



# Environmental Management and Pollution

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# Introduction

The third decade of the 21<sup>st</sup> century has begun and the environmental challenges we have ahead of us set out in the UN's 2030 agenda for sustainable development are many. This global plan of action adopted in 2015 puts forward specific measures to achieve a world that is fairer, more prosperous, and more respectful of the environment within the years until 2030. Right now, global climate change is the biggest major concern. It is seriously impacting the health of our planet and it is the reason behind so many other problems.

Some of the major environmental issues today are:

- Public health issues. Covid-19 revealed that most countries were vastly underprepared for a pandemic. Still the current environmental problems pose a lot of risk to the health of humans and animals. Dirty water is the biggest health risk globally and poses a threat to the quality of life and public health. The water crisis is a health crisis. Millions of people die each year from water, sanitation, and hygiene related diseases.
- Acid rain. It is rainfall or atmospheric moisture that has been mixed with elements and gases that have caused the moisture more acidic than normal. Acidic precipitation is caused by natural causes like volcanos but, as well from human activities such as cars and electricity generation. Acid rain is extremely harmful to the environment and to humans.
- Ozone layer depletion. The ozone layer is present in the stratosphere, and it protects the planet by stopping harmful UV radiation that comes from the sun.

But the ozone layer depletion increases the amount of UVB rays that reach the Earth's surface.

- Deforestation. To make the land available for residential, industrial, or commercial purposes. Our forests are sinks of CO<sub>2</sub> (Carbon Dioxide) and produce fresh oxygen. They also help regulate temperature. By 2030, the earth might have only 10% of its forests.
- Loss of Biodiversity. Human activity is leading to the extinction of species and habitats and loss of biodiversity. Ecosystems which took millions of years to perfect are in danger when any species population are decimating. Biodiversity is essential because every species on the Earth is helpful to keep many ecosystems healthy, thriving, and balanced. It plays a vital role in the sustainability of life on Earth.

The IUCN Red List confirms that more than 40,000 species are threatened with extinction. (IUCN, 2021)

- Ocean Acidification. Human activities release CO<sub>2</sub> and other greenhouse gases into the atmosphere which leads to atmospheric warming and climate change. Around one third of the CO<sub>2</sub> released by human activities is absorbed into the ocean which has a direct chemical effect on seawater which is called ocean acidification. Due to this, the PH level of the seawater increases affecting marine life and coral reefs.
- Waste disposal. The overconsumption of resources and the creation of plastics are creating a global crisis of waste disposal. Developed countries are the ones producing excessive waste and dumping their waste in the ocean in less developed countries. As well, there is the problem of disposing of waste into landfills which cause leaching of contaminants into soil and water and also

leads to the emissions of toxic gases in the atmosphere. Waste management has become a necessity.

- Overpopulation. Human population continues to grow rapidly. Right now, there are 7.9 billion people in the world and according to a report from UN this number will grow to 9.7 billion in 2050 and could peak at nearly 11 billion by 2100. (UN, 2019). More people mean an increase in demand for food, water, energy, shelter, healthcare, transportation and more. All consumption contributes to ecological degradation, increased conflicts, and a high unemployment rate as well as a higher rate of pandemics.
- Global warming. It occurs when CO<sub>2</sub> and other greenhouse gases collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Climate change is the result of human activities. It leads to rise in the temperature of the ocean and the earth's surface causing natural disasters like flooding, melting of the ice caps, rising sea levels and unnatural precipitation patterns such as flash floods, hurricanes, wildfires, drought, excessive snow, or desertification. The basics of how greenhouse gases warm the planet and what humanity might do, therefore, to the Earth's average temperature because of the increase of greenhouse gases has been known for more than 100 years. You'd never know that from climate skeptics and the climate change deniers, but the fact of the matter is that the first serious, absolutely brilliant scientific study of what would happen if the amount of carbon dioxide, CO<sub>2</sub>, in the atmosphere were to double, how temperature would change, was published in 1896 by Gustavus Arrhenius, a Nobel Laureate chemist in Sweden. What would happen if CO<sub>2</sub> were to double? He got the

answer right, that the temperature on the planet would rise by a few degrees centigrade.

