# Introduction to Environmental Challenges in All Over the World

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**Abstract** The environment that we live in and make use of is being stripped off its precious components day by day. There are many angles from which the problem of environmental challenge can be studied. Similarly, many different views come into play if we need to find practical solutions to these challenges. There are innumerable factors associated with conservation of environment and also these challenges are interrelated. Different factors affected the environment of the Earth as it is in constant conflict with it. In this chapter we explain the most important challenges and the causes and effects of them on human, animal and plant life.

**Keywords** Environmental perturbations · Ecosystem · Living organisms · Pollution

## Introduction

Definition of the environment is the complex of physical, chemical, and biotic factors (as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival. Our environment in the world is constantly changing. There is no denying that. However, as our environment changes, so does the need to become increasingly aware of the problems that surround it. All across the world, people are facing a wealth of new and challenging environmental problems every day. Some of them are small and

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only affect a few ecosystems, but others are drastically changing the landscape of what we already know. The earth planet is poised at the brink of a severe environmental crisis. Current environmental problems make us vulnerable to disasters and tragedies, now and in the future. We are in a state of planetary emergency, with environmental problems piling up high around us. Unless we address the various issues prudently and seriously we are surely doomed for disaster. Current environmental problems require urgent attention.

## The Major Current Environmental Problems

### *Environment Pollution*

Environmental pollution has existed for centuries but only started to be significant following the industrial revolution in the 19th century. Pollution occurs when the natural environment cannot destroy an element without creating harm or damage to itself. The elements involved are not produced by nature, and the destroying process can vary from a few days to thousands of years (that is, for instance, the case for radioactive pollutants). In other words, pollution takes place when nature does not know how to decompose an element that has been brought to it in an unnatural way. Pollution must be taken seriously, as it has a negative effect on natural elements that are an absolute need for life to exist on earth, such as water and air. Indeed, without it, or if they were present on different quantities, animals—including humans—and plants could not survive. We can identify several types of pollution on Earth: air pollution, water pollution and soil pollution (Shafi 2005).

### *Causes of Environmental Pollution*

1. Industries: Industries have been polluting our environment especially since the beginning of the industrial revolution, as mentioned above, notably due to the increasing use of fossil fuels. In the 19th century and for a significant part of the 20th century, coal has been use to make machines work faster, replacing human force. Though pollution by industries mainly causes air pollution, soil and water contamination can also occur. This is particularly the case for power-generating industries, such as plants producing electricity (May they be a dam, a nuclear reactor or some other type of plant). Also, the transportation of this energy can be harmful to the environment. We can take as an example the transportation of petrol through pipelines; if there is a leak in the pipeline, soil will automatically be polluted. At the same time, if the tanker transporting the petrol from its production plant to the place where it will be consumed leaks or sinks, the water will get contaminated.

2. Transportation: Ever since men abandoned animal power to travel, pollution of the environment has become higher and higher. Its levels have only been increasing until now. Similarly to industries, pollution caused by transport can mainly be attributed to fossil fuels. Indeed, humans went from horse carriages to cars, trains (which, before electricity, used to be propelled by coal), and airplanes. As the traffic is increasing every day, pollution follows that evolution.
3. Agricultural Activities: Agriculture is mainly responsible for the contamination of water and soil. This is caused by the increased use of pesticides, as well as by the intensive character of its production. Almost all pesticides are made from chemical substances and are meant to keep diseases and threatening animals away from the crops. However, by keeping these forms of life away, harm is almost always made to the surrounding environment as well. Furthermore, as agriculture gets more and more intensive to feed the increasing world population, more environments and ecosystems are destroyed to make space for the crops. Some of them like rapeseed-used to make oil-demand a lot of space for a relatively small output.
4. Trading Activities: Trading activities including the production and exchange of goods and services. Concerning goods, pollution can be caused by packaging (which often involves the use of plastic, which is made from fossil fuels) or transport, mainly.
5. Residences: Finally, residential areas provide their fair share of pollution as well. First, to be able to build homes, natural environment has to be destroyed in one way or another. Wildlife and plants are driven away and replaced by human constructions. As it requires the work of industries, construction itself is also a source of contamination of the environment. Then, when people settle in, they will produce waste every day, including a part that cannot be processed by the environment without harm yet (Harrison 2001).

## *Effects of Environmental Pollution*

Now that we have identified the main causes of environmental pollution, let us study the negative effects it has:

1. Effects on Humans: The effects of environmental pollution on humans are mainly physical, but can also turn into neuron-affections in the long term. The best-known troubles to us are respiratory, in the form of allergies, asthma, irritation of the eyes and nasal passages, or other forms of respiratory infections. Notably, these well spread affections can be observed when air pollution is high in cities, when the weather gets hot, for instance. On top of that, environmental pollution has been proven to be a major factor in the development of cancer. This can happen for example when we eat reminiscences of pollutants used in the production of processed foods, or pesticides from the crops. Other, rarer, diseases include hepatitis, typhoid affections, diarrhea and hormonal disruptions.

2. Effects on Animals: Environmental pollution mainly affects animal by causing harm to their living environment, making it toxic for them to live in. Acid rains can change the composition of rivers and seas, making them toxic for fishes, an important quantity of ozone in the lower parts of the atmosphere can cause lung problems to all animals. Nitrogen and phosphates in water will cause overgrowth of toxic algae, preventing other forms of life to follow their normal course. Eventually, soil pollution will cause harm and sometimes even the destruction of microorganisms, which can have the dramatic effect of killing the first layers of the primary food chain.
3. Effects on Plants: As for animals, plants, and especially trees, can be destroyed by acid rains (and this will also have a negative effect on animals as well, as their natural environment will be modified), ozone in the lower atmosphere block the plant respiration, and harmful pollutants can be absorbed from the water or soil.
4. Effects on the Ecosystem: In short, environmental pollution, almost exclusively created by human activities, has a negative effect on the ecosystem, destroying crucial layers of it and causing an even more negative effect on the upper layers (Spellman 2009).

## *Types of Pollution*

### Air Pollution

The air that we breathe today is full of toxic and hazardous pollutants. Pollution in the environment could leave mother Earth sapped of its beauty and biodiversity. Each year millions of people die all around the world due to different pollution related problems. The key to live a healthy life is to identify the sources of air pollution and implement practical ways so that you can help stop air pollution.

