Chapter 12

Environmental Problems

Ayşe Nesibe Önder
Gazi University

Ezgi Güven Yıldırım
Gazi University

Environmental Problems

The perception that the earth is a living planet emerged with the Gaia theory. According to the Gaia theory, all living things are physically interconnected through air, oceans, fresh waters and all fluids on Earth. Accordingly, trees, lakes, seas, animals, plants in the world are in constant interaction with each other. The existing energy is in a continuous cycle in the world. For this reason, the change of each part that interacts with the world will affect each other and therefore the whole. It is possible to explain this with the butterfly effect. We can explain the butterfly effect with an example in terms of environmental problems. Developed countries sell their waste to less developed countries. Even at the other end of the world, harmful gases such as carbon dioxide and methane are released into the atmosphere due to this garbage in countries that take this garbage. As it is known, carbon gas is one of the most important gases that cause the greenhouse effect. In other words, the damage caused by garbage extends to water, soil, plants, animals and people, with the increase of the greenhouse effect, global warming, drought, famine, deforestation and decrease in biodiversity. With the increase in the mentioned effects, nowadays people started to have anxiety for the future. The world is now alarming because of these effects. If we look at the emergence of these effects, it can be thought that the consumption of nature started with the emergence of humanity. Since ancient times, people have begun to consume nature for purposes such as nutrition, shelter and safety. The habit of consuming nature, which started as a natural process only for survival, has deviated from its purpose day by day. Today, the consumption rate of nature has increased thoroughly in order to meet the needs of the increasing population and to increase the living standards continuously. Due to this speed, nature cannot find enough opportunity to renew itself. Nature started to give people the message that "I can no longer catch up". Some other messages of nature are "I cannot keep up with the pace you consume me", "It cannot be renewed and I am being used up by the day", "I do not think I can be enough for future generations". It is very important to evolve into a society that can read these messages, internalize them and regulate their living habits by accepting that nature and human beings and all living things are an inseparable whole. Despite all the work done, no habitable planet has been found in the universe. So, planet earth is one in the universe, unique and fascinating. And we need it forever.

Therefore, in this chapter, ecology and environmental concepts, environmental pollution, types of environmental pollution, the effects of environmental pollution and the popular environmental problems of 2020 will be discussed.

Ecology and Environment

The term ecology, one of the fields of environmental sciences, was first used by Ernst Haeckel in 1869. It is extracted from the Greek "oikos" which means house or dwelling (Plutynski, 2018). According to McIntosh (1985) ecology is a "polymorphic" discipline because of being so diverse in its subject matter. It consists of many sub-disciplines; behavioral ecology; physiological ecology, community ecology, population ecology, ecosystem ecology, and evolutionary ecology. Ecology is a research field that investigates interactions of organisms (including human beings) with their environments. So ecologists are interested in not only how humans live, but also how they should relate to their environment (Kingsland, 1995; Mitman, 1992). The components of our environment are shown in Figure 1.
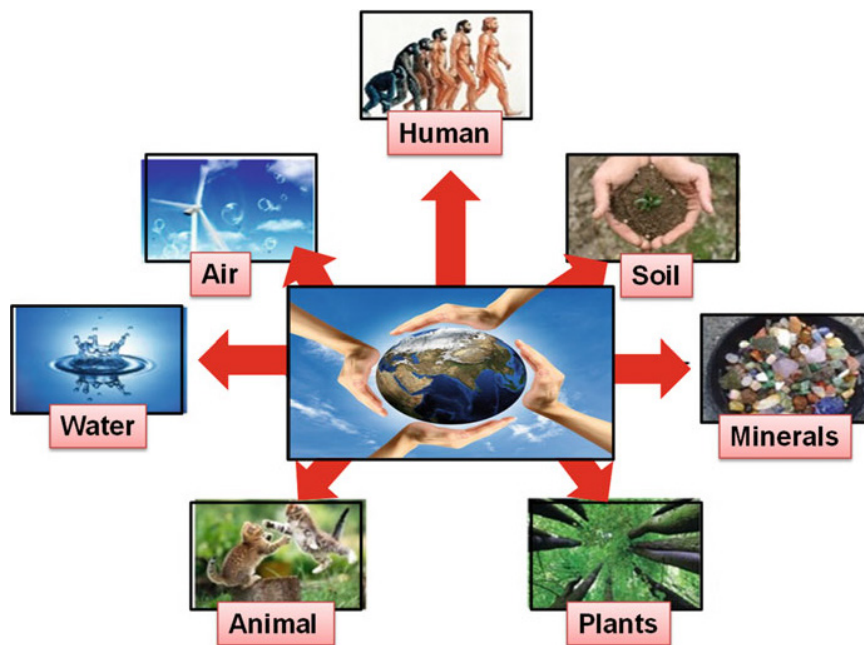

Figure 1. The Components of our Environment

The term environment means all the things around us. It explains organisms' all physical and biotic conditions. The natural environment consists of four basic components called; atmosphere, lithosphere, hydrosphere and biosphere. These four systems are both affected by human activities in constantly changing situations and also are affecting human activities. First of all, hydrosphere is the component that includes oceans, seas, lakes, streams and groundwater on land (Demirtaşlı, 1967; Singh & Singh, 2017). It covers 71% of the earth. The composition of the hydrosphere is shown in Figure 2.
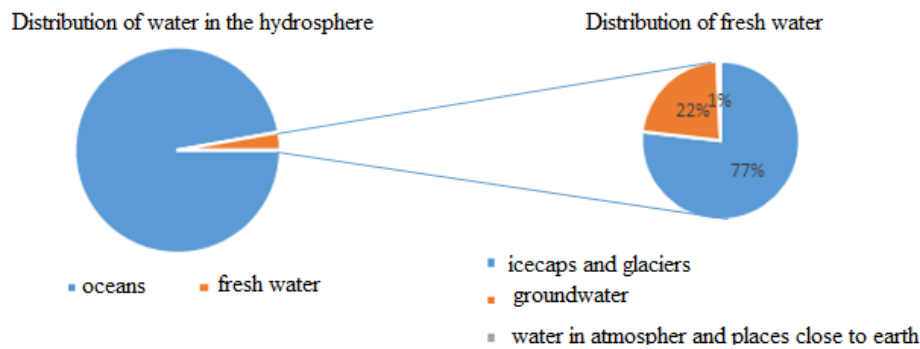
Figure 2. The composition of hydrosphere

The second component of the environment is the lithosphere and it is the solid part of the earth, composed of various rocks, 54 million square miles of which are above water and 143 million square miles are under water. The above water part of the lithosphere forms the continents. The gas cover that surrounds the whole earth is the atmosphere which is the third component of the environment. It contains gases like carbon dioxide, oxygen, helium, nitrogen, hydrogen, argon and ozone etc. The atmosphere consists of five layers. These are stratosphere, troposphere, thermosphere, mesosphere and exosphere. Last component is the biosphere which may also be named as the zone of life on Earth. It covers all organisms that exist in the world and their interactions with water and air. The biosphere is the total of all ecosystems, including all microorganisms, plants and animals from the smallest microscopic organisms to the largest creatures in nature (Singh & Singh, 2017). If there is a change in the quality or quantity of any of these natural environmental components it will affect living things negatively, an environmental problem will arise (Khan & Ghouri, 2011; Singh & Singh, 2017). The main environmental issues are pollution, ozone layer, acid rain, global warming, overpopulation, deforestation, waste disposal, plastic pollution and loss of biodiversity (Johnston, 1989; Mäler, 1990; Steinberg, 2007).