- Pollution. There are several key types of pollution: air, water, soil, noise, radioactive, light, and thermal. These are primary causes that affect the environment in many ways. All these types of pollution are interlinked and influence each other.

## Content

### What is pollution?

Pollution is the introduction of harmful materials into the environment. These harmful materials are called pollutants. Pollutants can be natural, such as volcanic ash. They can also be created by human activity, such as trash or runoff produced by factories. Pollutants damage the quality of air, water, and land. (National Geographic, n.d.)

The three major types of pollution are air pollution, water pollution, and land pollution.

- [Air pollution](#)

Humans are not the only ones who rely on air for survival. Animals, plants, trees, and all living organisms need air to live. The air is made up of different gases. One of the gases, O<sub>2</sub>, is what help us to breathe.

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere (WHO, (n.d.))

Air pollution consist of particles in the atmosphere that pose serious health and environmental threats. Some air pollution comes from natural sources like volcanic eruptions but most air pollution results from human activities such as energy use and agriculture.

There are different types of human-made air pollution. When we burn fossil fuels to produce energy, they release greenhouse gases into the air. These emissions such us CO<sub>2</sub> (carbon dioxide), CH<sub>4</sub> (methane), N<sub>2</sub>O (nitrous oxide), and fluorinated gases like CFCs (chlorofluorocarbons) trap heat from the sun in Earth`s atmosphere leading to rise in global temperatures. This creates a cycle where air pollution contributes to climate change and climate change creates higher temperatures. In turn, higher temperatures intensify some types of air pollution. For example, climate change increases smog (smog is a type of air pollution that reduces visibility and has serious health effects) because it forms in the presence of high heat and increased levels of ultraviolet radiation. Flooding, due to more extreme weather events because of climate change, contributes to damp condition and a rise in mold. Warmer weather also leads to longer pollen seasons and, therefore, more pollen production.

The WHO (World Health Organization) confirms that 4.2 million deaths every year occur as a result of exposure to ambient (outdoor) air pollution. (WHO, (n.d.)).

Figure 1, below, shows the relation between this topic (pollution) and health. The goal of SDG n°3 is to ensure healthy lives and promote well-being for all at all ages. Target 3.9 of SDG3 is: by 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination.





Figure 1 – [WHO. Sustainable Development Goals. SDG 3.](#)

One of the main drivers of climate changes is humanity's massive use of coal, oil, and natural gas, the three energy sources we call fossil fuels. When we burn coal, oil, and gas to move our cars, heat our buildings, drive our industrial production, produce electricity, we end up with carbon dioxide emitted into the atmosphere. And carbon dioxide in the atmosphere changes the climate.

- **Water pollution**

SDG`s 6 goal is to ensure access to safe water sources and sanitation for all. Access to water, sanitation and hygiene is a human right, yet billions are still faced with daily challenges accessing even the most basic of services. Around 1.8 billion people globally use a source of drinking water that is fecally contaminated. Some 2.4 billion people lack access to basic sanitation services, such as toilets or latrines. Water scarcity affects more than 40 per cent of the global population and is projected to rise.

More than 80 per cent of wastewater resulting from human activities is discharged into rivers or sea without any treatment, leading to pollution. (UN. Why it matters)

In Figure 2, below, we can see the summary progress 2021 with the indicators like: drinking water, sanitation, wastewater, water quality, water-use efficiency, integrated water management, ecosystems and what is the international cooperation and participation.

