Sustainability Reference Information

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Sustainability

The capacity to endure. In ecology the word describes how biological systems remain diverse and productive over time. For humans it is the potential for long-term maintenance of wellbeing, which in turn depends on the wellbeing of the natural world and the responsible use of natural resources.

Sustainability has become a wide-ranging term that can be applied to almost every facet of life on Earth, from a local to a global scale and over various time periods. Long-lived and healthy wetlands and forests are examples of sustainable biological systems. Invisible chemical cycles redistribute water, oxygen, nitrogen and carbon through the world's living and non-living systems, and have sustained life for millions of years. As the earth's human population has increased, natural ecosystems have declined and changes in the balance of natural cycles has had a negative impact on both humans and other living systems.

There is now abundant scientific evidence that humanity is living unsustainably. Returning human use of natural resources to within sustainable limits will require a major collective effort. Ways of living more sustainably can take many forms from reorganizing living conditions (e.g., ecovillages, eco-municipalities and sustainable cities), reappraising economic sectors (permaculture, green building, sustainable agriculture), or work practices (sustainable architecture), using science to develop new technologies (green technologies, renewable energy), to adjustments in individual lifestyles.

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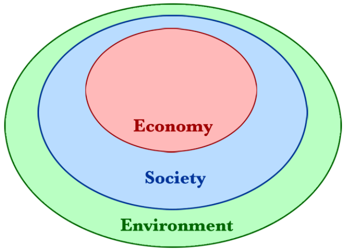

Definition

The word sustainability is derived from the Latin *sustinere* (*tenere*, to hold; *sus*, up). Dictionaries provide more than ten meanings for *sustain*, the main ones being to “maintain", "support", or "endure”. However, since the 1980s *sustainability* has been used more in the sense of human sustainability on planet Earth and this has resulted in the most widely quoted definition of sustainability and sustainable development, that of the Brundtland Commission of the United Nations:

“sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

It is usually noted that this requires the reconciliation of environmental, social and economic demands - the "three pillars" of sustainability. This view has been expressed as an illustration using three overlapping ellipses indicating that the three pillars of sustainability are not mutually exclusive and can be mutually reinforcing.

The UN definition is not universally accepted and has undergone various interpretations. What sustainability is, what its goals should be, and how these goals are to be achieved is all open to interpretation. For many environmentalists the idea of sustainable development is an oxymoron as development seems to entail environmental degradation. Ecological economist Herman Daly has asked, "what use is a sawmill without a forest?" From this perspective, the economy is a subsystem of human society, which is itself a subsystem of the biosphere, and a gain in one sector is a loss from another. This can be illustrated as three concentric circles.

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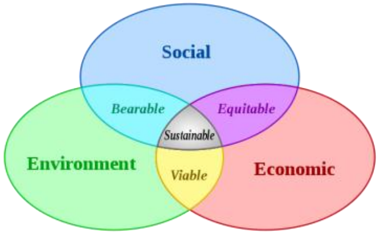
Definition



A universally-accepted definition of sustainability is elusive because it is expected to achieve many things. On the one hand it needs to be factual and scientific, a clear statement of a specific “destination”. The simple definition "sustainability is improving the quality of human life while living within the carrying capacity of supporting eco-systems", though vague, conveys the idea of sustainability having quantifiable limits. But sustainability is also a call to action, a task in progress or “journey” and therefore a political process, so some definitions set out common goals and values.

The Earth Charter speaks of “a sustainable global society founded on respect for nature, universal human rights, economic justice, and a culture of peace.”

To add complication the word *sustainability* is applied not only to human sustainability on Earth, but to many situations and contexts over many scales of space and time, from small local ones to the global balance of production and consumption. It can also refer to a future intention: "sustainable agriculture" is not necessarily a current situation but a goal for the future, a prediction. For all these reasons sustainability is perceived, at one extreme, as nothing more than a feel-good buzzword with little meaning or substance but, at the other, as an important but unfocused concept like "liberty" or "justice". It has also been described as a "dialogue of values that defies consensual definition".

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History

In early human history the environmental impacts of small bands of hunter-gatherers would have been relatively small, even though the use of fire and the desire for specific foods may have altered the natural composition of plant and animal communities.

The Neolithic Revolution 2,500 to 10,000 years ago marked the emergence of agriculture and settled communities. Societies outgrowing their local food supply or depleting critical resources either moved on or faced collapse. In contrast, stable communities of shifting cultivators and horticulturists existed in New Guinea and South America, and large agrarian communities in China, India, Polynesia and elsewhere have farmed in the same localities for centuries.

Technological advances over several millennia gave humans increasing control over the environment. But it was the Western industrial revolution of the 17th to 19th centuries that tapped into the vast growth potential of the energy in fossil fuels to power sophisticated machinery technology. These conditions led to a human population explosion and unprecedented industrial, technological and scientific growth that has continued to this day. From 1650 to 1850 the global population doubled from around 500 million to 1 billion people. By the 20th century, the industrial revolution had resulted in an exponential increase in the human consumption of resources and an increase in health, wealth and population. Ecology as a new scientific discipline was gaining general acceptance and ideas now part and parcel to sustainability were being explored including the recognition of the interconnectedness of living systems, the importance of global natural cycles, the passage of energy through trophic levels of living systems.

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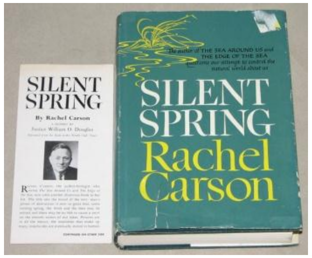
History Cont.



Silent Spring, published in 1962 this was one of the books that gave momentum to the environmental movement.

After the deprivations of the Great Depression and World War II the developed world entered a post-1950s "great acceleration" of growth and population (the "Golden age of capitalism") while a gathering environmental movement pointed out that there were environmental costs associated with the many material benefits that were now being enjoyed.

Technological innovations included plastics, synthetic chemicals and nuclear energy as fossil fuels also continued to transform society. The negative influences of the new technology were documented by American marine biologist and naturalist Rachel Carson in her influential book *Silent Spring* in 1962. A period of peak oil production was anticipated in 1956 by American geoscientist M. King Hubbert's peak oil theory.

In the 1970s environmentalism's concern with pollution, the population explosion, consumerism and the depletion of finite resources found expression in *Is growth obsolete?*, by American economists William Nordhaus and James Tobin, *Small Is Beautiful,* by British economist E. F. Schumacher in 1973, and *The Limits to Growth* published by the global think tank, the Club of Rome, in 1975. By the late twentieth century environmental problems were becoming global in scale and the 1973 and 1979 energy crises demonstrated the extent to which the global community had become dependent on a nonrenewable resource.

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History Cont.

In 1987 the United Nation's World Commission on Environment and Development (the Brundtland Commission), in its report *Our Common Future* suggested that sustainable development was needed to meet human needs while not increasing environmental problems.

In 1961 almost all countries in the world had the capacity to meet their own demand but by 2005 the situation had changed and many countries were able to meet their needs only by importing resources from other nations. A move toward more sustainable living emerged, based on increasing public awareness and adoption of recycling, and renewable energies. The development of renewable sources of energy in the 1970s and 80's, primarily in wind turbines and photovoltaics and increased use of hydroelectricity, presented more sustainable alternatives to fossil fuel and nuclear energy generation.

In the 21st century there is heightened awareness of the threat posed by the human-induced greenhouse effect. Ecological economics now seeks to bridge the gap between ecology and traditional neoclassical economics: and proposes an inclusive and ethical economic model for society. Many new techniques have arisen to help measure and implement sustainability, including Life Cycle Assessment (the Cradle to Cradle, the Ecological Footprint Analysis, and green building. The work of Bina Agarwal and Vandana Shiva amongst many others, has brought some of the cultural knowledge of traditional, sustainable agrarian societies into the academic discourse on sustainability, and blended that knowledge with modern scientific principles.

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Measurement

By establishing quantitative measures for sustainability it becomes possible to set goals, apply management strategies, and measure progress.

The Natural Step (TNS) framework developed by Karl-Henrik Robèrt examines sustainability and resource use from its thermodynamic foundations to determine how humans use and apportion natural capital in a way that is sustainable and just.

The TNS framework's *system conditions of sustainability* provide a means for the scientifically based measurement of sustainability.