Pollution

Any liquid, solid or gaseous substance in any concentration that may pose a hazard or harm to the environment is called pollution. Pollution is a global problem and has serious effects on the health of individuals (Fereidoun et al., 2007). It occurs mostly in the urban and industrial areas of developed countries (Kromm, 1973). Recent studies show that global concern for pollution is increasing in public health (Kimani, 2007). It is believed that today's exposure to pollution is higher than any other time (Schell et al, 2006). The main reasons for the pollution are natural and man-made reasons. There are two different pollution types called point source (PS) and non-point source (NPS) pollution. PS pollution is a pollution originating from a fixed location or a fixed facility where pollutants are dumped. NPS is a type of pollution that cannot be easily traced

back to its source. Common NPSs are; mining, agriculture, forestry and construction activities, urban, dams, canals, city streets and land disposal (Singh & Singh, 2017).

Environmental Pollution

Before settling down in ancient times, people used nature for their needs such as eating and sheltering. When they consumed their environment and decreased its efficiency, they migrated to new places where they can reach new resources. In this process, nature had enough time to renew itself to overcome the damage caused by humans. However, with the increase in population, rapid urbanization and industrialization nowadays, nature cannot find the time to renew itself. In this case, the constantly accumulating waste and the resulting destruction cause irreversible environmental problems that result from several pollution types. Those environmental pollution types are; solid, air, water, sound, light and electromagnetic pollution.

Soil Pollution

The soil is a material that covers the outside of the earth and consists of a mixture of various decomposition products of rocks and organic materials, containing and feeding countless living things. So it is a well-formed chemical, biological and physical material that has a significant role in the life of humans and other living things (Güler & Çobanoğlu, 1997). Surface soil is the most important part of the soil in terms of vital activities of living things. Human beings cultivate and consume the surface soil for purposes such as shelter, agricultural, industrial activity and recreational arrangement in the period from the beginning of living life to the present day (Karaca & Turgay, 2012). There are nine reasons for soil pollution. These are erosion, stoniness, aridity, fertilization, pesticide use, open pit mining, domestic and industrial wastes, use of agricultural land for non-agricultural activities and nuclear pollution. As a result of soil pollution, harmful pollutants in the soil can pass to the human body by nutrients through the plants. Some of these harmful pollutants have toxic effects when taken at high doses, while others can reach toxic amounts due to the accumulation effect even if taken in low doses (Güler & Çobanoğlu, 1997).

Air Pollution

Clean air is very important for a healthy life. However, air pollution is widespread especially in developed countries. The major pollutants in the air that living beings breathe include, sulphur oxides (SO_x), nitrogen oxides (NO_x), carbon monoxide (CO) emitted from industrial facilities and motor vehicles. Some other pollutants are methane, xylene, toluene, chlorofluorocarbon (CFC), peroxyacetyl nitrate, ozone (O_3), odours, metals etc (European Public Health Alliance, 2009; Singh & Singh, 2017). The increase of these substances in the air to a level that is harmful to other living things and non-

living things is defined as air pollution. Although there are many causes of air pollution, it is possible to investigate the causes in two main categories as air pollution caused by natural causes and as a result of several activities performed by people. Forest and vegetation fires, volcano eruptions and dust storms are natural causes. Industrialization and urbanization are the main causes of air pollution resulting from human activities. Industrialization is effective in air pollution as it is responsible for the release of pollutants into the atmosphere without taking the necessary precautions (Sümer, 2014). Air pollution causes global warming, acid rains and ozone depletion, it also brings many health problems like, bronchitis, cancer, asthma, heart disease, respiratory infections, premature mortality (Khomenko et al., 2021; Manisalidis et al., 2020; Miri et al., 2018; WHO, 2009).

Water Pollution

Water pollution occurs as a result of the pollution of water bodies such as oceans, seas, lakes and groundwater in the world. A chemical, physical or biological change in water resources is considered as water pollution, and this pollution adversely affects living things (Dojlido & Best, 1993). These changes occur as a result of industrial wastes (Eckenfelder, 2000), sewages (Ashraf et al, 2010), agricultural (Moss, 2008) or household wastes (Khan & Ghouri, 2011; Singh & Singh, 2017). As most of these activities lead to water pollution with various synthetic and geogenic natural chemicals, it is not surprising that chemical pollution in natural water has become a major public issue almost anywhere in the world. In the USA, research revealed that drinking water pollution is the primary environmental problem (Saad, 2009). There are two types of water pollution sources. First one is natural and the other is man-made. Natural sources of water pollution are minerals leaching from rocks, erosion and decayed organic matter. Man-made sources of water pollution are toxic chemical wastes such as detergents, heavy metals and fertilizers, agricultural wastes (pesticides), micro plastics and sewage water. The quality of soils and vegetation is affected by water pollution. So it affects the environment and public health (Singh & Singh, 2017). There are many researches that shown polluted water causes death of human beings and health hazards (Ashraf et al, 2010; Çağlar Irmak & Hepçimen, 2010; Jepsen & De Bruyn 2019; Mato et al. 2001; Scipeeps, 2009; Thiel et al. 2018; Varol, Davraz, & Varol, 2008).

Noise Pollution

The word noise, derived from the Latin word "nousea", can be defined as an unwanted unpleasant or unexpected disturbing sound (Firdaus & Ahmad, 2010). It can usually be referred to as high energy sound waves (Akman, Ketenoğlu, Evren, Kurt & Düzenli, 2000). Noise pollution is an important environmental pollution in developed and developing countries (EPA, 2016) and reduces people's quality of life (Firdaus & Ahmad, 2010).