Many people, when they think of air pollution, they think about smog and car emissions. This is what is called outdoor air pollution but it is more dangerous when it becomes indoor air pollution. Indoor air pollution occurs when certain air pollutants from particles and gases contaminate the air of indoor areas. These air pollutants can cause respiratory diseases or even cancer. Removing the air pollutants can improve the quality of your indoor air. Millions of people around the world prepare their meals using traditional methods (i.e. wood, charcoal, coal, dung, crop wastes) on open fires. Such inefficient practices can increase the amount of air pollutants inside the home and can also cause serious health problems. According to WHO, 4.3 million people a year die from the exposure to household air pollution. This type of pollution is significantly more dangerous due to how concentrated the air is in indoor environments. According to recent findings, over 2 million deaths occur every single year due to indoor air pollution. So what can we do about it? That is the question that many ask themselves every single day. Before you can fully comprehend the effects of indoor air pollution you must first be able to understand the causes of it as well as what we can do to improve our quality of air both indoors and outdoors (Agarwal 2005).

## Water Pollution

Water is the greatest gift of nature. Humans have exploited this natural resource to a level where controlling water pollution is impossible. Here are some important reasons why water is considered as a precious natural resource. The misuse of this can cause damaging consequences and a threat to human life. Here is an interesting way to analyze how water pollution is gradually causing so many deaths worldwide. The use of hazardous chemicals in manufacturing industries and agriculture cause severe water pollution as waste from these industries goes directly into nearby rivers, lakes and ponds without getting treated to remove harmful toxins and compounds. This not only affects the quality of water but also pose danger to several endangered aquatic species. Increase in the water pollution can badly affect marine life and their habitats. Poor people who do not have access to clean drinking water are forced to drink untreated water which makes them prone to water related diseases which directly affects their health (Goel 2006). According to Wikipedia, “Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds. Water pollution affects plants and organisms living in these bodies of water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities.”

## Soil Pollution

With the rise of concrete buildings and roads, one part of the Earth that we rarely see is the soil. It has many different names, such as dirt, mud and ground. However, it is definitely very important to us. The plants that feed us grow in soil and keeping it healthy is essential to maintaining a beautiful planet. However, like all other forms of nature, soil also suffers from pollution. The pollution of soil is a common thing these days, and it happens due to the presence of man-made elements. The main reason why the soil becomes contaminated is due to the presence of manmade waste. The waste produced from nature itself such as dead plants, carcasses of animals and rotten fruits and vegetables only adds to the fertility of the soil. However, our waste products are full of chemicals that are not originally found in nature and lead to soil pollution (Mani and Misra 2009).

## Global Warming and Climate Change

Climate change is yet another environmental problem that has surfaced in last couple of decades. It occurs due to rise in global warming which occurs due to increase in temperature of atmosphere by burning of fossil fuels and release of harmful gases by industries. Climate change has various harmful effects but not limited to melting of polar ice, change in seasons, occurrence of new diseases, frequent occurrence of floods and change in overall weather scenario. For the purpose of current and future impacts, the term “climate change” has become synonymous with modern global warming (Demeritt 2001). The latter, in turn, refers to post–Industrial Revolution changes in global mean surface-air temperature that are hypothesized to have been caused by increased atmospheric concentrations of carbon dioxide ($CO_2$) Fan active greenhouse gas F during the eighteenth, nineteenth, and twentieth centuries. In 1765, the $CO_2$ atmospheric concentration was about 280 parts per million by volume (ppmv); in 2000, it is near 364 (ppmv). The atmospheric concentrations of other greenhouses gases (methane, nitrous oxide, chlorofluorocarbons) have also risen as a result of accelerated economic activity and energy use in the last two centuries. The mean concentration of water vapor F another key greenhouse gas F in the atmosphere has remained at a level of about 3000 (ppmv) throughout the Holocene period (the last 10,000 years).The rapid rise in fossil-fuel combustion as an energy source since the late eighteenth century has caused the observed increase in the atmospheric concentration of 20 $CO_2$. While the post–Industrial Revolution rise in $CO_2$ atmospheric concentration is beyond doubt, the question of whether or not the earth’s mean surface-air temperature has increased relative to the pre–Industrial Revolution level is the focus of intense research. Recent estimates indicate that it has increased between 0.31 and 0.61 °C during the last 150 years (Hansen et al. 2002). A cause-effect linkage between the rise in key greenhouse gases and the estimated increase in the global mean surface-air temperature remains shrouded in uncertainty. This is due to the complex variability of the earth’s climate and its interdependence with multiple terrestrial and extraterrestrial phenomena (Loáiciga 2003).

## Overpopulation

The population of the planet is reaching unsustainable levels as it faces shortage of resources like water, fuel and food. Population explosion in less developed and developing countries is straining the already scarce resources. Intensive agriculture practiced to produce food damages the environment through use of chemical fertilizer, pesticides and insecticides. Overpopulation is one of the crucial current environmental problems.

Overpopulation is already affecting the 750 million people worldwide who have no access to potable water sources, and 2.5 billion are without proper sanitation. Many believe we've passed or are in the throes of a peak-water situation, meaning voracious demand has outpaced renewable supply, and ecological costs outweigh benefits of extraction. Besides industrial pollution, much of the water crisis is due to intensive agriculture designed to feed a growing number of humans: the latter half of the twentieth century saw irrigation systems nearly triple worldwide, from 100 million ha in 1950 to 280 million ha in 2000, to feed the burgeoning population. Consequently, many nations have dipped into non-renewable underground aquifers as global water supplies have been polluted or strained. The United Nations states that by 2025, 1.8 billion people may inhabit areas of "absolute water scarcity" (less than 1000 $m^3$ of water available per person per year), while two-thirds of the global population may be living in "water-stressed" regions (less than 1700 $m^3$ of water available per person per year). To put Western water consumption into perspective: sustaining the global population on average European or North American water habits would require water from 3.5 Earths.

## Natural Resource Depletion

Natural resource depletion is another crucial current environmental problem. Fossil fuel consumption results in emission of Greenhouse gases, which is responsible for global warming and climate change. Globally, people are taking efforts to shift to renewable sources of energy like solar, wind, biogas and geothermal energy. The cost of installing the infrastructure and maintaining these sources has plummeted in the recent years.