Natural capital includes resources from the earth's crust (i.e., minerals, oil), those produced by humans (synthetic substances), and those of the biosphere. Equitable access to natural capital is also a component of sustainability.

The energy generated in use of resources - referred to as exergy - can be measured as the embodied energy of a product or service over its life cycle.

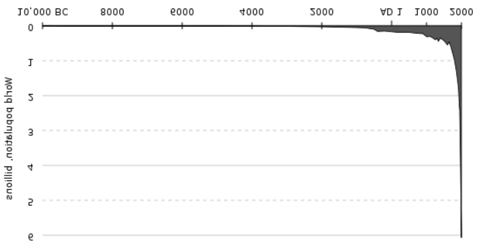
Its analysis, using methods such as Life Cycle Analysis or Ecological Footprint analysis provide basic indicators of sustainability on various scales.

Measurement Cont.

There is now a vast number of sustainability indicators, metrics, benchmarks, indices, reporting procedures, audits and more. They include environmental, social and economic measures separately or together over many scales and contexts. Environmental factors are integrated with economics through ecological economics, resource economics and thermoeconomics, and social factors through metrics like the Happy Planet Index which measures the well-being of people in the nations of the world while taking into account their environmental impact.

Some of the best known and most widely used sustainability measures include corporate sustainability reporting, Triple Bottom Line accounting, and estimates of the quality of sustainability governance for individual countries using the Environmental Sustainability Index and Environmental Performance Index.

At the global level, and from the equation I = PAT, it is clear that measuring sustainability requires a knowledge of the world's expected population. We also need estimates of how many people the Earth can support. This is a tall order but for many years now scientists have been refining models of the carrying capacity of planet Earth by measuring key human impacts, especially those that relate to biodiversity.



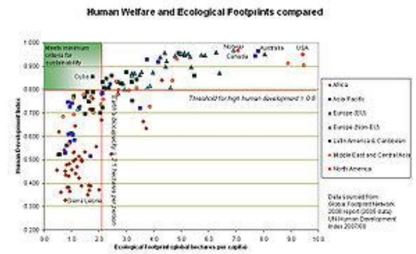
Population

According to the 2008 Revision of the official United Nations population estimates and projections, the world population is projected to reach 7 billion early in 2012, up from the current 6.9 billion (May 2009), to exceed 9 billion people by 2050. Most of the increase will be in developing countries whose population is projected to rise from 5.6 billion in 2009 to 7.9 billion in 2050. This increase will be distributed among the population aged 15–59 (1.2 billion) and 60 or over (1.1 billion) because the number of children under age 15 in developing countries will decrease.

In contrast, the population of the more developed regions is expected to undergo only slight increase from 1.23 billion to 1.28 billion, and this would have declined to 1.15 billion but for a projected net migration from developing to developed countries, which is expected to average 2.4 million persons annually from 2009 to 2050. Long-term estimates of global population suggest a peak at around 2070 of nine to ten billion people, and then a slow decrease to 8.4 billion by 2100.

Emerging economies like those of China and India aspire to the living standards of the Western world as does the non-industrialized world in general. It is the combination of population increase in the developing world and unsustainable consumption levels in the developed world that poses a stark challenge to sustainability.

Carrying Capacity



More and more data is indicating that humans are not living within the carrying capacity of the planet. The Ecological footprint measures human consumption in terms of the biologically productive land needed to provide the resources, and absorb the wastes of the average global citizen. In 2008 it required 2.7 global hectares per person, 30% more than the natural biological capacity of 2.1 global hectares (assuming no provision for other organisms). The resulting ecological deficit must be met from unsustainable *extra* sources and these are obtained in three ways: embedded in the goods and services of world trade; taken from the past (e.g. fossil fuels); or borrowed from the future as unsustainable resource usage (e.g. by over exploiting forests and fisheries).

The figure (right) compares the sustainability of countries by contrasting their Ecological Footprint with their UN Human Development Index (a measure of standard of living). The graph shows what is necessary for countries to maintain an acceptable standard of living for their citizens while, at the same time, maintaining sustainable resource use. The general trend is for higher standards of living to become less sustainable.

As always population growth has a marked influence on levels of consumption and the efficiency of resource use. The sustainability goal is to raise the global standard of living without increasing the use of resources beyond globally sustainable levels; that is, to not exceed "one planet" consumption. Information generated by reports at the national, regional and city scales confirm the global trend towards societies that are becoming less sustainable over time.

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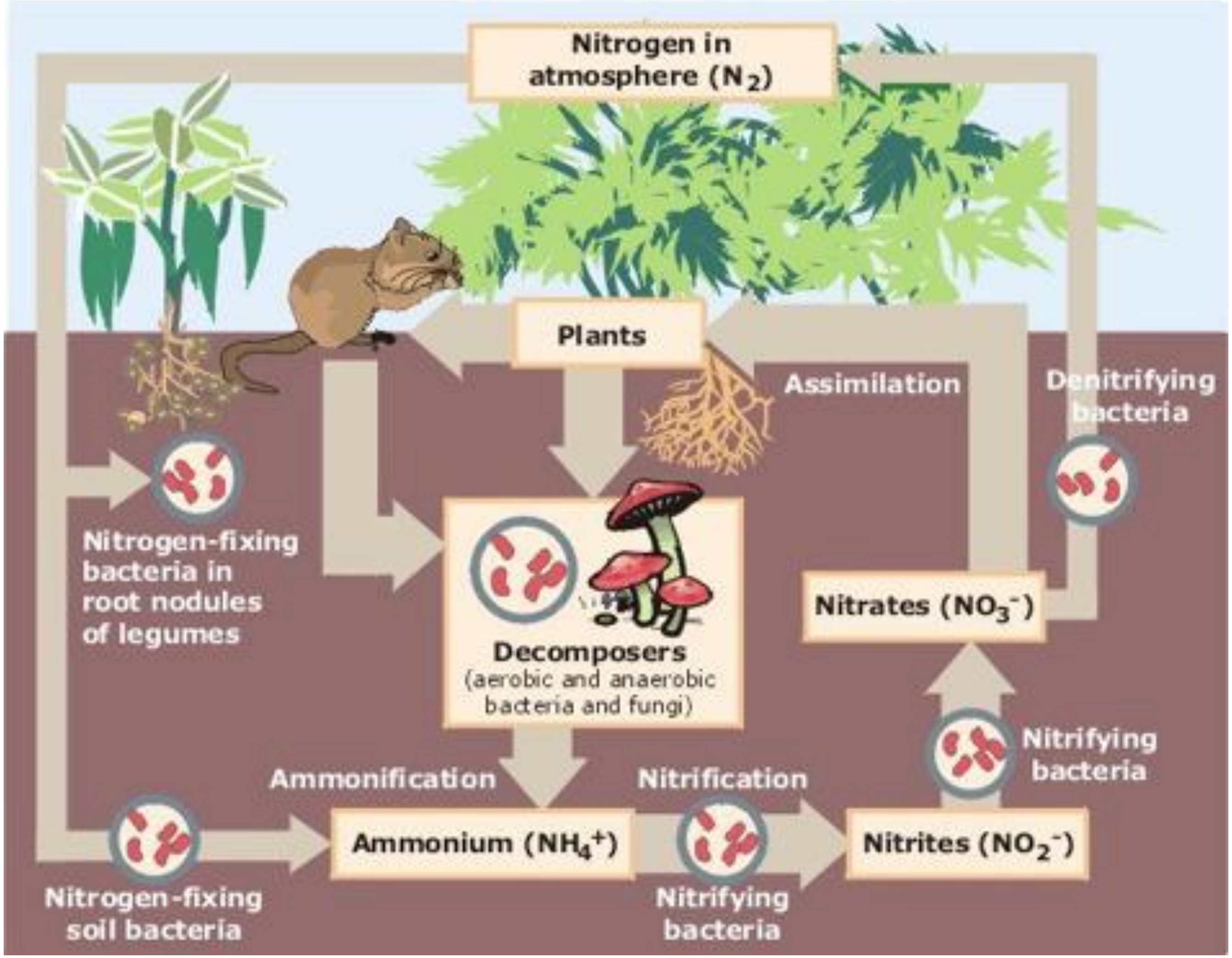
Nitrogen Cycle