Unlike air, soil and water pollution, noise pollution does not stay in the environment for a long time and does not accumulate. Besides, its effects occur in the short term (Cohen & Weinstein, 1981; Schulz, 1978). WHO Guideline on Community Noise reported health effects of noise in six categories (Berglund & Lindvall, 1995). These categories are; disturbances in mental health, negative social behavior and annoyance, interference with spoken communication, hearing impairment, sleep disturbances and cardiovascular disturbances. On the other hand, according to Hunashal and Patil (2012), the effects of noise on human health and quality of life depend on the duration and intensity of the noise. These effects are presented in four categories.

1) Hearing loss and headache due to prolonged exposure to noise,

2) Increased blood pressure, heart rhythm irregularity and ulcer,

3) Irregular sleep, insomnia, going to bed late, excessive irritability, being stressed and depression,

4) Misunderstanding of what you hear, decrease in production due to decreased work efficiency.

Light Pollution

Light pollution that negatively affects lives, is an important global problem that concerns the whole world and all individuals very closely. Using more light than needed, in the wrong direction and at an unsuitable time can be defined as light pollution (Aslan et al., 2011). The International Dark-Sky Association defined light pollution as "*any adverse effect of artificial light including sky glow, glare, light trespass, light clutter, decreased visibility at night, and energy waste*". Light pollution can be classified as annoying light and excessive light. It can also be classified as indoor and outdoor light pollution (Rajkhowa, 2014). The effects of light pollution are seen in the observation difficulties experienced in astronomy studies. In many urban areas with light pollution, the visibility of stars has decreased. Another effect of light pollution is the damage it caused to the ecosystems. Many nocturnal animals such as moths, beetles, spiders and crickets lose their ability to navigate due to light pollution. In addition, reproductions of caretta carettas are affected by light pollution (Longcore & Rich, 2004).

Electromagnetic Pollution

The Earth is surrounded by static electromagnetic fields varying between 25-65μT. It means that the Earth has a natural electromagnetic field (Feychting, Ahlbom, & Kheifets, 2005). The sources of the natural electromagnetic field are known as the sun, stars and lightning (Uygunol & Durduran, 2008). Natural electromagnetic waves are a part of the natural world and it is in our lives from the existence of the world to the present day.

However, with various technological devices produced by human beings, the amount of electromagnetic waves in their lives increases and as a result electromagnetic pollution occurs (Köklükaya, 2013; Köklükaya & Selvi, 2015; Köklükaya, Güven Yıldırım & Selvi, 2017; Önder & Güven Yıldırım, 2020). The sources of electromagnetic pollution that humans frequently use in their daily life are base stations, laptops, wireless modems, hair dryers, microwave ovens, mobile phones, televisions, radios etc (Ahldom & Feychting, 2003; Jin, Li, Zhou, & Ni, 2005; Redl, 2001). The effects of electromagnetic pollution depend on some variables. These variables are the frequency, intensity of the electromagnetic field, the distance of the electromagnetic field and lastly the duration of the electromagnetic field which is the most important variable (Ermol, 2008). Electromagnetic pollution has two types of effects on human health. The first of these are the effects that occur as a result of short-term exposure to electromagnetic pollution, and the second is the effects that occur as a result of long-term exposure. Short-term effects are weakness, dizziness, tiredness, burning in the eyes, eye pain, headache and etc (Wilén, Johansson, Kalezic, Lyskov, & Sandström, 2006). Long-term effects are the effects on molecular and chemical bond structures in living things, on the cell and on the body's defense system (Graham, Cook, Cohen, & Gerkovich, 1994; Kang et al., 1997).

Effects of Environmental Pollution

The environmental pollution mentioned above has some negative effects on the world (Singer, 1970). These effects are ozone layer depletion, global warming, loss of biodiversity and acid rain.

Global Warming and Climate Change

Global warming and climate change are seen as the most important problems of the 21st century all over the world. Global warming and climate change are interrelated so it is not possible to separate these two problems. The climate changes that all are beginning to witness are happening due to global warming (NRC, 2010). Global warming is a term used to refer to the average temperature increase in the Earth's atmosphere and oceans (Singh & Singh, 2017; Yazdanparast et al., 2013). It is possible to express the difference between global warming and climate change as follows. The concept global warming indicates increase in temperature on a global scale, while climate change refers to the change of weather and natural events that are not related to heat (Widiyawati, 2020).

As with many environmental problems, global warming has both natural and man-made reasons. Natural causes such as volcanic movements in the world and changes in the sun cause changes in global temperature. Moreover, the world's climate system contains many internal variations such as El Niño- Southern Oscillation and the Atlantic Multidecadal Os-cillation (Ring, Lindner, Cross, & Schlesinger, 2012; Schlesinger & Ramankutty, 1994). On the other hand, according to the assessment reports in the Intergovernmental

Panel on Climate Change, the impact of humans on climate change and global warming is greatly increasing (Ring, Lindner, Cross, & Schlesinger, 2012).

The industrial revolution can be regarded as the milestone of global warming and climate change problems. Before the industrial revolution, the emission of gases that caused global warming to the atmosphere was low and the atmosphere of the world was in balance. However, after the industrial revolution, the increase of harmful gases in the atmosphere, the increase in the use of fossil fuels, changing agricultural activities and deforestation started to disrupt the balance of the world (Singh & Singh, 2017). These gases are called greenhouse gases and the effect created by greenhouse gases is called the greenhouse effect. The increase in global warming over the years is shown in Figure 3.

