorities, or by private industry. Some areas, especially those in less developed countries, do not have a formal waste-collection system. Examples of waste handling systems include:

- In Australia, most urban domestic households have a 240-litre (63.4 U.S. gallon) bin that is emptied weekly from the curb using a mechanical arm attached to a truck that lifts the bin upside down on top of the truck where the rubbish then falls into the conatainer and compacted.
- In Europe and a few other places around the world, a few communities use a proprietary collection system known as Envac, which conveys refuse via underground conduits using a vacuum system.
- In Canadian urban centres curbside collection is the most common method of disposal, whereby the city collects waste and/or recyclables and/or organics on a scheduled basis. In rural areas people often dispose of their waste by hauling it to a transfer station. Waste collected is then transported to a regional landfill.
- In Taipei the city government charges its households and industries for the volume of rubbish they produce. Waste will only be collected by the city council if waste is disposed

in government issued rubbish bags. This policy has successfully reduced the amount of waste the city produces and increased the recycling rate.

Waste management concepts

There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely-used concepts include:

Diagram of the waste hierarchy.

- Waste hierarchy - the waste hierarchy refers to the "3 Rs" reduce, reuse and recycle, which classify waste management strategies according to their desirability in terms of waste minimization. The waste hierarchy remains the cornerstone of most waste minimization strategies. The aim of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste.
- Extended producer responsibility - Extended Producer Responsibility (EPR) is a strategy designed to promote the integration of all costs associated with products throughout their life cycle (including end-of-life disposal costs) into the market price of the product. Extended producer responsibility is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market. This means that firms which manufacture, import and/or sell products are required to be responsible for the products after their useful life as well as during manufacture.
- Polluter pays principle - the Polluter Pays Principle is a principle where the polluting party pays for the impact caused to the environment. With respect to waste management, this generally refers to the requirement for a waste generator to pay for appropriate disposal of the waste.

Landfill

A **landfill**, also known as a dump (and historically as a **midden**), is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world.
Landfills may include internal waste disposal sites (where a producer of waste carries out their own waste disposal at the place of production) as well as sites used by many producers. Many landfills are also used for other waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling).

A landfill also may refer to ground that has been filled in with soil and rocks instead of waste materials, so that it can be used for a specific purpose, such as for building houses. Unless they are stabilized, these areas may experience severe shaking or liquefaction of the ground in a large earthquake.

Site construction requirements

The construction of a landfill requires a staged approach. Landfill designers are primarily concerned with the viability of a site. To be commercially and environmentally viable a landfill must be constructed in accord with specific requirements, which are related to:

- **Location**
    - Easy access to transport by road

    - Transfer stations if rail network is preferred
    - Land value
    - Cost of meeting government requirements
    - Location of community served
    - Type of construction (more than one may be used at single site)
        - Pit - filling existing holes in the ground, typically left behind by mining
        - Canyon - filling in naturally occurring valleys or canyons
        - Mound - piling the waste up above the ground
- **Stability**
    - Underlying geology
    - Nearby earthquake faults
    - Water table
    - Location of nearby rivers, streams, and flood plains
- **Capacity** The available void space must be calculated by comparison of the landform with a proposed restoration profile.
    - This calculation of capacity is based on:
    - Density of the wastes
    - Amount of intermediate and daily cover
    - Amount of settlement that the waste will undergo following tipping
    - Thickness of capping
    - Construction of lining and drainage layers.

- **Protection of soil and water through**:
    - Installation of liner and collection systems.
    - Storm water control
    - Leachate management.
    - Landfill gas management.

- **Nuisances and hazards management.**

- **Costs**
    - Feasibility studies
    - Site after care
    - Site investigations (costs involved may make small sites uneconomical).
    - Site respect

Operations

Typically, in non hazardous waste landfills, in order to meet predefined specifications, techniques are applied by which the wastes are:

1. Confined to as small an area as possible.
2. Compacted to reduce their volume.
3. Covered (usually daily) with layers of soil.

Landfill operation. Note that the area being filled is a single, well-defined "cell" and that a rubberized landfill liner is in place (exposed on the left) to prevent contamination by leachates migrating downward through the underlying geological formation.