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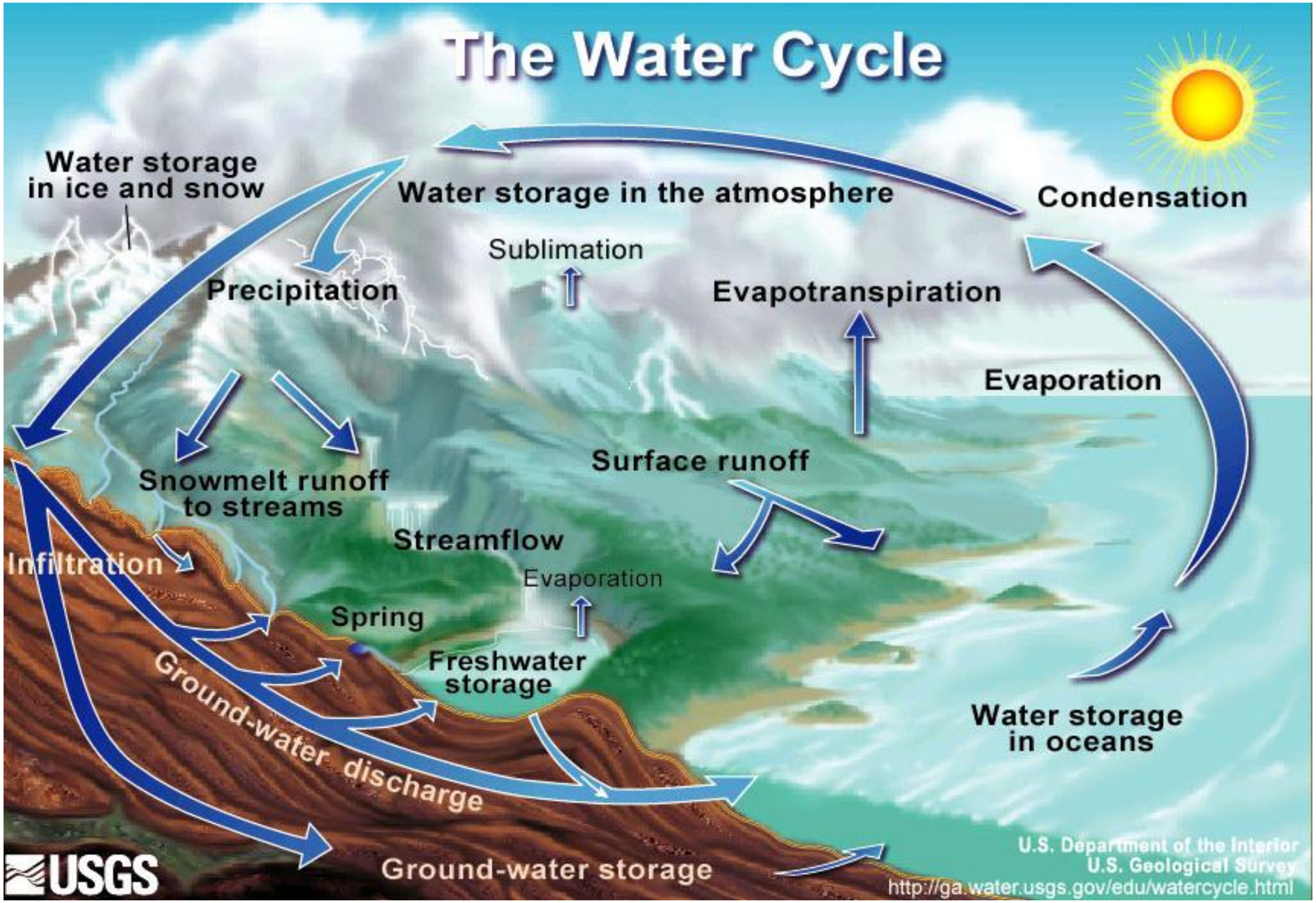
Nitrogen Cycle Cont.

The **nitrogen cycle** is the process by which nitrogen in all its forms, cycles through the earth, much in the same way the water cycle occurs. The majority of Earth's atmosphere (approximately 78-80%) is nitrogen, making it the largest pool of nitrogen.

Atmospheric nitrogen must be processed, or "fixed" (see page on nitrogen fixation), in order to be used by plants. Some fixation occurs in lightning strikes, but most fixation is done by free-living or symbiotic bacteria. These bacteria have the nitrogenase enzyme that combines gaseous nitrogen with hydrogen to produce ammonia, which is then further converted by the bacteria to make their own organic compounds.

Some nitrogen fixing bacteria, such as *Rhizobium*, live in the root nodules of legumes (such as peas or beans). Here they form a mutualistic relationship with the plant, producing ammonia in exchange for carbohydrates. Nutrient-poor soils can be planted with legumes to enrich them with nitrogen. A few other plants can form such symbioses. Today, a very considerable portion of nitrogen is fixated in ammonia chemical plants.

Water Cycle



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Water Cycle Cont.

The **water cycle**, also known as the **hydrologic cycle**, describes the continuous movement of water on, above and below the surface of the Earth. Since the water cycle is truly a "cycle," there is no beginning or end. Water can change states among liquid, vapor, and ice at various places in the water cycle. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go.

The sun, which drives the water cycle, heats water in oceans and seas. Water evaporates as water vapor into the air. Ice and snow can sublimate directly into water vapor. Evapotranspiration is water transpired from plants and evaporated from the soil. Rising air currents take the vapor up into the atmosphere where cooler temperatures cause it to condense into clouds. Air currents move water vapor around the globe, cloud particles collide, grow, and fall out of the sky as precipitation. Some precipitation falls as snow or hail, and can accumulate as ice caps and glaciers, which can store frozen water for thousands of years. Snowpack's can thaw and melt, and the melted water flows over land as snowmelt.

Most water falls back into the oceans or onto land as rain, where the water flows over the ground as surface runoff. A portion of runoff enters rivers in valleys in the landscape, with stream flow moving water towards the oceans. Runoff and groundwater are stored as freshwater in lakes. Not all runoff flows into rivers, much of it soaks into the ground as infiltration.

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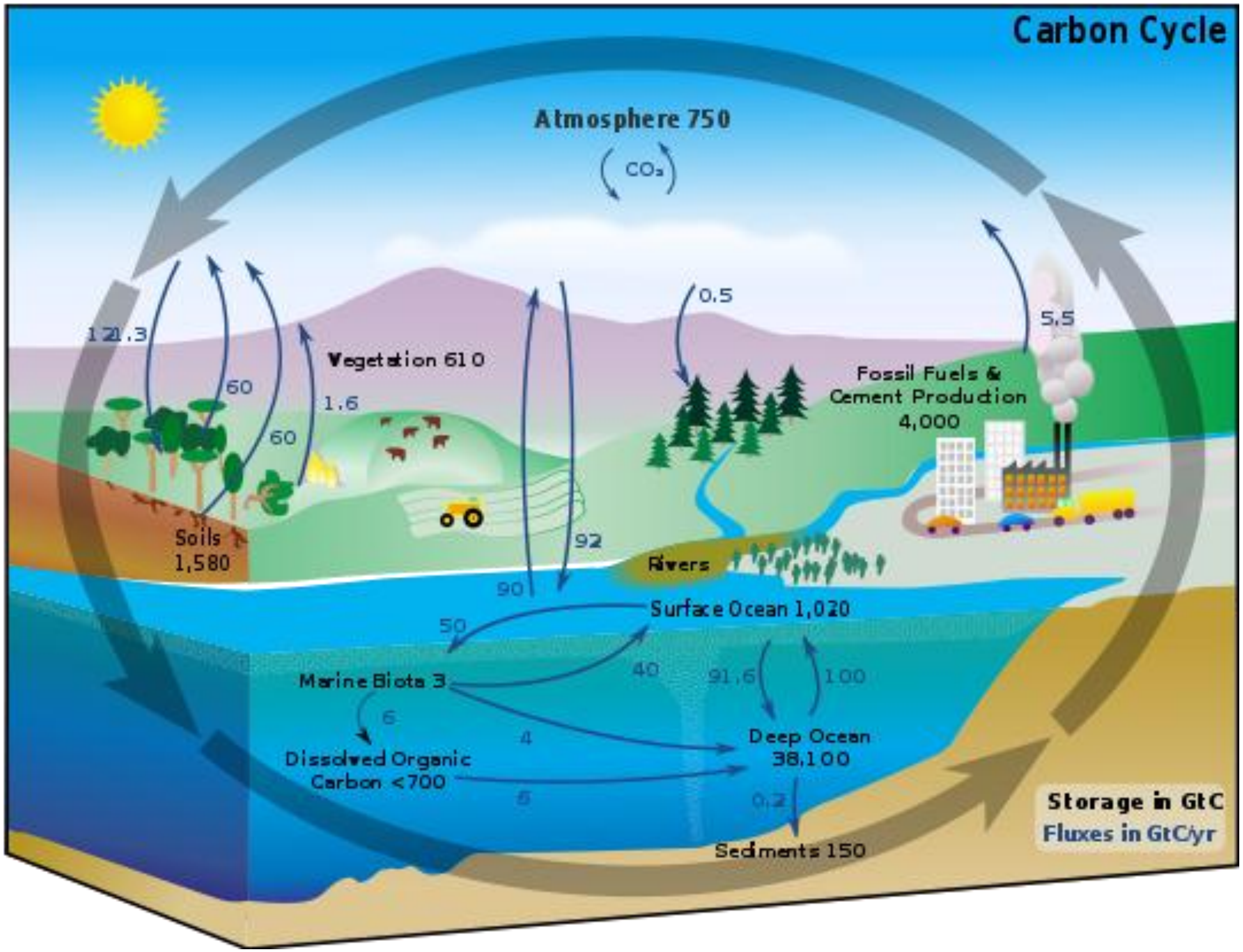
Carbon Cycle