1880-1884
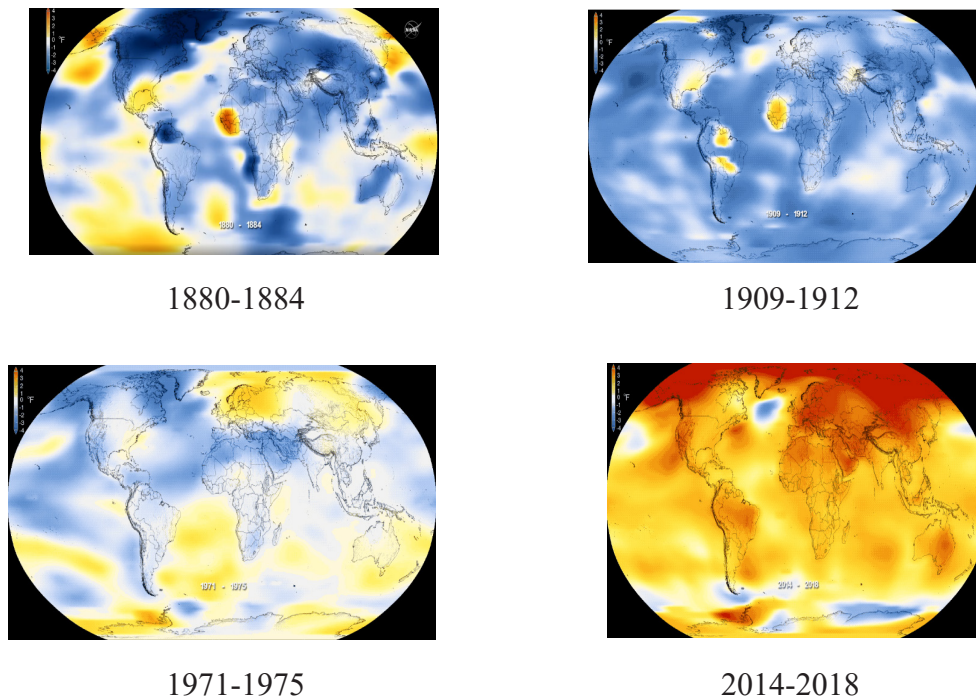

1909-1912

1971-1975

2014-2018

Figure 3. Global Climate Change

The graphic prepared according to the NASA data is given in Figure 4. It shows the change of the temperature of the Earth by months from 1880 to 2020.
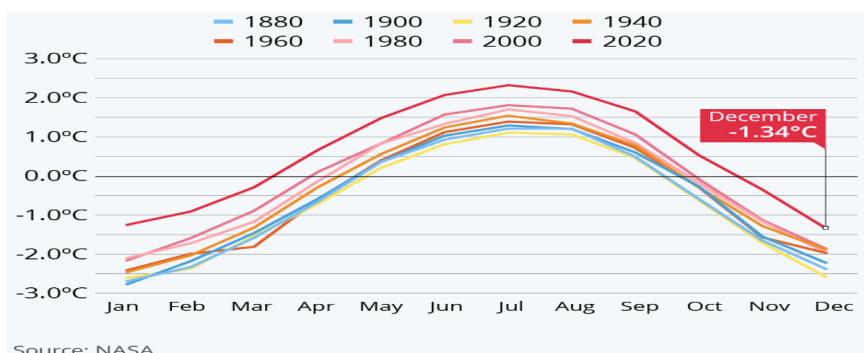

Figure 4. The Change of the Temperature of the Earth by Months (1880-2020)

Changes in climate have been observed since ancient times. However, when climate change is evaluated in terms of the time of change, it was taking place in a much longer period of time compared to today. The long period of change enabled the living creatures on Earth to adapt to this change. However, global warming is happening very quickly today and it becomes difficult for living creatures to adapt to the effects of this warming. The faster the climate change, the more harmful its effects will be. The major effects of global warming are rise in global temperature, rise in sea level, retreat of glaciers, decreasing crop yield, disease outbreaks (Singh & Singh, 2017).

Greenhouse Gasses and Greenhouse Effect

Greenhouse gasses are chlorofluorocarbons, water vapor, carbon dioxide, ozone, methane, and nitrogen oxides (U.K. Met Office, 2011). The most important greenhouse gas causing global warming is carbon dioxide. Carbon dioxide is generally released into the atmosphere through anthropogenic activities such as fossil fuels (coal, oil and natural gas), wood and solid waste burning (Bayar & Bahrend, 1994; Singh & Singh, 2017). Chlorofluorocarbons (CFCs) also make a significant contribution to global warming, even though they are present in very small amounts. The effects of greenhouse gasses on global warming are presented in Figure 5.
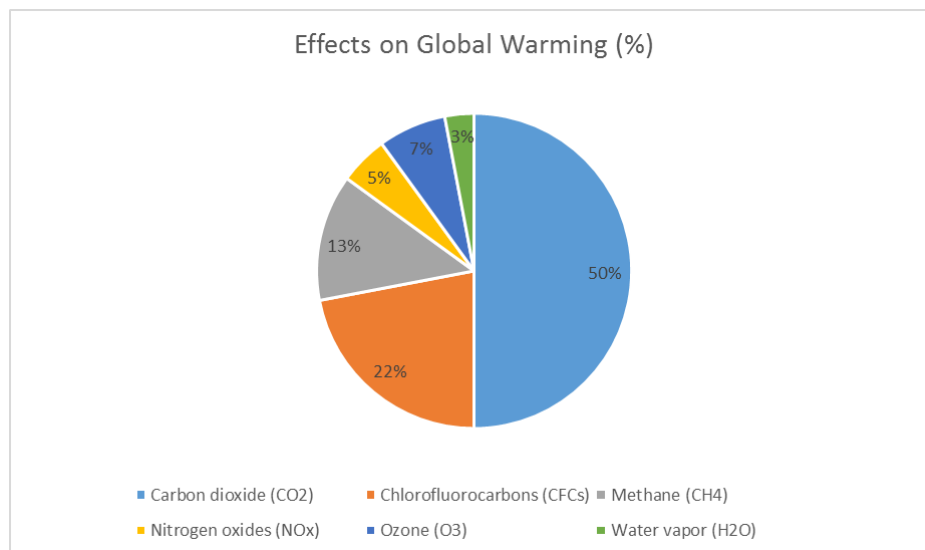

Figure 5. The Effects of Greenhouse Gasses on Global Warming

These greenhouse gases, which are present at high rates in the atmosphere, cause the Earth's temperature to increase by trapping the heat in the atmosphere. Therefore, the ability of greenhouse gases to keep the heat causes the greenhouse effect (The Royal Society, 2010). When solar radiation reaches the Earth, part of it is reflected back. Absorbed part of the solar radiation heats up the Earth. Thus, the Earth's temperature depends on how much sunlight is absorbed by the land, ocean, and atmosphere, and how much heat the Earth radiates into space. If the flow of incoming solar energy is