During landfill operations the waste collection vehicles are weighed at a weigh-bridge on arrival and their load is inspected for wastes that do not accord with the landfill's waste acceptance criteria. Afterwards, the waste collection vehicles use the existing road network on their way to the tipping face or working front where they unload their load. After loads are deposited, compactors or dozers are used to spread and compact the waste on the working face. Before leaving the landfill boundaries, the waste collection vehicles pass through the wheel cleaning facility. If necessary, they return to weighbridge in order to be weighed without their load. Through the weighing process, the daily incoming waste tonnage can be calculated and listed in databases. In addition to trucks, some landfills may be equipped to handle railroad containers. The use of 'rail-haul' permits landfills to be located at more remote sites, without the problems associated with many truck trips.

Typically, in the working face, the compacted waste is covered with soil daily. Alternative waste cover materials are several sprayed on foam products and temporary blankets. Blankets can be lifted into place with tracked excavators and then removed the following day prior to waste placement. Chipped wood and chemically 'fixed' bio-solids, may also be used as an alternate daily cover. The space that is occupied daily by the compacted waste and the cover material is called daily cell. Waste compaction is critical to extending the landfill life. Factors such as waste compressibility, waste layer thickness and the number of passes of the compactor over the waste affect the waste densities.

Impacts

A large number of adverse impacts occur from landfill operations. These impacts can vary: fatal accidents (e.g., scavengers buried under waste piles); infrastructure damage (e.g., damage to access roads by heavy vehicles); pollution of the local environment (such as contamination of groundwater and/or aquifers by leakage and residual soil contamination during landfill usage, as well as after landfill closure); off gassing of methane generated by decaying organic wastes (methane is a greenhouse gas many times more potent than carbon dioxide, and can itself be a danger to inhabitants of an area); harboring of disease vectors such as rats and flies, particularly from improperly operated landfills, which are common in Third-world countries; injuries to wildlife; and simple nuisance problems (e.g., dust, odor, vermin, or noise pollution).

Environmental noise and dust are generated from vehicles accessing a landfill as well as from working face operations. These impacts are best to intercept at the planning stage where access routes and landfill geometrics can be used to mitigate such issues. Vector control is also important, but can be managed reasonably well with the daily cover protocols.

Most modern landfills in industrialized countries are operated with controls to attempt manage problems such as these. Analyses of common landfill operational problems are available.

Some local authorities have found it difficult to locate new landfills. Communities may charge a fee or levy in order to discourage waste and/or recover the costs of site operations. Some landfills are operated for profit as commercial businesses. Many landfills, however, are publicly operated and funded.

موج صوتی چیست؟

امواج صوتی ، امواج مکانیکی طولی هستند. این فیزیک امواج می‌توانند در جامدات ، مایعات و گازها منتشر شوند. ذرات مادی منتقل کننده این فیزیک امواج ، در راستای انتشار موج نوسان می‌کنند. فیزیک امواج مکانیکی طولی در گستره وسیعی از بسامدها به وجود می‌آیند و در این میان بسامدهای فیزیک امواج صوتی در محدوده‌ای قرار گرفته‌اند که می‌توانند گوش و مغز انسان را برای شنیدن تحریک کنند.

این محدوده تقریبا از ۲۰ هرتز تا حدود ۲۰۰۰۰ هرتز است و گستره شنیده شدنی نامیده می‌شود. فیزیک امواج مکانیکی طولی را که بسامدشان زیر گستره شنیده شدنی باشد امواج فرو صوتی ، و آنهایی که بسامدشان بالای این گستره باشد ، امواج فراصوتی گویند.

روشهای جلوگیری از آلودگی‌های صوتی

با توجه به اینکه معمولا صداها از تولید کننده‌ای پخش ، توسط گیرنده‌ای دریافت می‌شوند بنابراین جهت کنترل این آلودگی ، کاهش شدت صدا جلوگیری از انتشار و نفوذ صدا و محافظت از گیرنده) سیستم شنوایی (می‌تواند موثر باشد. بنابراین در جهت جلوگیری ار آلودگی شدید صوتی

۱. میزان صدا در محیطهایی که کارگران بطور مداوم در معرض فعالیتهای مغزی قرار دارند نباید از ۱۰ دسی‌بل تجاوز نماید .
۲. سعی شود از ورود ماشین آلات که بیش از حد معین آلودگی صوتی تولید می‌کنند جلوگیری شود .
۳. صدای ماشین‌آلات کارخانه‌ها نباید به بیرون ازکارخانه‌ها برسد .