### *What Causes Natural Resource Depletion?*

One of the central causes to natural resource depletion is human activity, particularly as it relates to economic growth. Given the rise of the world population, Humans are becoming more and more reliant on food production for daily nutritional needs, which in turn is causing serious stress to the land and the environment. The main driving force leading to pressure on land resources has been increasing food production. Today food is needed for two billion more people than lived on the Earth three decades ago. Inefficient irrigation schemes can cause salinization and alkalization of soil, resulting in an estimated ten million hectares (38,610 square miles) of irrigated land abandoned annually. Humans also contribute to land degradation through poor soil management practices, deforestation, removal of natural vegetation, use of heavy machinery, overgrazing of livestock, and improper crop rotation" (Viotti and Kauppi 2013). Humans have been cutting trees for agriculture at very high rates. In addition, the increased uses of wood have continued to reduce the size of forests. As we are becoming more careless with our practices, as well as demanding more and more food, this in turn will continue to lead to natural resource depletion. As scholars point out, some of the underlying causes of natural resource depletion are the conditions facing humans. When humans need food, when they are in poverty (Viotti and Kauppi 2013), when they need employment, or ways to bring in income, they may look towards these practices such as deforestation, or agriculture without correct crop rotation, which in turn can and will continue to deplete the earth.

## *Forest Depletion*

When looking at the world's forests, one finds a depletion of natural resources; "The net loss of the global forest area (deforestation plus reforestation) in the last decade of the 20th century was about 94 million ha (363,000 square miles), the equivalent of 2.4% of total world forests. Deforestation of tropical forests is almost 1% annually" (Viotti and Kauppi 2013). When looking at natural resource depletion in places such as Latin America, one will find that issues such as tropical deforestation is a very real and continued threat to natural resources and the environment as a whole (Rowntree et al. 2015).

In fact, tropical forests are among the most at risk areas of earth as it pertains to deforestation. Thus, not only are plant and animal life affected with this tropical deforestation, but these actions also lead to an increase of additional $CO_2$s. According to scholars, "Current estimates suggest that fully 20% of all human-causes GHG emissions result from cutting and burning tropical forests" (Rowntree et al. 2015). But, as people continue to harm the forests for wood, palm oil, or other resources, it is expected that the negative effects on natural resource depletion related to forests and tropical forests will continue. And because of the human causes of natural resource depletion, many have asked whether current behaviors towards natural resources can continue the way that they are going, and if so, what the effects of this behavior will be.

## *What Are the Effects of Natural Resource Depletion?*

Current patterns of energy and natural resource use, agricultural practices, and urbanization appear to be largely unsustainable and require urgent remediation. Left unchecked, these patterns will lead to dangerous climate change and reduced economic growth, as a result of increased economic, social, and environmental costs and decreased productivity. Many of the world's natural resources have been greatly reduced do to human economic development in recent decades. In fact, the pace and scale of environmental damage has been well documented. More than one quarter of the world's land surface has been degraded as a result of soil erosion, salinization, nutrient depletion, and. Water withdrawals tripled in the past 50 years, leading to water scarcity and groundwater depletion. In developing countries, withdrawals are projected to increase by another 50% by 2030, by which time more than 5 billion people-two-thirds of the world's people-could be living in areas facing moderate to severe water stress (WRI forthcoming). Growth has also strained ecosystems. Roughly 60% of the world's ecosystem services are now of lower quality than they were 50 years ago, the current rate of species extinction is 100–1000 times higher than in prehuman days, and all of the planet's 13 hottest years on record have occurred since 1997 (Steer 2013).

There are also many economic effects as a result of current and historical natural resource depletion. For example, if one of the natural resources that are depleted is soil, then this will impact the agricultural output by those who are reliant on healthy soil for their income and economic livelihood. If individuals have depleted the soil, and the proper conditions no longer exist for efficient crop growth, then this will lead to lower output, and in turn will bring an individual, society, or state less income. In addition, from an international relations perspective, one also has to think about the effects of natural resource depletion on conflict. As it has been argued, "Conflict over natural resources may increase and significantly endanger development efforts in contexts where increased competition over natural resources spills over into the political sphere and leads to political violence" (Inforesources 2005).

## Waste Disposal

Waste disposal is one of urgent current environmental problem. Waste management is the handling of discarded materials. Recycling and composting, which transform waste into useful products, are forms of waste management. The management of waste also includes disposal, such as landfilling. Waste can be almost anything, including food, leaves, newspapers, bottles, construction debris, and chemicals from a factory, candy wrappers, disposable diapers, old cars, or radioactive materials. People have always produced waste, but as industry and technology have evolved and the human population has grown, waste management has become increasingly complex. A primary objective of waste management today is to protect the public and the environment from potentially harmful effects of waste. Some waste materials are normally safe, but can become hazardous if not managed properly. For example, 1 gal (3.75 l) of used motor oil can potentially contaminate one million gal (3,790,000 l) of drinking water. Every individual, business, or organization must make decisions and take some responsibility regarding the management of his or her waste. On a larger scale, government agencies at the local, state, and federal levels enact and enforce regulations governing waste management. These agencies also educate the public about proper waste management. In addition, local government agencies may provide disposal or recycling services, or they may hire or authorize private companies to perform those functions (Guerrero et al. 2013).

Throughout history, there have been four basic methods of managing waste: dumping it, burning it, finding another use for it (reuse and recycling), and not creating the waste in the first place (waste prevention). How those four methods are utilized depends on the wastes being managed. Municipal solid waste is different from industrial, agricultural, or mining waste. Hazardous waste is a category that should be handled separately, although it sometimes is generated with the other types (Tchobanoglous and Kreith 2002).

The first humans did not worry much about waste management. They simply left their garbage where it dropped. However, as permanent communities developed, people began to dispose of their waste in designated dumping areas. The use of such “open dumps” for garbage is still common in many parts of the world. Open dumps have major disadvantages, however, especially in heavily populated areas. Toxic chemicals can filter down through a dump and contaminate groundwater. The liquid that filters through a dump or landfill is called leachate. Dumps may also generate methane, a flammable and explosive gas produced when organic wastes decompose under anaerobic (oxygen-poor) conditions (Tchobanoglous and Kreith 2002).