balanced by an equal flow of heat into space, the earth reaches radiative equilibrium, and then resulting in a fairly constant average global temperature (Figure 4). Known as the greenhouse effect, this makes the earth's average surface temperature around 286K or 13°C. If there was no greenhouse effect, the world would be an uninhabitable place. The surface temperature would be about -17°C and it would be impossible to find water in liquid form at this temperature. In other words, greenhouse gases make a cover effect in the lower layers of the Earth's atmosphere and keep the Earth's temperature at a livable level. However, elements that increase or decrease the amount of energy coming to and leaving the Earth will disrupt the Earth's radiative balance. In this case, the global temperature will either increase or decrease. Unfortunately, as a result of human activities, the amount of greenhouse gases in the atmosphere is increasing and as a result of these increasing greenhouse gases, global warming is constantly increasing (Singh & Singh, 2017).
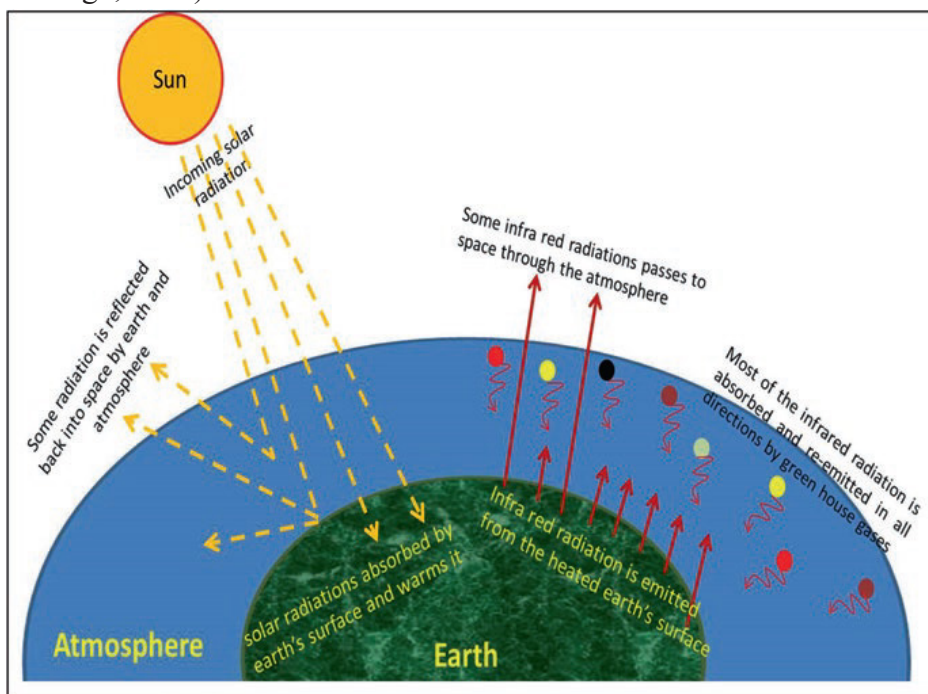

Figure 6. Greenhouse Effect

Ozone Layer Depletion

The atmosphere consists of 3 layers: mesosphere, stratosphere and troposphere. The ozone (O_3) layer is located in the stratosphere, which is 10-50 km from the Earth's surface. It is formed as a result of the natural accumulation of ozone particles in the stratosphere (Rye & Rubba, 2000). In other words, its formation is a natural process as well as its degradation. There is a balance between its formation and its natural extinction. Therefore, the total amount of ozone remains constant. Ozone occurs mostly at the equator where there is maximum solar energy and its concentration is highest between 19 and 23 km of atmosphere (Xiong et al., 2014). Ozone protects the world from harmful ultraviolet radiations (Singh & Singh, 2017). Ultraviolet (UV) wavelength is slightly

shorter than the wavelength of violet light and when it passes into the atmosphere, it is absorbed by living organisms and damages their proteins and DNA molecules. If all the UV radiation falling into the stratosphere could reach the Earth's surface, all organisms in the Earth would be greatly damaged. Here ozone absorbs most of the UV radiation and hence the ozone layer is mostly known as the UV radiation shield. Ozone is formed by the combination of UV-B radiation and oxygen (O_2) molecules in the stratosphere (Singh & Singh, 2017).

$$O_2 \xrightarrow{\text{UV-B}} O + O \text{ (atomic oxygen)}$$

$$O + O_2 = O_3 \text{ (ozone)}$$
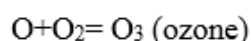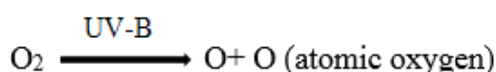
Sometimes, free oxygen atoms can combine with ozone molecules to form two oxygen molecules:

$$O + O_3 = O_2 + O_2 \text{ (molecular oxygen)}$$
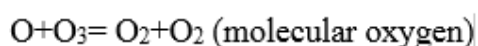
Lastly, ozone absorbs UV-B radiation again and turns into free oxygen:
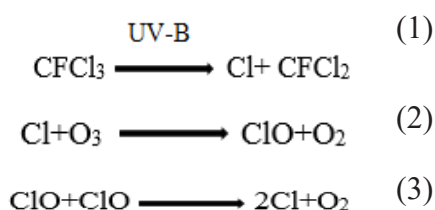
$$O_3 \xrightarrow{\text{UV-B}} O + O_2$$
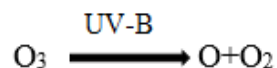
It means there is a balance between ozone's formation and extinction.

Some compounds released as a result of human activities cause damage to the ozone layer. The two important atoms released from these compounds are chlorine and bromine. When chlorine and bromine atoms in the stratosphere encounter ozone, they destroy the ozone atoms. The compounds that release chlorine and bromine are called ozone-depleting substances (ODS) (Newman, Daniel, Waugh, & Nash, 2007). Other ODS are chlorofluorocarbons (CFCs), halons, hydro chlorofluorocarbons (HCFCs), carbon tetrachloride, methyl bromide, chlorobromomethane, hydro bromofluorocarbons, dichloromethane and methyl chloroform (Cameron & Ward, 2020; Roy, 2020). The main uses of ODS include refrigerators and air conditioners, cleaning solvents, aerosol propellants, plastic blowing agents and refrigerants freon.

CFC is released to the atmosphere and reaches the stratosphere with other normal gasses and destroys the ozone. These CFC's come across the UV-B radiation in the stratosphere and break apart. Successive reactions are given below (Singh & Singh, 2017). Reactions (2) - (3), are called "chlorine catalytic cycle". Chlorine constantly reacts with ozone,
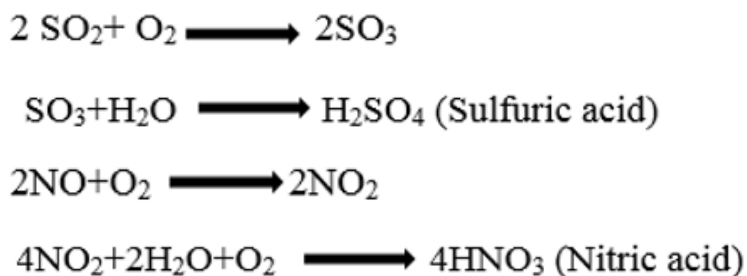
which reduces the amount of ozone and as a result causes damage to the ozone layer.

$$CFCl_3 \xrightarrow{\text{UV-B}} Cl + CFCl_2 \quad (1)$$

$$Cl + O_3 \longrightarrow ClO + O_2 \quad (2)$$

$$ClO + ClO \longrightarrow 2Cl + O_2 \quad (3)$$

Ozone depletion has several effects on living organisms such as cataracts, skin cancer, sunburn, weakening of the immune system and rapid aging as a result of overexposure to strong UV light. Meanwhile, many products that are vulnerable to UV light, such as corn, wheat, oats, broccoli, rice, cauliflower and tomatoes are damaged. At the same time, non-living materials such as plastic, wood, fabric and rubber are greatly degraded by too much UV radiation (Cameron & Ward, 2020).