منشا آلودگی صوتی

۱. سعی شود از ایجاد واحدهای مسکونی در مجاورت فرودگاهها جلوگیری شود .

۲. ضد صدا کردن ساختمانها و واحدهای مسکونی .
۳. مضاعف یا دو لایه کردن شیشه پنجره‌ها در جهت جلوگیری از نفوذ صدای بیرون به داخل ساختمان .
۴. محدود و ممنوع کردن عبور کامیونها و وسائط نقلیه پر صدا .
۵. ایجاد نوارهای عریضی از درختان و پوششهای گیاهی که به میزان ۱۰ دسی‌بل از شدت صوت می‌کاهد .

شدت صوت

احساس بلندی و کوتاهی صدا مربوط به انرژی حمل شده با امواج صوتی است و بر حسب واحد دسی بل می‌باشد که یک واحد مقایسه‌ای است و عبارت است از ده برابر log نسبت شدت صدای مورد نظر «I» به شدت یک سطح مقایسه‌ای =(I_0) بطور قراردادی صدایی است که دارای ۰/۰۰۰۲ میکرو بار فشار بوده و به عنوان آستانه شنوایی در انسان در نظر گرفته می‌شود .

$$dB=10\log(10/10)$$

بنابراین ۱۰ برابر افزایش در شدت یک صدای خالص فقط ۱۰ دسی بل به مقیاس شدت اضافه می‌کند یا اینکه می‌توان گفت مثلا صدای 50 دسی‌بل ۱۰ برابر بلندتر از صدای ۴۰ دسی‌بل و ۱۰۰ برابر بلندتر از صدای ۳۰ دسی‌بل است. فرکانس شنوایی انسان بین ۲۰۰۰۰ - ۲۰ سیکل در ثانیه یا معادل شدت صوتی برابر با 0 - 120 دسی بل است. صحبتهای معمولی در فرکانس بین ۱۰۰۰۰-۲۵۰ سیکل در ثانیه انجم می‌شود که دارای شدتی برابر با ۶۰ - ۳۰ دسی بل می‌باشد. ترافیک سبک در ۳۰متری دارای شدت صدای ۵۵ دسی بل می‌باشد و عدد برق۱۲۰دسی بل صدا ایجاد می‌نماید .

استانداردهای صدا در هوای آزاد ایران از ۷ صبح تا ۱۰ شب و از ۱۰ شب تا ۷ صبح به قرار زیر است .

استاندارد ملی صوت در هوای آزاد		
	۷صبح تا ۱۰ شب	۱۰شب تا ۷ صبح
منطقه مسکونی	**50dB**	**30dB**
منطقه تجاری	65	55
منطقه تجاری مسکونی	60	50
منطقه مسکونی صنعتی	70	60
منطقه صنعتی	75	65

پیامدهای منفی و زیانبار ناشی از آلودگی صوتی بطور کلی در انسانها به قرار زیر است :

۱. نگرانی و ناراحتی عصبی
۲. نگرانی همراه با خستگی و کاهش راندمان کار
۳. دگرگونیهای دائم یا موقت در رفتار زیستی از قبیل انقباض نایژکها و تغییر ضربان قلب
۴. ضایعه در دستگاه شنوایی و دیگر دستگاهای بدن .

اثرات آلودگی صوتی

آزمایشات نشان می‌دهند که صدای به شدت ۱۶۰-۱۵۰ دسی‌بل برای بعضی حیوانات کشنده و مرگبار است. این حیوانات قبل از مرگ به تشنجات موضعی ، فلج و رعشه دچار می‌گردند. در انسانها رنگ‌پریدگی و بالارفتن فشارخون از اثرات آلودگیهای صوتی است. درجه حرارت بدن نیز کاهش می‌یابد. صداهای مداوم عکس العملهایی را در بدن ایجاد می‌نماید. از جمله انقباض رگها بیشتر می‌گردد است .درجه حرارت بدن نیز کاهش می‌یابد. صداهای مداوم عکس‌العملهایی را در بدن ایجاد می‌نماید از جمله انقباض رگها بیشتر می‌گردد و این حالت پس از قطع صدا هنوز ادامه می‌یابد. بدن انسان در خواب نیز یه محرکهای صوتی پاسخ می‌دهد بدون اینکه فرد از خواب بیدار شود. (ضربان قلب و حالات ماهیچه‌ها تغییر می‌کند).