The landfill, also known as the “sanitary landfill,” was invented in England in the 1920s. At a landfill, the garbage is compacted and covered at the end of every day with several inches of soil. Landfilling became common in the United States in the 1940s. By the late 1950s, it was the dominant method for disposing municipal solid waste in the nation. Early landfills had significant problems with leachate and methane, but those have largely been resolved at facilities built since about the early 1970s. Well-engineered landfills are lined with several feet of clay and with thick plastic sheets. Leachate is collected at the bottom, drained through pipes, and processed. Methane gas is also safely piped out of many landfills. The dumping of waste does not just take place on land. Ocean dumping, in which barges carry garbage out to sea was once used as a disposal method by some United States coastal cities and is still practiced by some nations. Sewage sludge, or waste material from sewage treatment, was dumped at sea in huge quantities by New York City as recently as 1992, but this is now prohibited in the United States. Also called bio solids, sewage sludge is not generally considered solid waste, but it is sometimes composted with organic municipal solid waste (Christensen 1989).

Burning has a long history in municipal solid waste management. Some American cities began to burn their garbage in the late nineteenth century in devices called cremators. These were not very efficient, however, and cities went back to dumping and other methods. In the 1930s and 1940s, many cities built new types of more-efficient garbage burners known as incinerators. The early incinerators were rather dirty in terms of their emissions of air pollutants, and beginning in the 1950s they were gradually shut down. However, in the 1970s, waste burning enjoyed another revival. These newer incinerators, many of which are still in operation, are called “resource recovery” or “waste-to-energy” plants. In addition to burning garbage, they produce heat or electricity that can be used in nearby buildings or residences, or sold to a utility. Many local governments became interested in waste-to-energy plants following the energy crisis in 1973. However, since the mid-1980s, it became difficult to find locations to build these facilities, mainly because of public opposition focused on air-quality issues. Another problem with incineration is that it generates ash, which must be landfilled. Incinerators usually reduce the volume of garbage by 70–90%. The remainder of the incinerated waste comes out as ash that often contains high concentrations of toxic substances. Municipal solid waste will likely always be landfilled or burned to some extent. In the past 25 years, however, non-disposal methods such as waste prevention and recycling have become more common. Because of public concerns and the high costs of landfilling and burning (especially to build new facilities), local governments want to reduce the amount of waste that must be disposed in these ways. Municipal solid waste is a relatively small part of the overall waste generated in the United States. More than 95% of the total 4.5 billion tons of solid waste generated in the United States each year is agricultural, mining, or industrial waste. These wastes do not receive nearly as much attention as municipal solid waste, because most people do not have direct experience with them. Also, agricultural and mining wastes, which make up 88% of the overall total of solid waste, are largely handled at the places they are generated, that is, in the fields or at remote mining sites. Mining nearly always generates substantial waste, whether the material being mined is coal, clay, sand, gravel, building stone, or metallic ore. Early mining concentrated on the richest lodes of minerals. Because modern methods of mining are more efficient, they can extract the desired minerals from veins that are less rich. However, much more waste is produced in the process (Tchobanoglous and Kreith 2002).

Many of the plant and animal wastes generated by agriculture remain in the fields or rangelands. These wastes can be beneficial because they return organic matter and nutrients to the soil. However, modern techniques of raising large numbers of animals in small areas generate huge volumes of animal waste, or manure. Waste in such concentrated quantities must be managed carefully, or it can contaminate groundwater or surface water (Tchobanoglous and Kreith 2002).

Industrial wastes that are not hazardous have traditionally been sent to landfills or incinerators. The rising cost of disposal has prompted many companies to seek alternative methods for handling these wastes, such as waste prevention and recycling. Often a manufacturing plant can reclaim certain waste materials by feeding them back into the production process (Tchobanoglous and Kreith 2002).

Hazardous wastes are materials considered harmful or potentially harmful to human health or the environment. Wastes may be deemed hazardous because they are poisonous, flammable, or corrosive, or because they react with other substances in a dangerous way. Industrial operations have produced large quantities of hazardous waste for hundreds of years. Some hazardous wastes, such as mercury and dioxins, may be released as gases or vapors. Many hazardous industrial wastes are in liquid form. One of the greatest risks is that these wastes will contaminate water supplies. An estimated 60% of all hazardous industrial waste in the United States is disposed using a method called deep-well injection. With this technique, liquid wastes are injected through a well into an impervious rock formation that keeps the waste isolated from groundwater and surface water. Other methods of underground burial are also used to dispose hazardous industrial waste and other types of dangerous material. Pesticides used in farming may contaminate agricultural waste. Because of the enormous volumes of pesticides used in agriculture, the proper handling of unused pesticides is a daunting challenge for waste managers. Certain mining techniques also utilize toxic chemicals. Piles of mining and metal-processing waste, known as waste rock and tailings, may contain hazardous substances. Because of a reaction with the oxygen in the air, large amounts of toxic acids may form in waste rock and tailings and leach into surface waters (Tchobanoglous and Kreith 2002).

Public attitudes also play a pivotal role in decisions about waste management. Virtually every proposed new landfill or waste-to-energy plant is opposed by people who live near the site. Public officials and planners refer to this reaction as NIMBY, which stands for "Not in My Backyard." If an opposition group becomes vocal or powerful enough, a city or county council is not likely to approve a proposed waste-disposal project. The public also wields considerable influence with businesses. Recycling and waste prevention initiatives enjoy strong public support. About 19% of United States municipal solid waste was recycled or composted in 1994, 10% was incinerated, and 71% was landfilled. Preventing or reducing waste is typically the least expensive method for managing waste. Waste prevention may also reduce the amount of resources needed to manufacture or package a product. For example, most roll-on deodorants once came in a plastic bottle, which was inside a box. Beginning about 1992, deodorant manufacturers redesigned the bottle so that it would not tip-over easily on store shelves, which eliminated the need for the box as packaging. This is the type of waste prevention called source reduction. It can save businesses money, while also reducing waste. Waste prevention includes many different practices that result in using fewer materials or products, or using materials that are less toxic. For example, a chain of clothing stores can ship its products to its stores in reusable garment bags, instead of disposable plastic bags. Manufacturers of household batteries can reduce the amount of mercury in their batteries. In an office, employees can copy documents on both sides of a sheet of paper, instead of just one side. A family can use cloth instead of paper napkins (Tchobanoglous and Kreith 2002).