Acid Rain

Acid rain was first mentioned by pharmacist Ducros in 1845, but the first detailed studies were done by Robert Angus Smith in 1870's (Menz & Seip, 2004; Smith, 1872). The sources that cause acid rains can occur as a result of both natural and human activities. Natural sources are volcanoes and various aquatic creatures that emit these gases as a result of their biological processes (Abbasi, Poornima, Kannadasan & Abbasi, 2013). However, as with all environmental problems, human-induced causes constitute the main problem. Acid rain consists of SO_2 and NO_x released into the atmosphere due to the largely use of fossil fuels. When these oxides dissolve in the atmosphere and react with H_2O, they form H_2SO_4 (sulfuric acid) and HNO_3 (nitric acid). In this case, the acidity of the rain increases and acid rain occurs. The reactions by which sulfuric acid and nitric acid are formed are given below (Singh & Singh, 2017).

$$2 SO_2 + O_2 \longrightarrow 2SO_3$$

$$SO_3 + H_2O \longrightarrow H_2SO_4 \text{ (Sulfuric acid)}$$

$$2NO + O_2 \longrightarrow 2NO_2$$

$$4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3 \text{ (Nitric acid)}$$

Acid rains have enormous effects on the living and non-living environment. First of all, acid rains falling on oceans, seas, lakes and rivers change the pH value of the water. It increases the acidity. This is a fatal situation for the eggs of many fishes. In addition, aquatic plants and invertebrates, which are food for fish, are also damaged by this acidity which results in decrease in fish feed. Moreover, the acidity damages the gills of the fish

and prevents oxygen intake. It also causes bone calcification. Acid rains also damage forest ecosystems and results in nutrients such as calcium and phosphorus to leach from the soil. This decreases the productivity in that soil so plants cannot grow. In acidic groundwater, substances such as aluminum dissolve and make the water toxic. Finally, acid rains erode old and valuable buildings such as open-air museums and ruins over time and damage them irreparably (Singh & Singh, 2017).

Loss of Biodiversity

Biodiversity is a field that contains the diversity of living organisms, the communities and ecosystems in which they originate, the genetic differences between them, and the ecological and evolutionary processes that are constantly changing and adapting (Noss & Cooperrider, 1994). Shortly, biodiversity contains the diversity within species, among species and ecosystems (Singh & Singh, 2017). Also Heywood and Watson (1995) explained the composition of biodiversity in three parts. First one is ecological diversity that contains; biomes, ecosystems, habitats, bioregions landscapes and populations. Second is genetic diversity that contains; nucleotides, genes, chromosomes, individuals and populations. Lastly organismal diversity that contains; kingdoms phyla families, genera, species and populations.

2.1 million species are believed to be currently known today, but this includes only a small part of the total amount of species that exists (Heywood & Watson, 1995). According to the UNEP data, the number of living species by taxonomic group is given in Table 1.

Table 1. Number of Living Species by Taxonomic Group

Group Estimated	Identified species	Total
Bacteria and viruses	5,800	10,000
Fungi	80,000	1,500,000
Protozoa and algae	100,000	250,000
Nonvascular plants	150,000	200,000
Vascular plants	250,000	300,000
Invertebrates	1,500,000	7–50 million
Fishes	20,000	23,000
Amphibians and reptiles	12,000	13,000
Birds	9,100	9,200
Mammals	250,000	300,000
Total	2,125,300	9–52 million

The world is in danger about biodiversity (Wilson, 2002). In 2021, the International Union for Conservation of Nature (IUCN) reported that 37,400 of 112,432 species were threatened with extinction (IUCN, 2021). There are many reasons for the decrease in biological diversity. The biggest cause of this extinction is habitat loss. The destruction of forests, wetlands and other ecosystems has caused the extinction of millions of species

on Earth. The other reasons for the decrease in biological diversity are invasive species, hunting, pollution and diseases (Díaz, Fargione, Chapin, & Tilman, 2006). Therefore, there are many causes of global species losses that cannot be predicted in advance. It has been determined that at least 480 animals and 654 plant species have disappeared since the 17th century (Heywood & Watson, 1995). This number includes only the species that have been diagnosed. In fact, many more species disappeared. While it took 300 years for a species to disappear in nature under normal conditions, this period was shortened by the influence of humans.

<div align="center">

The Biggest Environmental Problems of 2020

</div>

In addition to the above mentioned problems the biggest environmental problems of 2020 can be classified as food waste, plastic pollution, deforestation, melting ice caps (https:// earth.org/the-biggest-environmental-problems-of-our-lifetime/). Also overpopulation and waste disposal can be added to these problems.

Food Waste

It is known that 1/3 of food is wasted today. This value corresponds to approximately 1.3 billion tons. 3 billion people can be feed by this wasted food. Food waste occurs in different ways in developed and developing countries. While 40% of food waste occurs at retail and consumer stages in developed countries, 40% of food waste occurs at post-harvest and processing levels in developing countries. An interesting reason for wasting food is aesthetics. At the retail level, therefore, huge amounts of food are wasted. In the US, it is known that more than 50% of trashed products are wasted because they are too "ugly" to be sold to consumers. This means that approximately 60 million tons of fruit and vegetables are wasted (https://earth.org/the-biggest-environmental-problems-of-our-lifetime/). Other food waste reasons are poor infrastructure and transportation, poor storage facilities, lack of refrigeration, poor packaging, inadequate market facilities, poor environmental conditions during display, quality standards, lack of planning, best-before-dates, limited focus on waste and leftovers. To prevent food waste, the following can be done. For low income countries it is recommended to pay attention to local investments, cooling chain when possible, education improved market facilities and improved packaging. For high income countries it is recommended to pay attention to education, awareness, improved communication in supply chains, improved purchase and consumption planning and consumer power (https://www.madr.ro/docs/ ind-alimentara/risipa_alimentara/presentation_food_waste.pdf).

Plastic Pollution

While more than 2 million tons of plastic was produced annually in the world in the 1950's, this number increased to 419 million tons as of 2015. According to a report from

the scientific journal Nature, about 11 million tons of plastic are thrown into the oceans every year and it is harming animals there. It is predicted that this value will increase to 29 million metric tons in 2040 if no precaution is taken. If micro plastics are included in this value, the total amount of plastic in the oceans could reach 600 million tons (https:// earth.org/the-biggest-environmental-problems-of-our-lifetime/). When the disposal methods of plastic thrown in between 1980 and 2015 are examined in Figure 7 (Geyer, Jambeck, & Law, 2017), it is seen that a very small portion of it is recycled. However, the increase in this value from year to year can be considered as hopeful.