تعریف صوت و آلودگی صوتی

سروصدا یا آلودگی صوتی را می‌توان بصورت صدای ناخواسته‌ای دانست که موجب بر هم زدن آرامش در زمان استراحت و یا تمرکز افراد در حین انجام کار می‌شود، به همین دلیل صدای موسیقی نیز اگر در یک موقعیت و زمان نامناسب اجرا شود بعنوان منبع آلودگی صوتی در نظر گرفته می‌شود.

آلودگی صوتی شایعترین علت کاهش شنوایی عصبی اکتسابی بالغین است . این بیماری هنگامی که به گوش آسیب رسانید دیگر قابل درمان نیست ؛ ولی قابل پیشگیری است.

اصولاً سر و صدای زیاد و آلودگی صوتی نوعی عامل استرس زای بیولوژیک است که نه تنها بر سیستم شنوایی بلکه بر کل بدن انسان اثر می گذارد

بدین صورت که باعث تحریک سیستم اعصاب مرکزی ، تأثیر بر سیستم غده هیپوفیزوآدرنال ایجاد اختلالات هورمونی و عدم سلامت می شود و هنگامی که باعث کاهش شنوایی شود ، شخص نمی تواند به راحتی با افراد اجتماع ارتباط برقرار کند و این خود باعث کاهش کیفیت زندگی و سلامت روانی او می شود و باری را بر دوش اجتماع و جامعه می گذارد.

زمین شناسی ، تکتونیک و لرزه خیزی

زمین شناسی علمی است که ترکیب، ساختار و تاریخ پیدایش زمین (یا سیاره‌های دیگر) را بررسی می‌کند. این علم درباره مواد سازندهٔ زمین، نیروهای مؤثر بر مواد مزبور، برآیندهای آن نیروها، پراکندگی سنگهای پوستهٔ سیاره، سرگذشت آن و همچنین گیاهان و جانورانی که در دوره‌های گوناگون زمین‌شناسی وجود داشته‌اند گفتگو می‌کند. زمین شناسی یا ژئولوژی (Geology) از لغت یونانی Geo به معنی "زمین" و Logos به معنی "علم" یا "منطق" گرفته شده است. به عبارت دیگرزمین شناسی علم مطالعه زمین می‌باشد. زمین شناسی علم قدیمی و سابقه‌داری است. اصولا بشر اولیه ، همیشه در مورد زمین کنجکاو بوده است. این کنجکاوی را می‌توان معلول دو علت اساسی دانست. اول اینکه بشر و سایر موجودات زنده ، هستی خود را مرهون زمین بوده و همیشه غذای خود را از آن بدست می‌آورده‌اند و بدین ترتیب مجبور بوده‌اند که دائما در مورد آن مطالعه کنند تا بتوانند غذای مناسب و حدالامکان متنوعی برای خود به دست آورند. نکته دومی که بشر را در مورد زمین نگران می‌کرده است، وقوع حوادث ناگواری مانند زلزله ، آتشفشان ، طوفان ، سیل و نظایر آن بوده که همیشه خسارات مالی و

جانی زیادی را سبب می‌شده است و بشر به ناچار همواره در صدد بوده است که علل این حوادث را دریابد تا بتواند حتی المقدور از وقوع آن جلوگیری و یا حداقل آن را پیش بینی می کند .