Composting grass clippings and tree leaves at home, rather than having them picked up for disposal or municipal composting is another form of waste prevention. A resident can leave grass clippings on the lawn after mowing (this is known as grass-cycling), or can compost leaves and grass in a backyard composting bin, or use them as mulch in the garden (Tchobanoglous and Kreith 2002).

When the current recycling boom began in the late 1980s, markets for the recyclables were not sufficiently considered. A result was that some recyclable materials were collected in large quantities but could not be sold, and some ended up going to landfills. Today, the development of recycling markets is a high priority. "Close the loop" is a catch-phrase in recycling education; it means that true recycling (i.e., the recycling loop) has not taken place until the new product is purchased and used. The high cost of government-created recycling programs is often criticized. Supporters of recycling argue it is still less expensive than land-filling or incineration, when all costs are considered. Another concern about recycling is that the recycling process itself may generate hazardous wastes that must be treated and disposed. Recycling of construction and demolition (C&D) debris is one of the growth areas for recycling. Although C&D debris is not normally considered a type of municipal solid waste, millions of tons of it have gone to municipal landfills over the years. If this material is separated at the construction or demolition site into separate piles of concrete, wood, and steel, it can usually be recycled. Composting is considered either a form of recycling, or a close relative. Composting occurs when organic waste—such as yard waste, food waste, and paper-is broken down by microbial processes. The resulting material, known as compost, can be used by landscapers and gardeners to improve the fertility of their soil. Yard waste, primarily grass clippings and tree leaves, makes up about one-fifth of the weight of municipal solid waste. Some states do not allow this waste to be disposed. These yard-waste bans have resulted in rapid growth for municipal composting programs. In these programs, yard waste is collected by trucks (separately from garbage and recyclables) and taken to a composting plant, where it is chopped up, heaped, and regularly turned until it becomes compost (Tchobanoglous and Kreith 2002).

Biological treatment, a technique for handling hazardous wastes, could be called a high-tech form of composting. Like composting, biological treatment employs microbes to break down wastes through a series of metabolic reactions. Many substances that are toxic, carcinogenic (cancer-causing), or undesirable in the environment for other reasons can be rendered harmless through this method. Extensive research on biological treatment is in progress. Genetic engineering, a controversial branch of biology dealing with the modification of genetic codes, is closely linked with biological treatment, and could produce significant advances in this field. Waste management became a particularly expensive proposition during the 1990s, especially for disposal. Consequently, waste managers constantly seek innovations that will improve efficiency and reduce costs. Several new ideas in land-filling involve the reclamation of useful resources from wastes.

For example, instead of just burning or releasing the methane gas that is generated within solid-waste landfills, some operators collect this gas, and then use it to produce power locally or sell it as fuel. At a few landfills, managers have experimented with a bold but relatively untested concept known as landfill mining. This involves digging up an existing landfill to recover recyclable materials, and sometimes to re-bury the garbage more efficiently. Landfill mining has been criticized as costly and impractical, but some operators believe it can save money under certain circumstances. In the high-tech world of incineration, new designs and concepts are constantly being tried. One waste-to-energy technology for solid waste being introduced to the United States is called fluidized-bed incineration. About 40% of incinerators in Japan use this technology, which is designed to have lower emissions of some air pollutants than conventional incinerators.

A 1994 United States Supreme Court ruling could increase the cost of incineration significantly. The Court ruled that some ash produced by municipal solid-waste incinerators must be treated as a hazardous waste, because of high levels of toxic substances such as lead and cadmium. This means that incinerator ash now has to be tested, and part or all of the material may have to go to a hazardous waste landfill rather than a standard landfill. A much smaller type of incinerator is used at many hospitals to burn medical wastes, such as blood, surgical waste, syringes, and laboratory waste. The safety of these medical waste incinerators has become a major issue in some communities. A study by the Environmental Protection Agency released in 1994 found that medical waste incinerators were leading sources of dioxin emissions into the air. The same study warned that dioxins, which can be formed by the burning of certain chemical compounds, pose a high risk of causing cancer and other health hazards in humans. As a hazardous waste, because of high levels of toxic substances such as lead and cadmium. This means that incinerator ash now has to be tested, and part or all of the material may have to go to a hazardous waste landfill rather than a standard landfill.

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## Loss of Biodiversity

Biodiversity means the variety of life, including variation among genes, species, and functional traits.

- Richness: number of unique life forms
- Evenness: equitability among life forms
- Heterogeneity: dis-similarity among life forms.

Ecosystem functions are ecological processes that control the fluxes of energy, nutrients, and organic matter through an environment. Examples include …

- Primary production: the process by which plants use sunlight to convert inorganic matter into new biological tissue
- Nutrient cycling: the process by which biologically essential nutrients are captured, released, and then recaptured
- Decomposition: the process by which organic wastes like dead plants and animals are broken-down and recycled.

Ecosystem Services are the suite of benefits that ecosystems provide to humanity

- Provisioning services: Production of renewable resources (e.g., food, wood, freshwater)
- Regulating services: Processes that lessen environmental change (e.g., climate regulation, pest/disease control).

Loss of diversity across trophic levels has the potential to influence ecosystem functions even more Loss of diversity across trophic levels has the potential to influence ecosystem functions even more strongly than diversity loss within trophic levels Much work has shown that food web interactions are key mediators of ecosystem functioning, and that loss of higher consumers can cascade through a food web to influence plant biomass. Loss of one or a few top predator species can reduce plant biomass by at least as much as does the transformation of a diverse plant assemblage into a species monoculture. Loss of consumers can also alter vegetation structure, fire frequency, and even disease epidemics in a range of ecosystems 51. Strongly than diversity loss within trophic levels much work has shown that food web interactions are key mediators of ecosystem functioning, and that loss of higher consumers can cascade through a food web to influence plant biomass. Loss of one or a few top predator species can reduce plant biomass by at least as much as does the transformation of a diverse plant assemblage into a species monoculture. Loss of consumers can also alter vegetation structure, fire frequency, and even disease epidemics in a range of ecosystems. We can find the very complex relationship between ecosystem, Biodiversity and global change (Fig. 1).