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Carbon Cycle Cont.

The **carbon cycle** is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth. It is one of the most important cycles of the earth and allows for the most abundant element to be recycled and reused throughout the biosphere and all of its organisms.

The carbon cycle is usually thought of as five major reservoirs of carbon interconnected by pathways of exchange. These reservoirs are:

- The atmosphere
- The terrestrial biosphere, which is usually defined to include fresh water systems and non-living organic material, such as soil carbon.
- The oceans, including dissolved inorganic carbon and living and non-living marine biota,
- The sediments including fossil fuels.

Carbon Cycle Cont.

The earth's interior, carbon from the earths mantle and crust is released to the atmosphere and hydrosphere by volcanoes and geothermal systems.

The annual movements of carbon, the carbon exchanges between reservoirs, occur because of various chemical, physical, geological, and biological processes. The ocean contains the largest active pool of carbon near the surface of the Earth, but the deep ocean part of this pool does not rapidly exchange with the atmosphere.

The **global carbon budget** is the balance of the exchanges (incomes and losses) of carbon between the carbon reservoirs or between one specific loop (e.g., atmosphere ↔ biosphere) of the carbon cycle.

An examination of the carbon budget of a pool or reservoir can provide information about whether the pool or reservoir is functioning as a source or sink for carbon dioxide.

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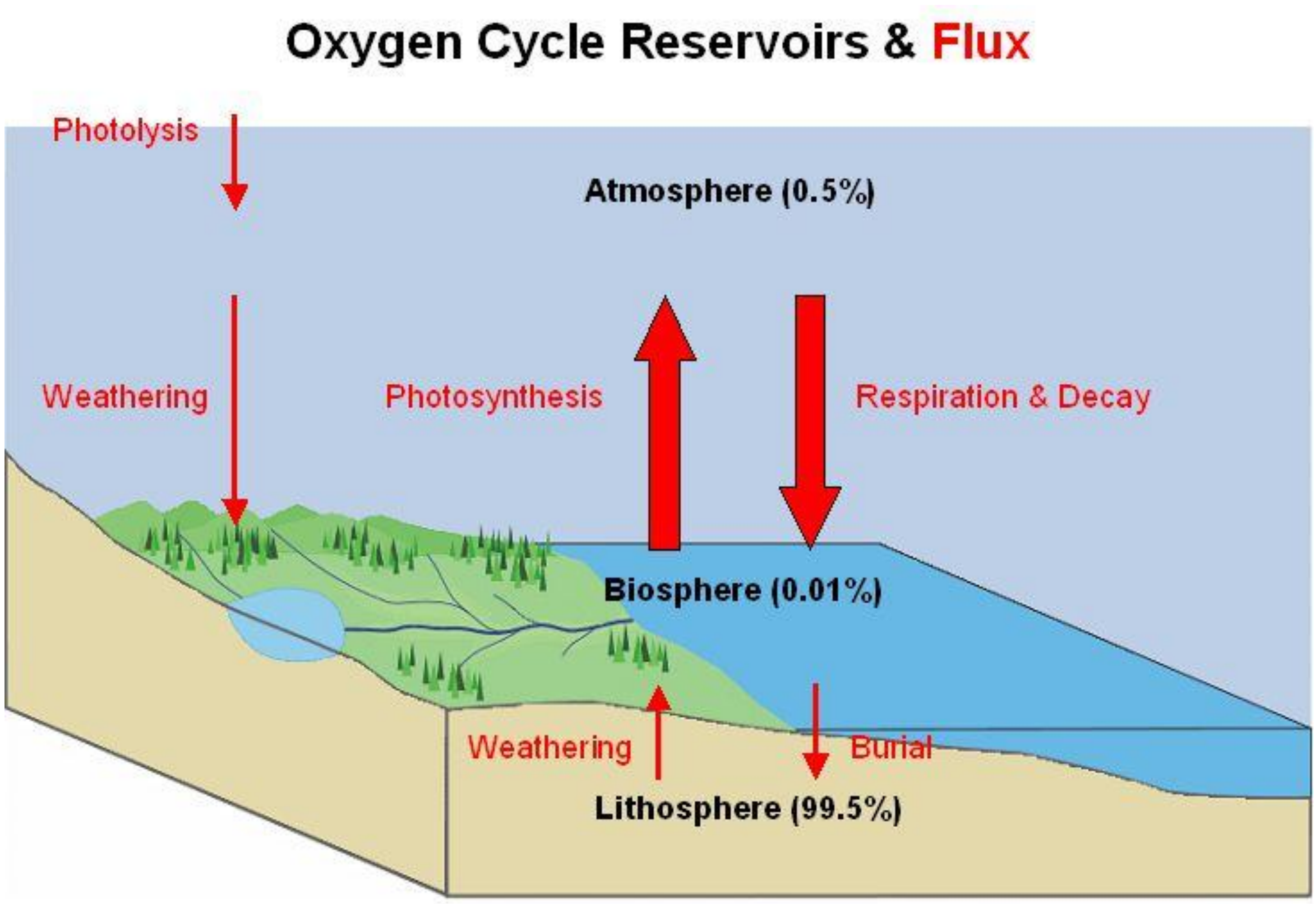
Oxygen Cycle



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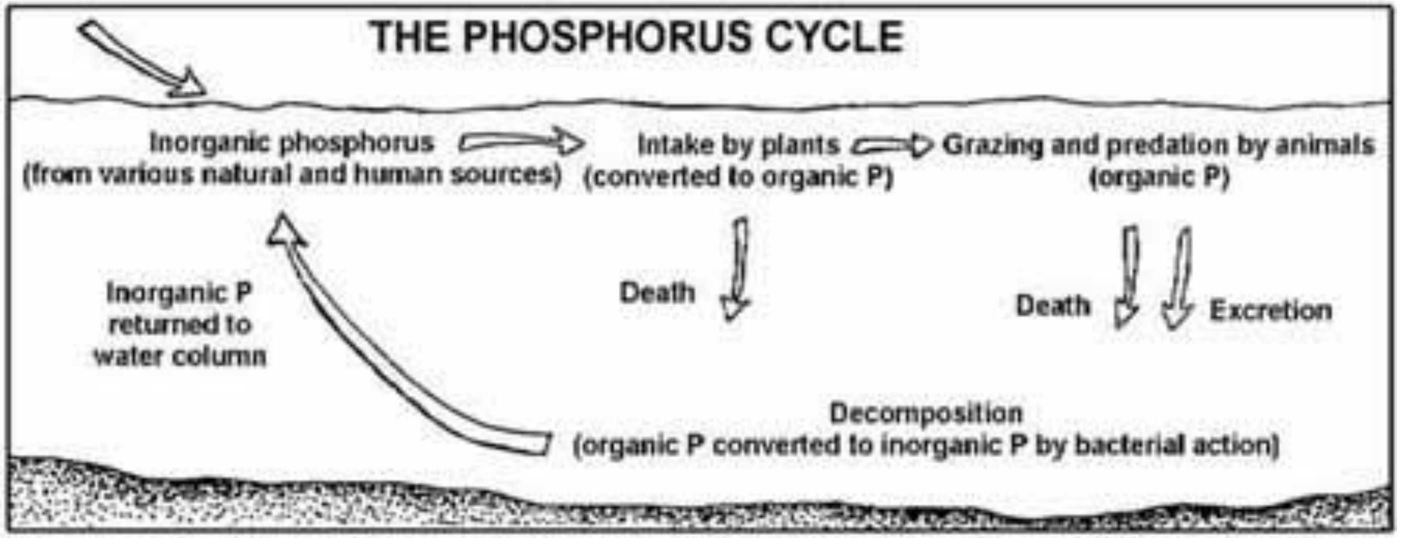
Oxygen Cycle Cont.