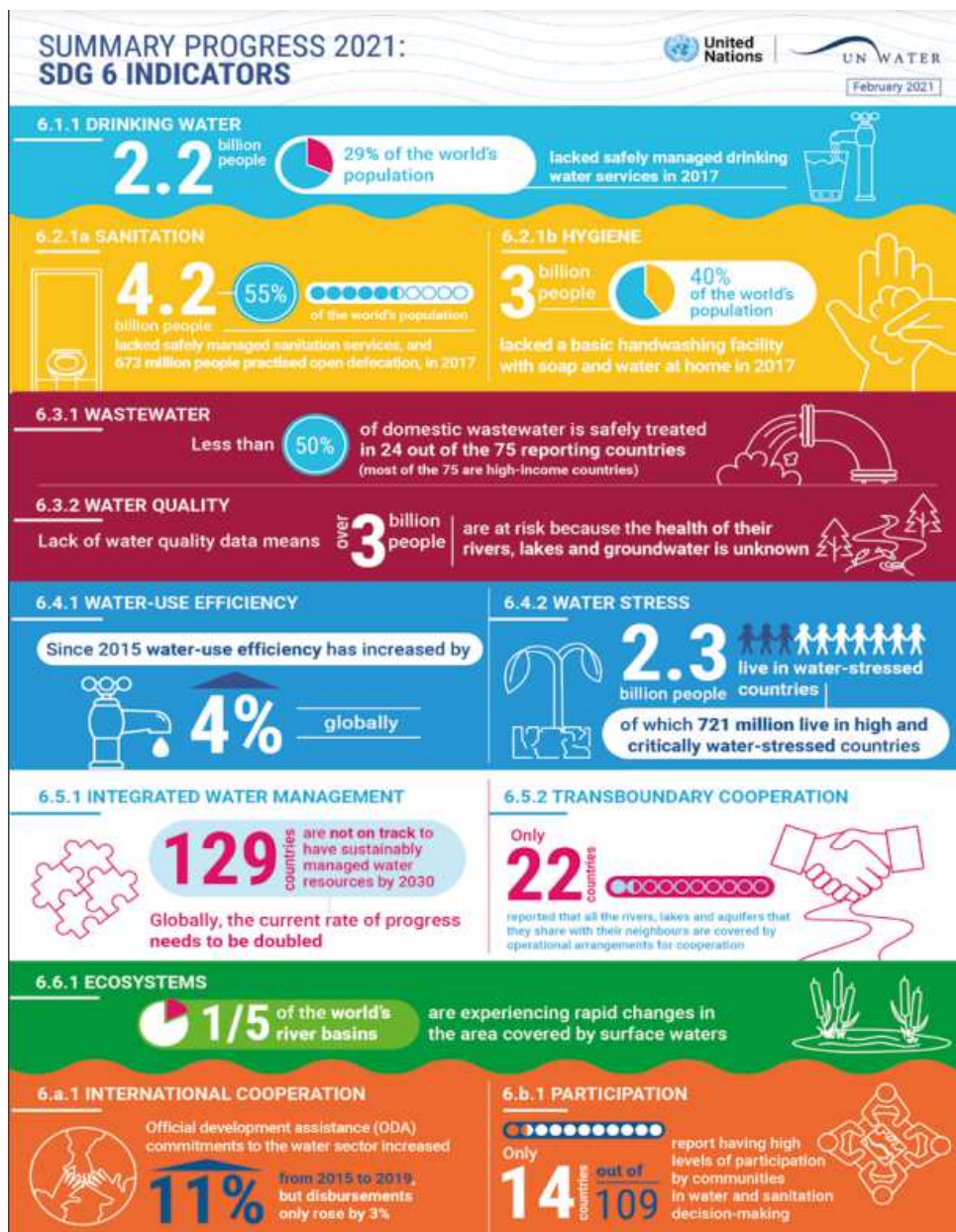


Figure 2 – Summary progress 2021. SDG 6 indicators.