Human activity is leading to the extinction of species and habitats and loss of bio-diversity. Eco systems, which took millions of years to perfect, are in danger when any species population is decimating. Balance of natural processes like

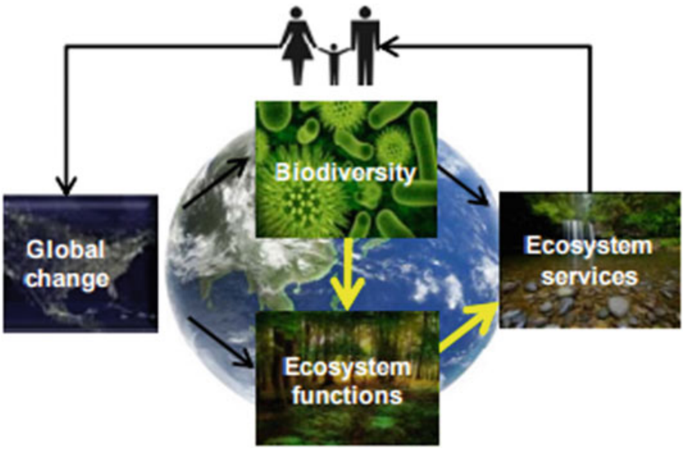


**Fig. 1** Relationship between ecosystem, biodiversity and global change

pollination is crucial to the survival of the eco-system and human activity threatens the same. Another example is the destruction of coral reefs in the various oceans, which support the rich marine life (Cardinale 2012).

## Ozone Layer Depletion

The ozone layer is not really a layer at all, but has become known as such because most ozone particles are scattered between 19 and 30 km (12–30 miles) up in the Earth's atmosphere, in a region called the stratosphere. The concentration of ozone in the ozone layer is usually under 10 parts ozone per million. Without the ozone layer, a lot of ultraviolet (UV) radiation from the Sun would not be stopped reaching the Earth's surface, causing untold damage to most living species. In the 1970s, scientists discovered that chlorofluorocarbons (CFCs) could destroy ozone in the stratosphere. Ozone is created in the stratosphere when UV radiation from the Sun strikes molecules of oxygen ($O_2$) and causes the two oxygen atoms to split apart. If a freed atom bumps into another $O_2$, it joins up, forming ozone ($O_3$). This process is known as photolysis. Ozone is also naturally broken down in the stratosphere by sunlight and by a chemical reaction with various compounds containing nitrogen, hydrogen and chlorine. These chemicals all occur naturally in the atmosphere in very small amounts. In an unpolluted atmosphere there is a balance between the amount of ozone being produced and the amount of ozone being destroyed. As a result, the total concentration of ozone in the stratosphere remains relatively constant. At different temperatures and pressures (i.e. varying altitudes within the stratosphere), there are different formation and destruction rates. Thus, the amount of ozone within the stratosphere varies according to altitude. Ozone concentrations are highest between 19 and 23 km. Most of the ozone in the stratosphere is formed over the equator where the level of sunshine striking the Earth is greatest. It is transported by winds towards higher latitudes. Consequently, the amount of stratospheric ozone above a location on the Earth varies naturally with latitude, season, and from day-to-day. Under normal circumstances highest ozone values are found over the Canadian Arctic and Siberia, whilst the lowest values are found around the equator. The ozone layer over Canada is normally thicker in winter and early spring, varying naturally by about 25% between January and July. Weather conditions can also cause considerable daily variations.

Ultraviolet radiations (UVR), are high energy electromagnetic waves emitted from the Sun. UV radiation includes UV-A, the least dangerous form of UV radiation, UV-B, and UV-C, which is the most dangerous. UV-C is unable to reach the Earth's surface due to stratospheric ozone's ability to absorb it. The real threat comes from UV-B, which can enter the Earth's atmosphere, and has adverse effects (Fig. 2).

Ozone layer depletion first captured the attention of the whole world in the latter half of 1970, and since then, a lot of research has been done to find its possible effects and causes. Various studies have been undertaken to find out possible solutions. Let us take a look at some of the causes and effects of ozone layer depletion.

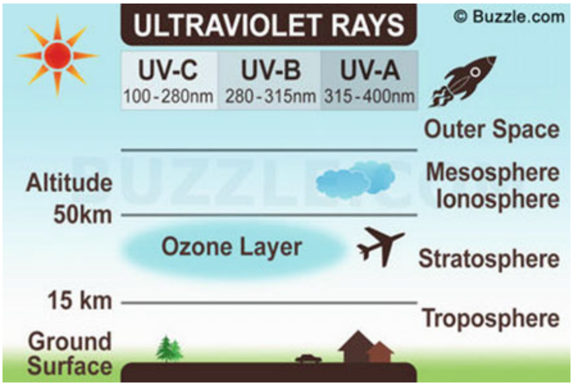


**Fig. 2** Different type of Ultraviolet radiations

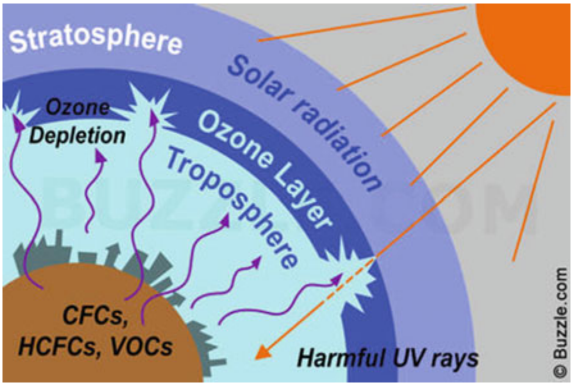


**Fig. 3** Ozone Depletion Ozone by CFCs, VOCs, HCFCs

Causes of Ozone Depletion Ozone is a triatomic form of oxygen ($O_3$), found in the Earth's atmosphere. A combination of low temperatures, elevated chlorine, and bromine concentrations in the upper stratosphere are responsible for the destruction of ozone. The production and emission of chlorofluorocarbons (CFCs), is the leading cause of ozone layer depletion. CFC's account for almost 80% of the total depletion of ozone. Other ozone-depleting substances (ODS), include hydro chlorofluorocarbons (HCFCs), and volatile organic compounds (VOCs). These are often found in vehicle emissions, byproducts of industrial processes, refrigerants, and aerosols. ODS are relatively stable in the lower atmosphere of the Earth, but in the stratosphere, they are exposed to ultraviolet radiation and thus, they break down to release a free chlorine atom. This free chlorine atom reacts with an ozone molecule ($O_3$), and forms chlorine monoxide (ClO), and a molecule of oxygen. Now, ClO reacts with an ozone molecule to form a chlorine atom, and two molecules of oxygen. The free chlorine molecule again reacts with ozone to form chlorine monoxide. The process continues, and this results in the depletion of the ozone layer (Fig. 3).