چینه شناسی

علوم زمین به عنوان یکی از بنیادی ترین علوم پایه دارای گرایش های گوناگون است تابتواند به پرسشهای کاربران در زمینه های گوناگون « زمین » پاسخگو باشد. یکی ازگرایش بنیادی علوم زمین « چینه شناسی » است که با انجام آن می توان به بسیاری ازوقایع و حوادث گذشته زمین مثل نوع شرایط حوضه های رسوبی، پیوند زمانی و مکانی حوضه ها، زیست گذشته (Paleoecology)، آب و هوای دیرینه (Paleoclimatology)، جغرافیای کهن (Paleogeography)، فازهای گوناگون آتشفشانی، پدیده های دگرگونی، فازهای فلززایی،دوره های کوهزایی و . . . پی برد. بدینسان دیده می شود که چینه شناسی بنیان بسیاریاز گرایشهای علوم زمین است به همین رو، امروزه چینه شناسی دانشی تخصصی شده با توجه به تخصصی بودن چینه شناسی و اهمیت آن در علوم زمین، لازم دانسته شده است در سراسر جهان اینگونه مطالعات در چارچوب های استاندارد و همسان صورت گیرد تا داده های چینه نگاری با زبانی واحد تدوین و کاربری آن در کشورهای گوناگون آسان باشد. برای همسان سازی روشهای چینه شناسی در کشورهای گوناگون، گروهی کاری به نام زیرکمیسیون بین المللی طبقه بندی چینه شناسی (International Subcommission in Stratigraphic Classification) وابسته به اتحادیهٔ جهانی زمین شناسان (Unico International of Geological Science) تشکیل و فعالیت دارد، جدا اززیرکمیسیون بین المللی، در هر کشورمنجمله ایران نیز یک کمیتهٔ ملی چینه شناسی (Stratigraphy Committee National Iranian) و بر اساس دستورالعمل های زیرکمیسیون بین المللی چینه شناسی تشکیل می شود که به طور معمول توسط سازمانهای زمین شناسی و با همکاری مراکزآموزش عالی، مهندسین مشاور و سایر دست اندرکاران چینه شناسی فعالیت دارد تا واحدهای معرفی شده توسط زمین شناسان را بررسی و در صورت داشتن ویژگی های استاندارد تصویب وبه صورت یک واحد چینه نگاری رسمی معرفی نماید

تکتونیک

زمین‌ساخت (Structural Geology) یکی از شاخه‌های زمین‌شناسی می باشد که به مطالعه تغییرشکل پوسته زمین بر اثر تنش ها و کرنش های وارده در طول دوران های مختلف زمین شناسی می پردازد[۱] . هدف اصلی این رشته توجیه هندسه و نحوه پیدایش سازه ها و ساختارهای زمین شناسی مانند طاقدیس ها، گسل ها، درزه ها و ناودیس ها می باشد. تئوری تکتونیک صفحه ای که به حرکت تکه های پوسته زمین در ابعاد قاره ای می پردازد بخشی از این شاخه است. از این دانش برای مطالعه نحوه رخداد زلزله، زمین شناسی مهندسی و مطالعه مخازن نفت و گاز استفاده می شود .

اهمیت زمین شناسی در EIA

ارتباط زمین شناسی و مهندسی عبارت است از کاربرد زمین شناسی در کارهای مهندسی به ویژه در مهندسی عمران (راه و ساختمان). همانگونه که به وسیله مجمع مهندسین زمین شناس در ۱۹۶۹ تبیین گردید : " این علم کاربرد داده ها, فن آوری و مبانی زمین شناسی در مطالعه رخنمون های طبیعی، مصالح سنگی و خاکی یا آب زیر زمینی با هدف اطمینان از شناخت دقیق، تفسیر، استفاده و ارایه فاکتورهای زمین شناسی که ساختگاه,

برنامه ریزی, طراحی , ساخت ,اجرا و نگهداری سازه های مهندسی را تحت تأثیر قرار می دهند، می باشد. برای دستیابی به اهداف فوق, مهندس زمین شناس از علم زمین شناسی ,هیدروژئولوژی , مکانیک خاک، مکانیک سنگ و کاوش های زیر سطحی(شامل گمانه زنی و آزمایش های ژئوتکنیک و ژئوفیزیک) بهره می برد.