The **Oxygen cycle** is the biogeochemical cycle that describes the movement of oxygen within and between its three main reservoirs: the atmosphere (air), the total content of biological matter within the biosphere (the global sum of all ecosystems), and the lithosphere (Earth's crust).

Failures in the oxygen cycle within the hydrosphere (the combined mass of water found on, under, and over the surface of a planet) can result in the development of hypoxic zones. The main driving factor of the oxygen cycle is photosynthesis, which is responsible for the modern Earth's atmosphere and life.

Phosphorous Cycle



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Phosphorous Cycle Cont.

Phosphorus is an essential nutrient for plants and animals in the form of ions. Phosphorus forms parts of important life sustaining molecules but is not very common in the biosphere. Phosphorus does not enter the atmosphere, remaining mostly on land and in rock and soil minerals. 80 percent of the phosphorus is used to make fertilizers and a type of phosphorus such as dilute phosphoric acid is used in soft drinks. Phosphates may be effective in such ways but also causes pollution issues in lakes and streams. Over enrichment of phosphate can lead to algae bloom, because of the excess nutrients. This causes more algae to grow, bacteria consumes the algae and causes more bacteria to grow in large amounts. They use all the oxygen in the water during cellular respiration, causing many fish to die.

Phosphorus normally occurs in nature as part of a phosphate ion, consisting of a phosphorus atom and some number of oxygen atoms, the most abundant form (called orthophosphate). Most phosphates are found as salts in ocean sediments or in rocks. Over time, geologic processes can bring ocean sediments to land, and weathering will carry these phosphates to terrestrial habitats. Plants absorb phosphates from the soil, then bind the phosphate into organic compounds. The plants may then be consumed by herbivores who in turn may be consumed by carnivores. After death, the animal or plant decays, and the phosphates are returned to the soil. Runoff may carry them back to the ocean or they may be reincorporated into rock.

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Phosphorous Cycle Cont.

The primary biological importance of phosphates is as a component of nucleotides, which serve as energy storage within cells (ATP) or when linked together, form the nucleic acids DNA and RNA. Phosphorus is also found in bones, whose strength is derived from calcium phosphate, and in phospholipids (found in all biological membranes). Phosphates move quickly through plants and animals; however, the processes that move them through the soil or ocean are very slow, making the phosphorus cycle overall one of the slowest biogeochemical cycles.

Unlike other cycles of matter compounds, phosphorus cannot be found in air as a gas. This is because at normal temperature and circumstances, it is a solid in the form of red and white phosphorus. It usually cycles through water, soil and sediments. Phosphorus is typically the limiting nutrient found in streams, lakes and fresh water environments. As rocks and sediments gradually wear down, phosphate is released. In the atmosphere phosphorus is mainly small dust particles. Initially, phosphate weathers from rocks. The small losses in a terrestrial system caused by leaching through the action of rain are balanced in the gains from weathering rocks. In soil, phosphate is absorbed on clay surfaces and organic matter particles and becomes incorporated (immobilized). Plants dissolve ionized forms of phosphate. Herbivores obtain phosphorus by eating plants, and carnivores by eating herbivores. Herbivores and carnivores excrete phosphorus as a waste product in urine and feces. Phosphorus is released back to the soil when plants or animal matter decomposes and the cycle repeats.

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Environmental Dimension/Management

Healthy ecosystems provide vital goods and services to humans and other organisms. There are two major ways of reducing negative human impact and enhancing ecosystem services:

a) Environmental management. This direct approach is based largely on information gained from earth science, environmental science and conservation biology.

However, this is management at the end of a long series of indirect causal factors that are initiated by human consumption, so a second approach is through demand management of human resource use.

b) Management of human consumption of resources, an indirect approach based largely on information gained from economics. Herman Daly has suggested three broad criteria for ecological sustainability: renewable resources should provide a sustainable yield (the rate of harvest should not exceed the rate of regeneration); for non-renewable resources there should be equivalent development of renewable substitutes; waste generation should not exceed the assimilative capacity of the environment.

At the global scale and in the broadest sense environmental management involves the oceans, freshwater systems, land and atmosphere, but following the sustainability principle of scale it can be equally applied to any ecosystem from a tropical rainforest to a home garden.

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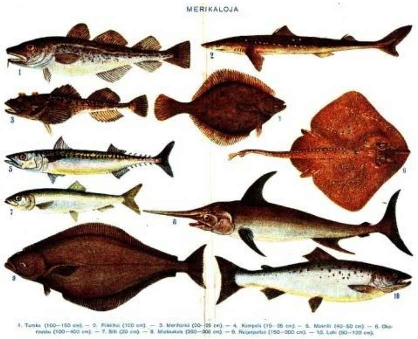

Oceans

Ocean circulation patterns have a strong influence on climate and weather and, in turn, the food supply of both humans and other organisms. Scientists have warned of the possibility, under the influence of climate change, of a sudden alteration in circulation patterns of ocean currents that could drastically alter the climate in some regions of the globe. Major human environmental impacts occur in the more habitable regions of the ocean fringes – the estuaries, coastline and bays. Ten per cent of the world's population – about 600 million people – live in low-lying areas vulnerable to sea level rise.

Trends of concern that require management include: over-fishing (beyond sustainable levels); coral bleaching due to ocean warming and ocean acidification due to increasing levels of dissolved carbon dioxide; and sea level rise due to climate change. Because of their vastness oceans also act as a convenient dumping ground for human waste. Remedial strategies include: more careful waste management, statutory control of overfishing by adoption of sustainable fishing practices and the use of environmentally sensitive and sustainable aquaculture and fish farming, reduction of fossil fuel emissions and restoration of coastal and other marine habitat.

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Freshwater

Water covers 71% of the Earth's surface. Of this, 97.5% is the salty water of the oceans and only 2.5% freshwater, most of which is locked up in the Antarctic ice sheet. The remaining freshwater is found in lakes, rivers, wetlands, the soil, aquifers and atmosphere. All life depends on the solar-powered global water cycle, the evaporation from oceans and land to form water vapor that later condenses from clouds as rain, which then becomes the renewable part of the freshwater supply.

Awareness of the global importance of preserving water for ecosystem services has only recently emerged as, during the 20th century, more than half the world's wetlands have been lost along with their valuable environmental services. Biodiversity-rich freshwater ecosystems are currently declining faster than marine or land ecosystems making them the world's most vulnerable habitats. Increasing urbanization pollutes clean water supplies and much of the world still does not have access to clean, safe water.

In the industrial world demand management has slowed absolute usage rates but increasingly water is being transported over vast distances from water-rich natural areas to population-dense urban areas and energy-hungry desalination is becoming more widely used. Greater emphasis is now being placed on the improved management of blue (harvestable) and green (soil water available for plant use) water, and this applies at all scales of water management.

Land

Loss of biodiversity stems largely from the habitat loss and fragmentation produced by the human appropriation of land for development, forestry and agriculture as natural capital is progressively converted to man-made capital.

Land use change is fundamental to the operations of the biosphere because alterations in the relative proportions of land dedicated to urbanization, agriculture, forest, woodland, grassland and pasture have a marked effect on the global water, carbon and nitrogen biogeochemical cycles and this can impact negatively on both natural and human systems.

At the local human scale major sustainability benefits accrue from the pursuit of green cities and sustainable parks and gardens.