Water pollution can come from a variety of sources. Pollution can enter water directly, through both legal and illegal discharges from factories, for example, or imperfect water treatment plants. Spills and leaks from oil pipelines or hydraulic fracturing (fracking) operations can degrade water supplies. Wind, storms, and littering—especially of plastic waste—can also send debris into waterways. (National Geographic, 2010)

- Land pollution

Many of the same pollutants that foul the water also harm the land. Mining sometimes leaves the soil contaminated with dangerous chemicals.

Pesticides and fertilizers from agricultural fields are blown by the wind. They can harm plants, animals, and sometimes people. Some fruits and vegetables absorb the pesticides that help them grow. When people consume the fruits and vegetables, the pesticides enter their bodies. Some pesticides can cause cancer and other diseases. (National geographic, n.d.)

Soil pollution seems invisible, but it is a problem that affects us all. It is a worldwide problem that poisons the food we eat, the water we drink and the air we breathe. Posing a serious risk to food security, human health, and the environment. Most of the pollutants originate from human activities such as unsustainable farming practices, industrial activities and mining, untreated urban waste, and other non-environmentally friendly practices. The SDGs 2, 3, 12 and 15 have targets which recommend direct consideration of soil resources, especially soil pollution and degradation in relation to food security.

In 2017, for the first time at a UN Environment Assembly, environment ministers issued a declaration. This declaration said nations would honor efforts to prevent, mitigate and manage the pollution of air, land and soil, freshwater, and oceans – which harms our health, societies, ecosystems, economies, and security (UNFCCC, 2017).

The consensus achieved on the declaration on soil pollution during this UN Environment Assembly is a clear sign of global determination to tackle pollution and its causes. Combating soil pollution requires us to join forces and turn determination into action.

The Food and Agriculture Organization of the United Nations (FAO) in 2018 released a report called “Soil pollution a hidden reality” in which the main pollutants of soil are listed: heavy metals and metalloids; nitrogen, and phosphorus; pesticides; polycyclic aromatic hydrocarbons; persistent organic pollutants; radionuclides; emerging pollutants; pathogenic microorganisms; antimicrobial resistant bacteria and genes (Rodríguez Eugenio et al., 2018)

### Hazards of heavy metal contamination

The term “heavy metals” refers to the group of metals and metalloids of relatively high atomic mass ( $>4.5 \text{ g/cm}^3$ ) such as Pb (lead), Cd (cadmium), Cu (copper), Hg (mercury), Sn (tin), and Zn (zinc), that can cause toxicity problems. (FAO, 2018).

The main anthropogenic sources of heavy metals are industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, application of fertilizers, animal manures, sewage sludge, pesticides, wastewater irrigation, coal combustion residues, spillage of petrochemicals, and atmospheric deposition from varied sources (Alloway, 2013). (FAO, 2018).

By putting heavy metals in the soil, they then enter our food chain and, eventually, our bodies.

## Environmental and Chemical Carcinogenesis

### What is a carcinogen?

Your risk of cancer can increase through exposure to cancer-causing agents, also referred to as 'carcinogens'. These agents may be biological (specific viruses or bacteria), physical (ultraviolet light, x-rays) or chemical. Only a minor fraction of chemicals cause cancer. Many chemical carcinogens are well known, and exposure is preventable, such as chemicals in asbestos or tobacco smoke. Some are less well recognized, such as alcohol. As some are distinct from lifestyle choices (choosing to smoke, drink alcohol or engage in deliberate sun exposure), exposure to carcinogens may occur outside your control. Exposure may occur in the workplace, or in the wider environment through air, water, or soil pollution. You may also be exposed to chemicals through the use of consumer products. Involuntary exposure to carcinogens often comes to the public's attention through reports in the media concerning particular issues (use of herbicides, contaminants of food, hazards associated with cosmetics etc) (Cancer council, n.d.)

Environmentally derived substances or chemicals that may enter the human body through food, air, or materials are called environmental carcinogens. Various natural and anthropogenic substances present in the environment are responsible for two thirds of cancers. (ScienceDirect, n.d.)