Global plastic waste by disposal, 1980 to 2015
Estimated share of global plastic waste by disposal method.

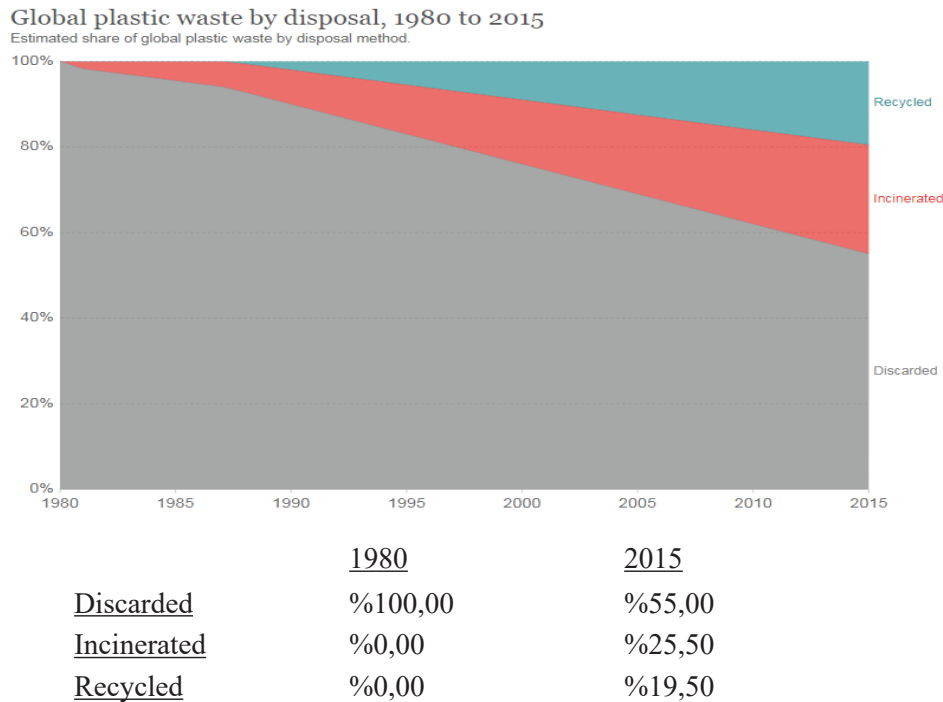|	1980	2015
Discarded	%100,00	%55,00
Incinerated	%0,00	%25,50
Recycled	%0,00	%19,50

Figure 7. Global Plastic waste by Disposal from 1980 to 2015

Recycling is the process of separating usable products and parts from the used products and using and utilizing them in the production of the new products (Kumar et al., 2016). In the recycling process, the material is recovered without preserving the structure of the product (Fleischmann, 2003). In terms of wastes; it is the reuse of wastes for original purposes or for other purposes, including organic transformation, excluding energy recovery, by subjecting them to a production procedure. With recycling, recyclable materials in waste are brought back to the economy.

Stages of Recycling System

Collection; The recycling process of waste starts when the products are consumed. Recyclable components in solid waste require the waste to be collected regularly and economically at a specific location. Two basic collection methods are used; the first is the consumer to bring, the other is to reach and buy from the consumer. A collection system developed recently especially for the collection of packaging wastes is milk run. In this

system, the vehicle that takes the products to one place picks up other wastes from the same place. In this way, the company can transform most of the packaging material used in production (Erdal et al., 2008).

Separation; The materials collected for recycling must be separated in the form and meticulousness required by the selected evaluation method. Also, undesirable substances are also eliminated at this stage from collected materials.

Evaluation; It is the economic recycling process of separated, cleaned and reprocessed materials. While this process, products are changed physically and chemically and return to the economy as new products.

Bringing the new product to the economy; It is the stage of bringing the recycled product to re-use (Şengül, 2010).

Deforestation

Deforestation means destroying forest areas to use them for other purposes like urban development or grazing (Van Kooten & Bulte, 2000) and agriculture. The amount of tropical forests decreases due to deforestation day by day and causes extinction of living creatures in these areas (Barraclough & Ghimire, 2000). This means that living things are left homeless, either to die or to look for other houses. Thus, biological diversity is decreasing. In addition, the greenhouse effect increases with deforestation (Angelsen & Kaimowitz, 1999). Myers says that half of all tropical forests on earth still exist (Myers, 1992). However, this situation is alarming. For this reason, efforts to save forests and rainforests continue in the world. In order for these efforts to be carried out efficiently, the main reasons for deforestation should be determined well. Pearce and Brown (1994) explained two basic factors affecting deforestation as follows.

- Human competition for ecological niches in land and coastal areas. Deforestation of fertile coastal and land regions and marketing them with various constructions such as hotels, facilities and houses.

- Failure in the functioning of economic systems. Forests are basically not given due importance by the governments and their real value and benefits are not marketed.

Under these two main factors, some direct causes of deforestation are given as follows.

Expansion of farming land: 60% of deforestation is for agricultural settlement (Myers, 1994). This value makes agricultural settlement the main source of deforestation. Millions of people live very cheaply in the rainforests. Most of these people are estimated to be foreign settlers. Increasing life in these areas causes the destruction of forest lands. As deforestation occurs, people migrate to find new forests, damaging new forests (Amor,

2008; Amor & Pfaff, 2008; Wilkie et al., 2000). This cycle goes on like this.

Logging and fuel wood: Fuel wood collection is common in degraded forest areas and tropical dry forests (Repetto, 1988; Rowe, Sharma & Bowder, 1992). Firewood is not usually the primary cause of deforestation in humid tropics, but it can happen in some populated areas.

Overgrazing: Although overgrazing is seen in some parts of the tropics, the main problem arises in dry areas when trees are cut down for grazing and natural vegetation. Soil erosion occurs because of overgrazing (Hays, 2008).

Fires: Although fire has benefits such as clearing forests and improving grasslands, when abused, fire may be a major reason of deforestation (Repetto, 1988; Rowe, Sharma & Bowder, 1992). According to the data of 118 countries representing 65 percent of the forests in the world, it is known that one percent of all forests which is an average of 19.8 million hectares is significantly affected by fires each year (Anon., 2010).

Mining: Mining is an activity that leaves intense destruction in nature and has destructive effects (Mather, 1991; Sands, 2005). It is not seen as a primary cause of deforestation as it is carried out on relatively small land. However, mining is seen as a gainful activity as it encourages people to settle in this area after deforestation (Staff, 2010).