Atmosphere

In March 2009 at a meeting of the Copenhagen Climate Council 2,500 climate experts from 80 countries issued a keynote statement that there is now "no excuse" for failing to act on global warming and that without strong carbon reduction targets "abrupt or irreversible" shifts in climate may occur that "will be very difficult for contemporary societies to cope with". Management of the global atmosphere now involves assessment of all aspects of the carbon cycle to identify opportunities to address human-induced climate change and this has become a major focus of scientific research because of the potential catastrophic effects on biodiversity and human communities.

Other human impacts on the atmosphere include the air pollution in cities, the pollutants including toxic chemicals like nitrogen oxides, sulphur oxides, volatile organic compounds and particulate matter that produce photochemical smog and acid rain, and the chlorofluorocarbons that degrade the ozone layer.

Anthropogenic particulates such as sulphate aerosols in the atmosphere reduce the direct irradiance and reflectance (albedo) of the Earth's surface. Known as global dimming the decrease is estimated to have been about 4% between 1960 and 1990 although the trend has subsequently reversed. Global dimming may have disturbed the global water cycle by reducing evaporation and rainfall in some areas. It also creates a cooling effect and this may have partially masked the effect of greenhouse gases on global warming.

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Forests

Since the Neolithic Revolution about 47% of the world’s forests have been lost to human use. Present-day forests occupy about a quarter of the world’s ice-free land with about half of these occurring in the tropics. In temperate and boreal regions forest area is gradually increasing (with the exception of Siberia), but deforestation in the tropics is of major concern.

Forests moderate the local climate and the global water cycle through their light reflectance (albedo) and evapotranspiration. They also conserve biodiversity, protect water quality, preserve soil and soil quality, provide fuel and pharmaceuticals, and purify the air.

These free ecosystem services have no market value and so forest conservation has little appeal when compared with the economic benefits of logging and clearance which, through soil degradation and organic decomposition returns carbon dioxide to the atmosphere.

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Forests

The United Nations Food and Agriculture Organization (FAO) estimates that about 90% of the carbon stored in land vegetation is locked up in trees and that they sequester about 50% more carbon than is present in the atmosphere. Changes in land use currently contribute about 20% of total global carbon emissions (heavily logged Indonesia and Brazil are a major source of emissions). Climate change can be mitigated by sequestering carbon in reafforestation schemes, plantations and timber products. Also wood biomass can be utilized as a renewable carbon-neutral fuel.

The FAO has suggested that, over the period 2005–2050, effective use of tree planting could absorb about 10–20% of man-made emissions – so monitoring the condition of the world's forests must be part of a global strategy to mitigate emissions and protect ecosystem services.

However, climate change may pre-empt this FAO scenario as a study by the International Union of Forest Research Organizations in 2009 concluded that the stress of a 2.5C (4.5F) temperature rise above pre-industrial levels could result in the release of vast amounts of carbon so the potential of forests to act as carbon "sinks" is "at risk of being lost entirely".

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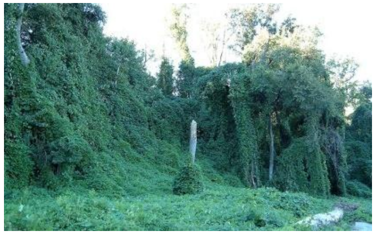
Extinctions

Although biodiversity loss can be monitored simply as loss of species, effective conservation demands the protection of species within their natural habitats and ecosystems. Following human migration and population growth, species extinctions have progressively increased to a rate unprecedented since the Cretaceous–Tertiary extinction event. Known as the Holocene extinction event this current human-induced extinction of species ranks as one of the worlds six mass extinction events. Some scientific estimates indicate that up to half of presently existing species may become extinct by 2100. Current extinction rates are 100 to 1000 times their prehuman levels with more than 10% birds and mammals threatened, about 8% of plants, 5% of fish and more than 20% of freshwater species.

The 2008 IUCN Red List warns that long-term droughts and extreme weather put additional stress on key habitats and, for example, lists 1,226 bird species as threatened with extinction, which is one-in-eight of all bird species. The Red List Index also identifies 44 tree species in Central Asia as under threat of extinction due to over-exploitation and human development and threatening the region's forests which are home to more than 300 wild ancestors of modern domesticated fruit and nut cultivars.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability



Biological Invasions

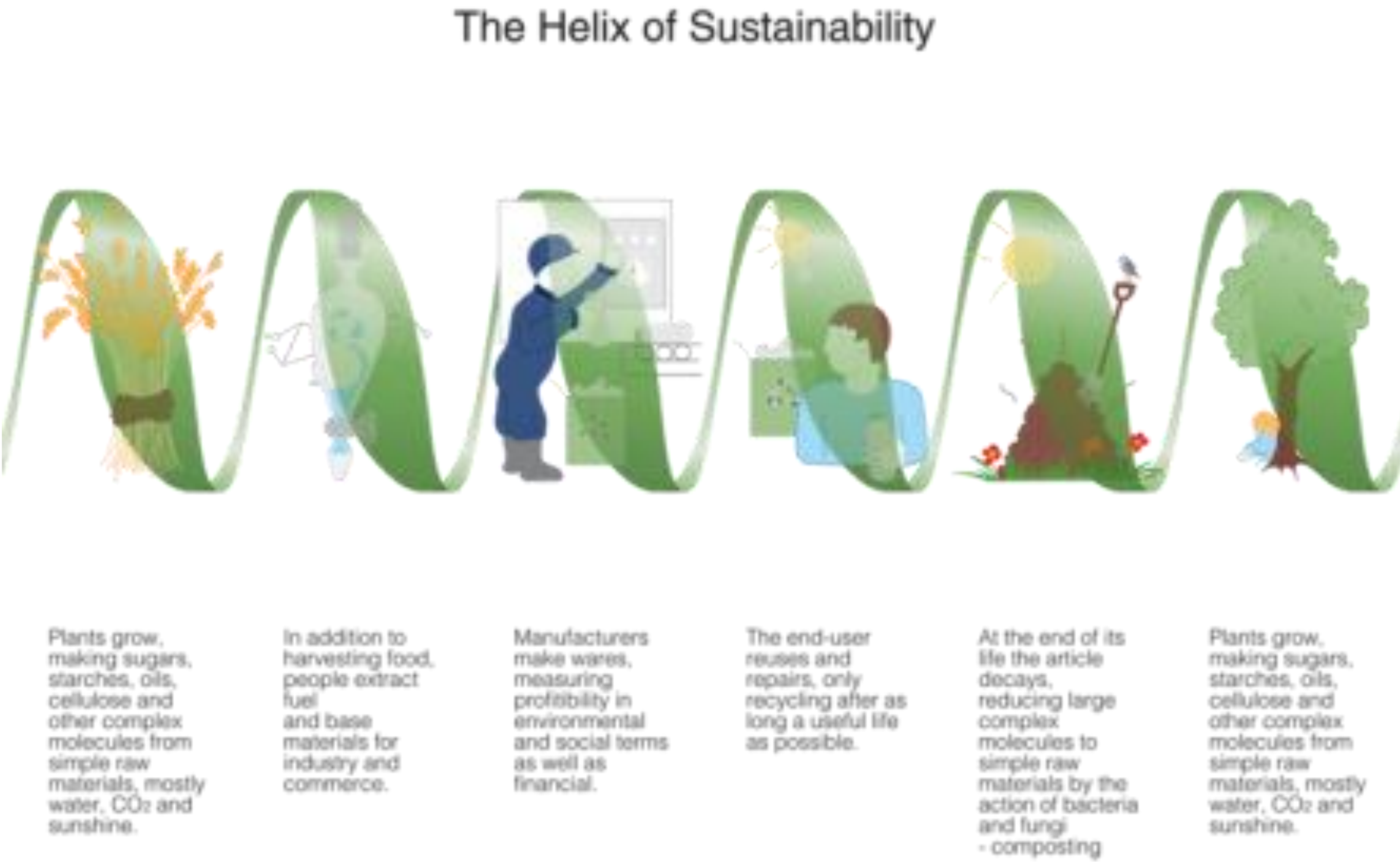
In many parts of the industrial world land clearing for agriculture has diminished and here the greatest threat to biodiversity, after climate change, has become the destructive effect of invasive species. Increasingly efficient global transport has facilitated the spread of organisms across the planet. The potential danger of this aspect of globalization is starkly illustrated through the spread of human diseases like HIV AIDS, mad cow disease, bird flu and swine flu, but invasive plants and animals are also having a devastating impact on native biodiversity.