People are continuously exposed exogenously to varying amounts of chemicals that have been shown to have carcinogenic or mutagenic properties in experimental

systems. Exposure can occur exogenously when these agents are present in food, air, or water, and endogenously when they are products of metabolism or pathophysiologic states such as inflammation. It has been estimated that exposure to environmental chemical carcinogens may contribute significantly to the causation of a sizable fraction, perhaps a majority, of human cancers, when exposures are related to —life-style factors such as diet, tobacco use, etc. (Srinivas et al., 2021)

### Food and Chemical Carcinogenesis

Cancer is a leading cause of death worldwide and diet is thought to play a substantial role in cancer etiology. The salutatory and detrimental effects of different foods, food components, and food contaminants have been widely studied in the laboratory and in epidemiologic studies. The importance of food contaminants in the link between diet and cancer has been widely studied and formal risk assessments are routinely completed by several governmental and international agencies. Two important complementary programs exist that classify whether exposures pose a carcinogenic risk to humans. First, the US National Toxicology Program produces the “*Report on Carcinogens*”, currently in its 11<sup>th</sup> edition. And second, the International Agency for Research on Cancer (IARC) produces “*IARC Monographs on the Evaluation of Carcinogenic Risks to Humans*” (Abnet, C. (2009).

### Waste Management

Waste is a global issue. If not properly dealt with, waste poses a threat to public health and the environment. It is a growing issue linked directly to the way society produces and consumes. It concerns everyone. Waste management is one of the essential utility services underpinning society in the 21st century, particularly in urban areas. Waste management is a basic human need and can also be regarded as a ‘basic human

right'. Ensuring proper sanitation and solid waste management sits alongside the provision of potable water, shelter, food, energy, transport, and communications as essential to society and to the economy as a whole. Despite this, the public and political profile of waste management is often lower than other utility services. Unfortunately, the consequences of doing little or even nothing to address waste management can be very costly to society and to the economy overall. In the absence of waste regulations and their rigorous implementation and enforcement, a generator of waste will tend to opt for the cheapest available course of action. For example, household solid waste may be dumped in the street, on vacant land, or into drains, streams, or other watercourses, or it may be burned to lessen the nuisance of accumulated piles of waste.



Figure 3 – [Landfill – Global Waste Management Outlook. UNEP \(2019\)](#)

## Conclusion

One of the most important messages of sustainable development is that we have become a threat to ourselves. Economic production has become so large, our productivity in many ways so high, and the numbers of us on the planet so vast, that the effect of all this economic activity on the physical Earth itself has become overwhelming.

### Planetary Boundaries

In a previous assignment I mentioned that we have left the stable Holocene era behind, and scientists have given a new name to this geologic era calling it the Anthropocene era in which human activities are causing the climate to change. Humanity is changing the basic Earth processes.

A group of scientists got together a few years ago. And noted that it is not only the carbon dioxide in the air, but many other things that we're doing. The way we're using water, the way that we are putting nitrogen-based fertilizers into the soil to help crop productivity but putting it on in such large amounts that the nitrogen cycle, itself, is affected. The way that carbon dioxide in the atmosphere affects the ocean chemistry, making the ocean more acidic. The way we're chopping down trees to make room for new pastureland and farmland. In other words, all the varied effects of a big, crowded planet and a lot of economic activity, threatening the planet systems.

And so, this group of scientists said we are trespassing, boundaries that are safe for humanity. These scientists, led by Professor Johan Rockström, said we need to identify the safe operating limits for the planet, we need to understand what those are. And around the circle you see here is their visualization of those planetary boundaries.