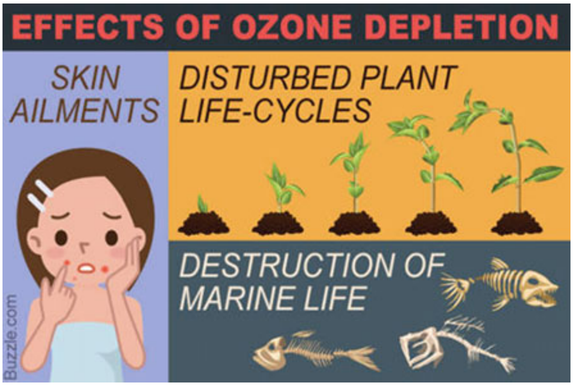


**Fig. 4** Effects of ozone depletion on Humans, Amphibians, Marine Ecosystemsand Plants

As ozone depletes in the stratosphere, it forms a 'hole' in the layer. This hole enables harmful ultraviolet rays to enter the Earth's atmosphere. Ultraviolet rays of the Sun are associated with a number of health-related and environmental issues. Let us take a look at how ozone depletion affects different life forms (Fig. 4).

## *Impact on Humans*

- Skin cancer: Exposure to ultraviolet rays poses an increased risk of developing several types of skin cancers, including malignant melanoma, and basal and squamous cell carcinoma.
- Eye damage: Direct exposure to UV radiations can result in photo keratitis (snow blindness), and cataracts.
- Immune system damage: Effects of UV rays include impairment of the immune system. Increased exposure to UV rays weakens the response of the immune system.
- Accelerated aging of skin: Constant exposure to UV radiation can cause photo allergy, which results in the outbreak of rashes in fair-skinned people.
- Other effects: Ozone chemicals can cause difficulty in breathing, chest pain, throat irritation, and hamper lung functioning.

## *Effects on Amphibians*

Ozone depletion is listed as one of the causes for the declining numbers of amphibian species. Ozone depletion affects many species at every stage of their life cycle. Some of the effects are mentioned below. Hampers growth and development in larvae

- Changes behavior and habits
- Causes deformities in some species
- Decreases immunity. Some species have become more vulnerable to diseases and death
- Retinal damage and blindness in some species.

## Effects on Marine Ecosystems

Plankton (phytoplankton and bacteriaplankton) is threatened by increased UV radiation. Marine phytoplankton plays a fundamental role in both the food chain as well as the oceanic carbon cycle. It plays an important role in converting atmospheric carbon dioxide into oxygen. Ultraviolet rays can influence the survival rates of these microscopic organisms, by affecting their orientation and mobility. This eventually disturbs and affects the entire ecosystem.

## Impact on Plants

- In some species of plants, UV radiation can alter the time of flowering, as well as the number of flowers produced by a plant.
- Plant growth can be directly affected by UV-B radiation. Despite mechanisms to reduce or repair these effects, physiological and developmental processes of plants are affected.

## Other Effects

Another observation is an increase in the ozone present in the lower atmosphere due to the decrease in the ozone in the stratosphere. Ozone present in the lower atmosphere is regarded as a pollutant and a greenhouse gas that can contribute to global warming and climate change. However, studies have pointed out that the lifespan of lower atmospheric ozone is quite less, compared to stratospheric ozone. At the same time, increase in the level of ozone in the lower atmosphere can enhance the ability of sunlight to synthesize vitamin D, which can be regarded as an important beneficial effect of ozone layer depletion.

Growing concern for ozone depletion led to the adoption of the Montreal Protocol in 1987, in order to reduce and control industrial emission of chlorofluorocarbons (CFCs). Such international agreements have succeeded to a great extent in reducing the emission of these compounds. However, more cooperation and understanding among all the countries is required to solve the problem completely. You too can do your bit to save the ozone. Use/buy more recycled products, save energy, use public transport, and most importantly, spread awareness. Our individual efforts can go a long way in saving the Earth's blanket.

This is one of the most important current environmental problems (Sivasakthivel and Reddy 2001).

## Acid Rain

Acid rain, or acid deposition, is a broad term that includes any form of precipitation with acidic components, such as sulfuric or nitric acid that fall to the ground from the atmosphere in wet or dry forms. This can include rain, snow, fog, hail or even dust that is acidic.

### *Causes of Acid Rain*

Acid rain results when sulfur dioxide ($SO_2$) and nitrogen oxides ($NO_X$) are emitted into the atmosphere and transported by wind and air currents. The $SO_2$ and $NO_X$ react with water, oxygen and other chemicals to form sulfuric and nitric acids. These then mix with water and other materials before falling to the ground.

While a small portion of the $SO_2$ and $NO_X$ that cause acid rain is from natural sources such as volcanoes, most of it comes from the burning of fossil fuels. The major sources of $SO_2$ and $NO_X$ in the atmosphere are:

- Burning of fossil fuels to generate electricity. Two thirds of $SO_2$ and one fourth of $NO_X$ in the atmosphere come from electric power generators.
- Vehicles and heavy equipment.
- Manufacturing, oil refineries and other industries.

Winds can blow $SO_2$ and $NO_X$ over long distances and across borders making acid rain a problem for everyone and not just those who live close to these sources.

### *Forms of Acid Deposition*

#### Wet Deposition

Wet deposition is what we most commonly think of as acid rain. The sulfuric and nitric acids formed in the atmosphere fall to the ground mixed with rain, snow, fog, or hail.