Non-indigenous organisms can quickly occupy disturbed land and natural areas where, in the absence of their natural predators, they are able to thrive. At the global scale this issue is being addressed through the Global Invasive Species Information Network but there is improved international biosecurity legislation to minimize the transmission of pathogens and invasive organisms.

Also, through CITES legislation there is control the trade in rare and threatened species. Increasingly at the local level public awareness programs are alerting communities, gardeners, the nursery industry, collectors, and the pet and aquarium industries, to the harmful effects of potentially invasive species.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Management of Human Consumption



Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Management of Human Consumption

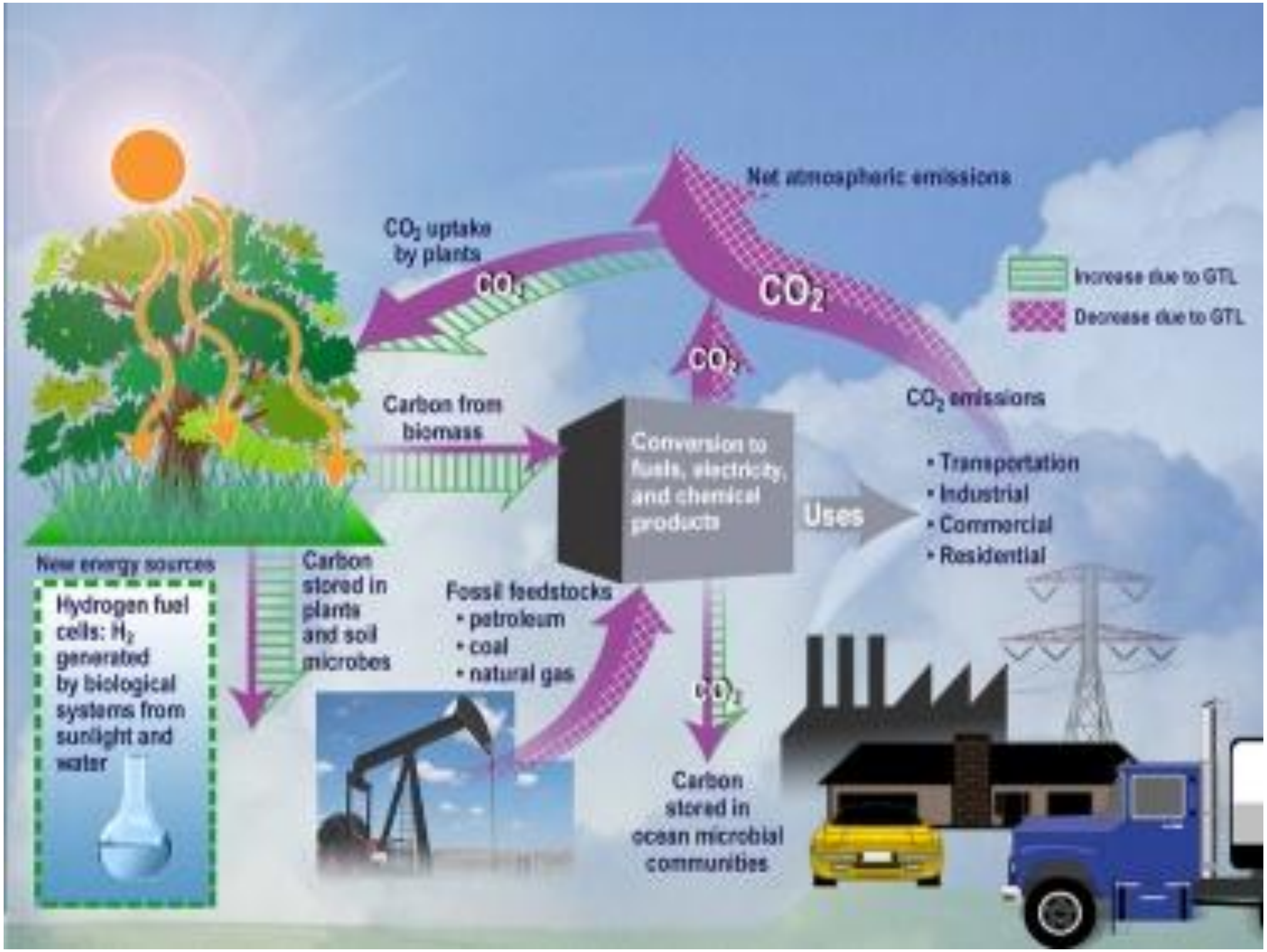
The underlying driver of direct human impacts on the environment is human consumption. This impact is reduced by not only consuming less but by also making the full cycle of production, use and disposal more sustainable.

Consumption of goods and services can be analyzed and managed at all scales through the chain of consumption, starting with the effects of individual lifestyle choices and spending patterns, through to the resource demands of specific goods and services, the impacts of economic sectors, through national economies to the global economy. Analysis of consumption patterns relates resource use to the environmental, social and economic impacts at the scale or context under investigation.

The ideas of embodied resource use (the total resources needed to produce a product or service), resource intensity (the resources needed for each dollar spent on a good or service), and resource productivity (the amount of good or service produced for a given input of resource) are important tools for understanding the impacts of consumption with simple key resource categories indicating human needs being food, energy, materials and water.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Energy



Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Energy Cont.

The Sun's energy, stored by plants (primary producers) during photosynthesis, passes through the food chain to other organisms to ultimately power all living processes. Since the industrial revolution the concentrated energy of the Sun stored in fossilized plants as fossil fuels has been a major driver of technology which, in turn, has been the source of both economic and political power. In 2007 climate scientists of the IPCC concluded that there was at least a 90% probability that atmospheric increase in CO_2 was human-induced, mostly as a result of fossil fuel emissions but, to a lesser extent from changes in land use. Stabilizing the world's climate will require high income countries to reduce their emissions by 60-90% over 2006 levels by 2050 which should hold CO_2 levels at 450-650 ppm from current levels of about 380 ppm. Above this level and temperatures could rise by more than 2 °C (36 °F) to produce "catastrophic" climate change.[104][105] Reduction of current CO_2 levels must be achieved against a background of global population increase and developing countries aspiring to energy-intensive high consumption Western lifestyles.

Reducing greenhouse emissions, referred to as decarbonization, is being tackled at all scales, ranging from tracking the passage of carbon through the carbon cycle to the exploration of renewable energies, developing less carbon-hungry technology and transport systems and attempts by individuals to lead carbon neutral lifestyles by monitoring the fossil fuel use embodied in all the goods and services they use.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Water

Water security and food security are inextricably linked. In the decade 1951-60 human water withdrawals were four times greater than the previous decade. This rapid increase resulted from scientific and technological developments impacting through the economy - especially the increase in irrigated land, growth in industrial and power sectors, and intensive dam construction on all continents.

This altered the water cycle of rivers and lakes, affected their water quality and had a significant impact on the global water cycle. Currently towards 35% of human water use is unsustainable, drawing on diminishing aquifers and reducing the flows of major rivers.

This percentage is likely to increase if climate change worsens, populations increase, aquifers become progressively depleted and supplies become polluted and unsanitary. From 1961 to 2001 water demand doubled - agricultural use increased by 75%, industrial use by more than 200%, and domestic use more than 400%..

Water Cont.

Humans currently use 40-50% of the globally available freshwater in the approximate proportion of 70% for agriculture, 22% for industry, and 8% for domestic purposes and the total volume is progressively increasing.

Water efficiency is being improved on a global scale by increased demand management, improved infrastructure, improved water productivity of agriculture, minimizing the water intensity (embodied water) of goods and services, addressing shortages in the non-industrialized world, concentrating food production in areas of high productivity; and planning for climate change.

At the local level people are becoming more water-self-sufficient by harvesting rainwater and reducing use of mains water.

Food

The American Public Health Association (APHA) defines a "sustainable food system" as "one that provides healthy food to meet current food needs while maintaining healthy ecosystems that can also provide food for generations to come with minimal negative impact to the environment.

A sustainable food system also encourages local production and distribution infrastructures and makes nutritious food available, accessible, and affordable to all. Further, it is humane and just, protecting farmers and other workers, consumers, and communities."

Concerns about the environmental impacts of agribusiness and the stark contrast between the obesity problems of the Western world and the poverty and food insecurity of the developing world have generated a strong movement towards healthy, sustainable eating as a major component of overall ethical consumerism.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Food Cont.