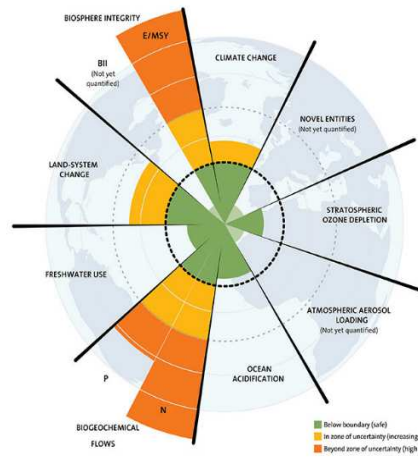


Figure 4 – The nine planetary boundaries. [Stockholmresilience.org](http://Stockholmresilience.org)

Have a close look: climate change, ocean acidification, ozone depletion, the nitrogen cycle, the phosphorous cycle, global freshwater use, changes in land use, loss of biodiversity, driving other species to extinction, that is, aerosol loading, the particles we're putting into the atmosphere through industrial processes, and chemical pollution, poisoning air, and waterways. These are planetary boundaries that we trespass at profound risk for ourselves and for our children.

Of the nine boundaries, the researchers report that four of these have now been crossed: extinction rate (one of two indicators for biosphere integrity), deforestation, atmospheric carbon dioxide (an indicator for climate change), and the flow of nitrogen and phosphorus. Action therefore needs to be taken to return to safe operating space in these processes. (Science for environment policy, 2015)

A core goal of the science of sustainable development is to understand these risks and most importantly to determine what we can do so that we stay within the safe operating limits of humanity, we honor and respect these planetary boundaries, as we continue to improve our well-being. It is the combination of economic prosperity, social

inclusion, ending poverty, and ensuring environmental sustainability, that is the holistic objective of sustainable development.

Climate change is the biggest of all the environmental threats that we face. It is the very toughest of public policy problems that humanity on a whole has ever faced.

The consequences of a business-as-usual trajectory for this planet could absolutely be dire. We are on a path of putting so much carbon dioxide, methane, nitrous oxide into the atmosphere that the temperature increase on average on the planet could be several degrees centigrade by the end of this century.

### Mitigation and Adaptation

We need to respond to this challenge. There are two terms to reflect two different ways of responding. Both of which are important.

- One term, mitigation, means to reduce what we're doing that's causing the climate to change. So, we want to mitigate climate change by reducing the anthropogenic or human-caused emissions of greenhouse gases.
- The other term that we use is adaptation. That means learning to live with climate change as best as possible. To protect our cities from storms surges to protect our crops from high temperatures or flooding or droughts, by helping to improve the quality of the seeds to have traits like drought resistance or heat tolerance.

Since humanity has already increased the temperature by one degree Celsius, we would need to, dramatically, reduce CO<sub>2</sub> emissions in the coming decades.

## The Paris Agreement

The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 Parties at COP 21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. To achieve this long-term temperature goal, countries aim to reach global peaking of greenhouse gas emissions as soon as possible to achieve a climate neutral world by mid-century. (UNFCCC, n.d.)

## Heavy metals

When people get old, their bodies will be full of metals. Metals inhibit mitochondrial function (mitochondrial functions are intimately associated with neurological symptoms), they lower testosterone levels, they cause hair loss, and they cause cancer, as well as many other diseases. So, we must lower our exposure to them, and we must get rid of them in our bodies. Some of us are very good at detoxifying while others are not.

Chelating agents are used to reduce blood and tissue levels of injurious heavy metals. Chelating agents are generally classified based upon the target heavy metal – iron, copper, mercury, and lead being the major targets. (NIH, 2017). So, chelating agents that you can take with your food will help get rid of those metals.

After doing this assignment I am going to ask for an appointment to my doctor to do a urine test or a hair test to try to find out what is the content of heavy metals like mercury or lead in my organism. It looks like this issue is one of the most ignored and underappreciated causes of chronic diseases. Definitely, I am going to include natural

heavy metal chelating agents in my diet like cilantro, parsley, chlorella as well as amino acids (eggs and fish).

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