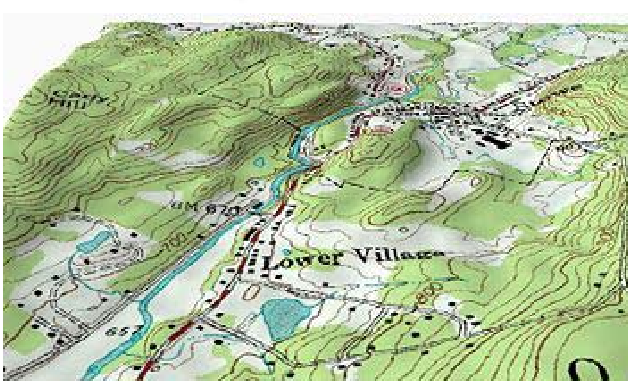
توپوگرافی

در تمام مطالعات دقیق جغرافیایی نیاز به یک نقشه مبنا یا نقشه پایه وجود دارد.اگر چه دقیق ترین نقشه های پایه ، عکسهای هوایی هستند اما به دلیل مشکلات تهیه عکسهای هوایی واطلاعات اضافی روی آنها و مشکلات فنی ناشی از اعوجاج تصویر و تغییر ارتفاع پرواز و...نمی توان همیشه از آنها استفاده کرد .به این جهت نقشه هایی که بتوانند اطلاعات اولیه و دقیقی را در اختیار جغرافیدانان بگذارند از اولویت زیادی برخوردارند .به نقشه هایی که واقعیت ها را ثبت کرده باشد ، مرز ها مشخص گردیده باشند و مطالب مورد نیاز روی آنها یادداشت شده باشند و گسترش مکانی مشاهدات به طور دقیق روی آن ثبت شده باشد ؛ نقشه پایه میگوییم.انتخاب نقشه پایه در مطالعات جغرافیایی بسیار اهمیت دارد .
نقشه پایه تا حدودی چگونگی تجزیه و تحلیل و شکل نهایی نمایش داده ها را به صورت آماری وترسیمی معین می کند .در بین انواع نقشه های پایه موجود، نقشه های توپوگرافی به دلیل ارائه اطلاعات اولیه مورد نیاز جغرافیدانان ، بهترین در نوع خود محسوب می شوند.
از این رو اهمیت نقشه های توپوگرافی بخصوص نقشه هایی که مقیاس بزرگ دارند دراغلب پروژه های تحقیقاتی جغرافیا ، ثابت شده است.

نقشهٔ توپوگرافی

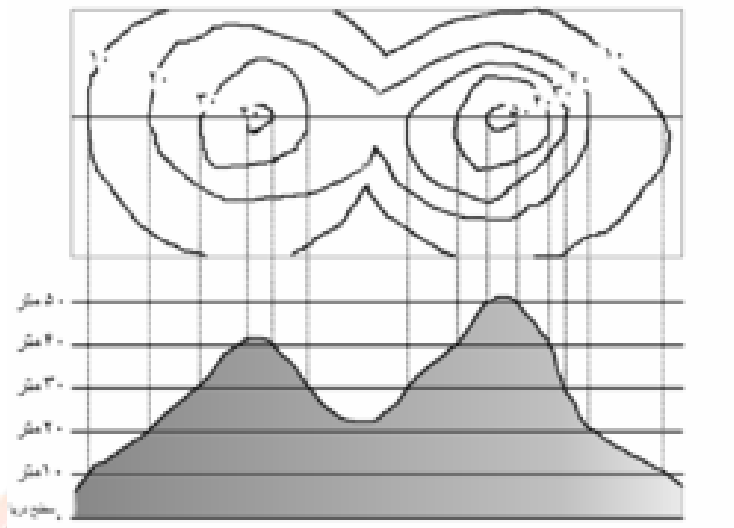
نقشه‌ای است که برای نمایاندن ویژگی‌های فیزیکی سطح زمین به کار می‌رود. این نقشه‌ها در مقیاس‌های بزرگ و کوچک می‌باشند و در مطالعات زمین‌شناسی به دلیل داشتن اطلاعات فواصل افقی یا ارتفاع عمودی بسیار به کار می‌روند.نخستین مجموعهٔ چندبرگ نقشهٔ توپوگرافی از سرتاسر یک کشور «Carte géométrique de la France» فرانسه بود که در سال ۱۷۸۹ کامل شد. نقشه‌های توپوگرافی توسط ارتش و با هدف سهولت طرح‌ریزی برای جنگ و نیز تعیین محل‌های دفاعی ایجاد شد. بنابراین اطلاعات پیرامون ارتفاع، از اهمیت به سزایی برخوردار بوده‌است. پس از آن نقشه‌های توپوگرافی به یکی از منابع پایهٔ ملی کشورهای پیشرفته در طراحی زیرساخت‌ها و بهره‌برداری از منابع تبدیل شد. در آمریکا در سال ۱۸۷۹ نقشهٔ توپوگرافی سرتاسر آمریکا تهیه شد که تا امروز نیز باقی مانده‌است .