### Dry Deposition

Acidic particles and gases can also deposit from the atmosphere in the absence of moisture as dry deposition. The acidic particles and gases may deposit to surfaces (water bodies, vegetation, buildings) quickly or may react during atmospheric transport to form larger particles that can be harmful to human health. When the accumulated acids are washed off a surface by the next rain, this acidic water flows over and through the ground, and can harm plants and wildlife, such as insects and fish.

The amount of acidity in the atmosphere that deposits to earth through dry deposition depends on the amount of rainfall an area receives. For example, in desert areas the ratio of dry to wet deposition is higher than an area that receives several inches of rain each year.

## *Measuring Acid Rain*

Acidity and alkalinity are measured using a pH scale for which 7.0 is neutral. The lower a substance's pH (less than 7), the more acidic it is; the higher a substance's pH (greater than 7), the more alkaline it is. Normal rain has a pH of about 5.6; it is slightly acidic because carbon dioxide ($CO_2$) dissolves into it forming weak carbonic acid. Acid rain usually has a pH between 4.2 and 4.4 (Fig. 5).

Policymakers, research scientists, ecologists, and modelers rely on the National Atmospheric Deposition Program's (NADP) National Trends Network (NTN) for measurements of wet deposition. The NADP/NTN collects acid rain at more than 250 monitoring sites throughout the US, Canada, Alaska, Hawaii and the US Virgin Islands. Unlike wet deposition, dry deposition is difficult and expensive to measure. Dry deposition estimates for nitrogen and sulfur pollutants are provided by the Clean Air Status and Trends Network (CASTNET). Air concentrations are measured by CASTNET at more than 90 locations.

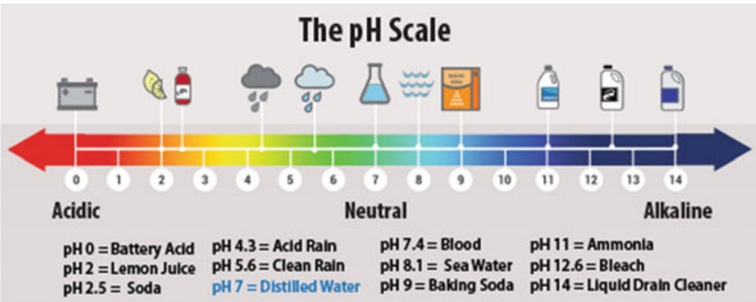


**Fig. 5** The pH scale

When acid deposition is washed into lakes and streams, it can cause some to turn acidic. The Long-Term Monitoring (LTM) Network measures and monitors surface water chemistry at over 280 sites to provide valuable information on aquatic ecosystem health and how water bodies respond to changes in acid-causing emissions and acid deposition (EPA 2008).

## Genetic Engineering

Genetic modification of food using biotechnology is called genetic engineering. Genetic modification of food results in increased toxins and diseases as genes from an allergic plant can transfer to target plant. Genetically modified crops can cause serious environmental problems as an engineered gene may prove toxic to wildlife. Another drawback is that increased use of toxins to make insect resistant plant can cause resultant organisms to become resistant to antibiotics.

### *Genetic Engineering Risks and Impacts*

Any technology that offers benefits will usually come with risks as well. In order to make wise decisions about using a technology, we must understand its potential impacts well enough to decide whether the risks are acceptably low.

What are the risks posed by the use of genetic engineering (GE) in agriculture? The answers fall mostly into two categories: risks to human health, and environmental impacts.

### *GE Health Risks*

Health risks of genetic engineering have sometimes been described in exaggerated, alarmist terms, implying that foods made from GE crops are inherently unsafe. There is no evidence, for instance, that refined products derived from GE crops, such as starch, sugar and oils, are different than those derived from conventionally bred crops. It is also an exaggeration, however, to state that there are no health risks associated with GE. For one thing, not enough is known: research on the effects of specific genes has been limited-and tightly controlled by the industry. But we do know of ways in which genetically engineered crops could cause health problems. For instance, genes from an allergenic plant could transfer this unwanted trait to the target plant. This phenomenon was documented in 1996, as soybeans with a Brazil nut gene-added to improve their value as animal feed-produced an allergic response in test subjects with Brazil nut allergies. Unintended consequences like these underscore the need for effective regulation of GE products. In the absence of a rigorous approval process, there is nothing to ensure that GE crops that cause health problems will always be identified and kept off the market.

## GE Environmental Impacts

Genetically engineered crops can potentially cause environmental problems that result directly from the engineered traits. For instance, an engineered gene may cause a GE crop (or a wild relative of that crop) to become invasive or toxic to wildlife. But the most damaging impact of GE in agriculture so far is the phenomenon of pesticide resistance. Millions of acres of U.S. farmland are now infested by weeds that have become resistant to the herbicide glyphosate. Overuse of Monsanto's "Roundup Ready" trait, which is engineered to tolerate the herbicide, has promoted the accelerated development of resistance in several weed species. Looking for ways to fight back against these "super weeds," farmers are now turning to older, more toxic herbicides such as 2,4-D and dicamba. As if on cue, agribusiness companies have begun to develop new GE crops engineered to tolerate these older herbicides-with no guarantee that the Roundup Ready story will not repeat itself, producing a new wave of resistant weeds. And this issue is not confined to herbicides: recent reports suggest a growing problem of corn rootworms resistant to the insecticide Bt, which some corn varieties have been engineered to produce.

## GE and Industrial Agriculture

As the super weed crisis illustrates, current applications of genetic engineering have become a key component of an unsustainable approach to food production: industrial agriculture, with its dependence on monoculture-supported by costly chemical inputs-at the expense of the long-term health and productivity of the farm.

A different approach to farming is available-what UCS calls "healthy farms." This approach is not only more sustainable than industrial agriculture, but often more cost-effective. Yet as long as the marketplace of agricultural products and policies is dominated by the industrial model, prioritizing expensive products over knowledge-based agro ecological approaches, healthy farm solutions face an uphill battle.

In the case of GE, better solutions include crop breeding (often assisted by molecular biology techniques) and agro ecological practices such as crop rotation, cover crops, and integrated crop/livestock management.

Such healthy farm practices are the future of U.S. agriculture-and policymakers can help speed the transition by supporting research and education on them. In the meantime, stronger regulation of the biotechnology industry is needed to minimize health and environmental risks from GE products (Nicholl 2008).

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