The environmental effects of different dietary patterns depend on many factors, including the proportion of animal and plant foods consumed and the method of food production. The World Health Organization has published a *Global Strategy on Diet, Physical Activity and Health* which was endorsed by the May 2004 World Health Assembly.

It recommends the Mediterranean diet which is associated with health and longevity and is low in meat, rich in fruits and vegetables, low in added sugar and limited salt, and low in saturated fatty acids; the traditional source of fat in the Mediterranean is olive oil, rich in monounsaturated fat.

The healthy rice-based Japanese diet is also high in carbohydrates and low in fat. Both diets are low in meat and saturated fats and high in legumes and other vegetables; they are associated with a low incidence of ailments and low environmental impact.

At the global level the environmental impact of agribusiness is being addressed through sustainable agriculture and organic farming. At the local level there are various movements working towards local food production, more productive use of urban wastelands and domestic gardens including permaculture, urban horticulture, local food, slow food, sustainable gardening, and organic gardening.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Economic Dimension

Sustainability interfaces with economics through the social and ecological consequences of economic activity. Sustainability economics represents: "... a broad interpretation of ecological economics where environmental and ecological variables and issues are basic but part of a multidimensional perspective.

Social, cultural, health-related and monetary/financial aspects have to be integrated into the analysis.“ However the concept of sustainability is much broader than the concepts of sustained yield of welfare, resources or profit margins.

At present the average per capita consumption of people in the developing world is sustainable but population numbers are increasing and individuals are aspiring to high consumption Western lifestyles. The developed world population is only increasing slightly but consumption levels are unsustainable

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Economic Dimension Cont.

The challenge for sustainability is to curb and manage Western consumption while raising the standard of living of the developing world without increasing its resource use and environmental impact.

This must be done by using strategies and technology that break the link between, on the one hand, economic growth and on the other, environmental damage and resource depletion.

In addressing this issue several key areas have been targeted for economic analysis and reform: the environmental effects of unconstrained economic growth; the consequences of nature being treated as an economic externality; and the possibility of a more ethical economics that takes greater account of the social and environmental consequences of market behavior

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Decoupling Environmental Degradation and Economic Growth

In the second half of the 20th century world population doubled, food production tripled, energy use quadrupled, and overall economic activity quintupled.

Historically there has been a close correlation between economic growth and environmental degradation: as communities grow, so the environment declines. This trend is clearly demonstrated on graphs of human population numbers, economic growth, and environmental indicators.

Unsustainable economic growth has been starkly compared to the malignant growth of a cancer because it eats away at the Earth's ecosystem services which are its life-support system. There is concern that, unless resource use is checked, modern global civilization will follow the path of ancient civilizations that collapsed through overexploitation of their resource base.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Decoupling Environmental Degradation and Economic Growth

While conventional economics is concerned largely with economic growth and the efficient allocation of resources, ecological economics has the explicit goal of sustainable scale (rather than continual growth), fair distribution and efficient allocation, in that order.

The World Business Council for Sustainable Development states that "business cannot succeed in societies that fail“. Sustainability studies analyze ways to reduce (decouple) the amount of resource (e.g. water, energy, or materials) needed for the production, consumption and disposal of a unit of good or service whether this be achieved from improved economic management, product design, new technology etc.

Ecological economics includes the study of societal metabolism, the throughput of resources that enter and exit the economic system in relation to environmental quality

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Nature as an Economic Externality

The economic importance of nature is indicated by the use of the expression ecosystem services to highlight the market relevance of an increasingly scarce natural world that can no longer be regarded as both unlimited and free. In general as a commodity or service becomes more scarce the price increases and this acts as a restraint that encourages frugality, technical innovation and alternative products.

However, this only applies when the product or service falls within the market system. As ecosystem services are generally treated as economic externalities they are unpriced and therefore overused and degraded, a situation sometimes referred to as the Tragedy of the Commons.

One approach to this dilemma has been the attempt to "internalize" these "externalities" by using market strategies like ecotaxes and incentives, tradable permits for carbon, water and nitrogen use etc., and the encouragement of payment for ecosystem services. Community currencies such as LETS, a gift economy and Time Banking have also been promoted as a way of supporting local economies and the environment. Green economics is another market-based attempt to address issues of equity and the environment. The global recession and a range of government policies that have been connected to that, are likely to bring the biggest annual fall in the world's carbon dioxide emissions in 40 years

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Economic Opportunity

Treating the environment as an externality may generate short-term profit at the expense of sustainability. Sustainable business practices, on the other hand, integrate ecological concerns with social and economic ones (i.e., the triple bottom line). Growth that depletes ecosystem services is sometimes termed "uneconomic growth" as it leads to a decline in quality of life.

Minimizing such growth can provide opportunities for local businesses. For example, industrial waste can be treated as an "economic resource in the wrong place". The benefits of waste reduction include savings from disposal costs, fewer environmental penalties, and reduced liability insurance. This may lead to increased market share due to an improved public image. Energy efficiency can also increase profits by reducing costs.

The idea of sustainability as a business opportunity has led to the formation of organizations such as the Sustainability Consortium of the Society for Organizational Learning, the Sustainable Business Institute, and the World Council for Sustainable Development. The expansion of sustainable business opportunities can contribute to job creation through the introduction of green-collar workers.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Peace, Security, Social Justice

Social disruptions like war, crime and corruption divert resources from areas of greatest human need, damage the capacity of societies to plan for the future, and generally threaten human well-being and the environment.

Broad-based strategies for more sustainable social systems include improved education and the political empowerment of women, especially in developing countries; greater regard for social justice notably equity between rich and poor both within and between countries; and intergenerational equity.

Depletion of natural resources including fresh water increases the likelihood of "resource wars". This aspect of sustainability has been referred to as environmental security and creates a clear need for global environmental agreements to manage resources such as aquifers and rivers which span political boundaries, and to protect global systems including oceans and the atmosphere.

Human Settlements

One approach to sustainable living, exemplified by small-scale urban transition towns and rural ecovillages, seeks to create self-reliant communities based on principles of simple living, which maximize self-sufficiency particularly in food production. These principles, on a broader scale, underpin the concept of a bioregional economy. Other approaches, loosely based around new urbanism, are successfully reducing environmental impacts by altering the built environment to create and preserve sustainable cities which support sustainable transport.

Residents in compact urban neighborhoods drive fewer miles, and have significantly lower environmental impacts across a range of measures, compared with those living in sprawling suburbs.

Ultimately, the degree of human progress towards sustainability will depend on large scale social movements which influence both community choices and the built environment. Eco-municipalities may be one such movement. Eco-municipalities take a systems approach, based on sustainability principles.

The eco-municipality movement is participatory, involving community members in a bottom-up approach. In Sweden, more than 70 cities and towns — 25 per cent of all municipalities in the country — have adopted a common set of "Sustainability Principles" and implemented these systematically throughout their municipal operations.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Human Relationship to Nature

According to Murray Bookchin, the idea that humans must dominate nature is common in hierarchical societies. Bookchin contends that capitalism and market relationships, if unchecked, have the capacity to reduce the planet to a mere resource to be exploited.

Nature is thus treated as a commodity: "The plundering of the human spirit by the market place is paralleled by the plundering of the earth by capital." Still more basically, Bookchin argued that most of the activities that consume energy and destroy the environment are senseless because they contribute little to quality of life and well being.

The function of work is to legitimize, even create, hierarchy. For this reason understanding the transformation of organic into hierarchical societies is crucial to finding a way forward.

Reference Material From Wikipedia, http://en.wikipedia.org/wiki/Sustainability

Human Relationship to Nature

Social ecology, founded by Bookchin, is based on the conviction that nearly all of humanity's present ecological problems originate in, indeed are mere symptoms of, dysfunctional social arrangements. Whereas most authors proceed as if our ecological problems can be fixed by implementing recommendations which stem from physical, biological, economic etc studies,

Bookchin's claim is that these problems can only be resolved by understanding the underlying social processes and intervening in those processes by applying the concepts and methods of the social sciences.

Deep ecology establishes principles for the well-being of all life on Earth and the richness and diversity of life forms. This is only compatible with a substantial decrease of the human population and the end of human interference with the nonhuman world. To achieve this, deep ecologists advocate policies for basic economic, technological, and ideological structures that will improve the *quality of life* rather than the *standard of living*. Those who subscribe to these principles are obliged to make the necessary change happen.