تجسمی از یک نقشهٔ توپوگرافی



مفهوم منحنی میزان در نقشه توپوگرافی

منحنی‌های میزان در نقشه‌های توپوگرافی خطوطی فرضی هستند که تمام نقاط آن‌ها دارای یک ارتفاع می‌باشند.یک نقشه توپوگرافیک، چیزی نیست جز تعدادی خطوط ساده که گاه به صورت پیچ در پیچ و گاه به صورت صاف کشیده شده‌اند. به این خطوط، خطوط حد فاصل یا Contour lines می‌گویند. این خطوط، نمایشگر مکانهایی بر روی نقشه هستند که نسبت به یک نقطه مرجع دارای ارتفاع ثابتی هستند. یعنی اگر شما یکی از این خطوط contour را دنبال کنید تمامی نقاطی که با این خط مشخص شده‌اند ارتفاع یکسانی دارند.



تجسمی از یک مفهوم منحنی میزان

جهات جغرافیایی

از اصلی ترین و ابتدائی ترین مباحث نقشه خوانی ، آگاهی از جهات جغرافیایی است .چهار

جهت اصلی را در دوره های آموزش ابتدائی آموخته اید .که شامل: شمال ؛ جنوب ، شرق و غرب می باشد.حال می خواهیم علاوه بر این جهات اصلی ،جهات فرعی را نیز بشناسیم .و از آنجا که قرار است پس از این نقشه ها را با زبان بین المللی بخوانیم لازم است تا با الفبای جهات جغرافیایی نیز آشنا شویم. Wغرب E شرق S جنوب N شمال که حروف اول کلمات

North, South, East , west هستند .

چهار جهت فرعی شامل : شمال شرقی NE ، شمال غربی NW ، جنوب شرقی SE وجنوب غربیSW نی باشند .

هشت جهت فرعی دیگر نیز وجود دارد که بین جهات فرعی چهار گانه فوق قرار می گیرند وخواندن آنها بر اساس حروف ؛ از چپ به راست خواهد بود.که عبارتند از:

شمال شمال غربی NNW شمال شمال شرقیNNE

جنوب جنوب غربی SSW جنوب جنوب شرقیSSE

غرب شمال غربی WNW شرق شمال شرقیENE

غرب جنوب غربی WSW شرق جنوب شرقیESE

شیب و ا نواع آن:

دامنه ها در جغرافیا از اهمیت بسیاری برخوردارند .سطحی که بین خط الراس و خط القعر قرار دارد ، دامنه می نامند .دامنه ، مادر عوارض زمین است .بر روی دامنه؛ انواع شیب ها را می توان دید .با اندکی تمرین می توان انواع شیب را روی نقشه های توپوگرافی تشخیص داد.چنانچه فاصله منحنی های میزان بدون هیچ تغییری به صورت مساوی تا انتهای نقطه ارتفاعی امتداد داشته باشد؛ شکل شیب ساده را نشان می دهد.

در صورتی که در قسمت بالای دامنه فاصله منحنی میزان ها زیاد باشد و هر چه به سمت پایین دست برویم فاصله منحنی ها کمتر وکمتر بشوند .با شیب محدب یا کوژ مواجه هستیم.اگر فاصله منحنی های میزان در بالای دامنه به هم نزدیک باشند و هر چه به سمت پایین برویم فاصله آنها بیشتر شود . شیب عارضه مقعر یا کاو خواهد بود. گاهی در یک دامنه منحنی های میزان به هم نزدیک و دور می شوند .در این صورت درطبیعت شاهد دامنه ای مرکب خواهیم بود که هم شیب محدب وهم شیب مقعر دارد.چنانچه مهارت خود را در زمینه خواندن نقشه ها در مورد شیب ها افزایش دهید ؛ قادرخواهید بود در روی نقشه انواع پرتگاهها نظیر پرتگاه صخره ای ، پرتگاه گسلی ، پرتگاه ساحلی و پرتگاه رودخانه ای را تشخیص دهید.

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