20 football field sizes of forests are cut down every minute in the world. In 2030, it is predicted that only 10% of the current forests will exist. If deforestation is not prevented, all forests are in danger of extinction in less than 100 years. In this case, more erosion and landslides will occur in the world. In addition, there will be no more carbon emission by forests. Thus, the greenhouse effect will increase. Countries with the highest rates of deforestation are the Democratic Republic of Congo, Brazil and Indonesia (https://earth.org/the-biggest-environmental-problems-of-our-lifetime/).

Melting Ice Caps

The cryosphere (ice sphere), which consists of snow and glaciers in the world, reflects almost half of the rays coming from the sun to the earth and plays a fundamental role in the formation and protection of the energy (heat) balance of the Earth. Because of this property of the snow, soils outside the Polar Regions do not freeze easily. In this way, many plant species have the opportunity to live in areas where it snows (Akın, 2013). Also glaciers are water (Akhtar et al., 2008; Xu et al., 2010) and energy (Sternberg, 2010; Zimmermann, 2001) source. For example, the city of La Paz, which has a population of more than one million in Bolivia, provides 85% of its water needs from glaciers. But unfortunately it is known that global warming causes the temperature of both ocean waters and the atmosphere to rise. This temperature rise results in glaciers to melt faster

than ever before (Akın, 2013; Barnhart et al., 2016; Day et al., 2012; Kay et al., 2011). It has been documented that this melting occurs continuously (Comiso, 2012; Kinnard et al., 2011; Rodrigues, 2008) and this process has been going on for centuries. Recent satellite observations show that the melting rate is much higher than predicted (Kattsov et al., 2010; Rampal et al., 2011). Glaciers and interglacial periods that occur in geological times result from the cycle of the solar system. In other words, it is a natural event that takes place within nature's own cycle. However, today's glacial melting is one of the events triggered by Global Warming, which is caused by overpopulation and excessive greenhouse gas emissions as a result of industrialization (Dedegil, 2007; Gibbard & Cohen, 2008; Lowe & Walker, 1999). At the end of the current century (in the year 2100), an increase of one meter in sea level is expected according to the most optimistic estimates. Three factors will cause a one-meter rise in sea level.

1. Global warming will cause about 30 cm rise by heating the water of the oceans.

2. Glaciers in mountains such as the Himalayan, Alpine, Andean and Rocky Mountains will melt with the effect of global warming. It is estimated that it will provide 30 cm rise in the oceans.

3. Also with the melting of the glaciers in Greenland, Alaska, the Arctic and Antarctica 30-40 cm rise is expected.

As stated above the most optimistic forecast is that by the end of this century, sea level will increase by about one meter as the glaciers in the North and South poles and high mountains melt. The extent of the danger can be better understood if one is remembered that more than a hundred million people around the world live along the continental coast at levels one meter above sea level. If the sea level rises by one meter, the people living there have to move to other settlements and the population of the migrated places will increase more than necessary. Therefore, as the land for agriculture in the migrated areas will be reduced, there will be drought and there will be no clean environment. Thirst, hunger and infectious diseases will cause problems in human life. If people living on the shores one meter above sea level want to live there, they will have to spend trillions of money to protect the sea shores by building concrete barriers. As a result of global warming, the coasts of countries such as Vietnam, Bangladesh, Egypt, Denmark, the Netherlands, America (Florida coasts) will become uninhabitable and some of the island states in the oceans will be removed from the map (Akın, 2013).

Overpopulation

The ability of living things to reproduce is one of their most basic common characteristics. The ability of living things to reproduce is different from each other. When evaluated in terms of reproduction number, although humans are one of the least reproducing creatures,

the population of humans in the world is increasing rapidly. The average growth rate of the world population in recent years is around 1.7%. While the doubling time of the world's population occurred in 2000 years, the doubling time decreased to 40 years between 1950-1990 (Çamurcu, 2005). The main causes of overpopulation are lack of family planning, immigration, and a decrease in mortality. The rapid increase in the human population has increased the demand for development and caused environmental degradation by increasing the consumption of various natural resources. Global overpopulation causes many environmental problems. These problems are; global warming and climate change, environmental degradation, land / soil degradation, habitat destruction, depletion of natural resources, loss of biodiversity, air pollution, water pollution, water scarcity, food scarcity and health problems (Singh & Singh, 2017). According to the report published by the United Nations, the world population is expected to exceed 10 billion in 2050. Due to this dense population, it will be almost impossible for people to live in cities, and besides, there will be no clean water for drinking and communication tools will become inoperable. According to a study conducted by the National Academy of Sciences of the USA, if the population growth in the world continues to increase at today's rate, the number of population to be reached in 2075 will be 30 billion (Çamurcu, 2005).

Waste Disposal

Waste can be categorized according to various characteristics such as consumption, production, chemical and physical properties. One of these classifications is solid liquid and gaseous wastes. Waste of whatever source (commercial, domestic or industrial) can be defined as losing its usefulness after the use of raw materials, fuel and water and thus losing its economic value for the individual (Read, 1999). According to the United Nations Environment Program (UNEP), waste is defined as "substances that the owner does not want, need, do not use, that needs to be treated and disposed of" (Öztürk, 2010). Wastes are substances that are undesirable for human and environmental health and therefore must be disposed of regularly. The wastes in the waste cycle are in direct or indirect interaction with people and environment from the time they are produced to the time they are disposed of. Solid wastes can affect environment and people health directly with pathogenic substances or indirectly because of being a source of nutrition and reproduction for other creatures such as mice and flies. Since it is a source of nutrition and reproduction for other living things, it can indirectly affect the environment and human health negatively (Güler & Çobanoğlu, 1996; Tokgöz & Sarmaşık, 1982). The effects of wastes on the environment and people could be biological, chemical and physical. While diseases such as plague, leprosy, malaria, cholera, tuberculosis, dysentery, rabies that can be transmitted directly or by intermediate animals are examples of biological negativities, leakage waters and gases that occur in landfill sites cause biological and chemical adverse effects and wastes left in the environment irresponsibly can cause

physical adverse effects to individuals. The relationship between the environment and human health and poor sanitation and waste management practices is evident in developed and developing countries (Palabıyık, 2001).

Solution Suggestions for Environmental Problems

It has been observed that human beings, who did not give sufficient importance to the environmental issue until the 1970s, began to notice these problems from the beginning of the 1970s with the increasing ecological problems. During this period, the existing economic system was questioned in various books, international conferences and meetings. It was stated that a new system that does not disrupt the functioning of the environment should be developed. For example, in 1972, in the capital city of Sweden, Stockholm, at the UN Conference on Environment and Development, the view "we have only one world" was adopted and some solution proposals were discussed in this conference (Karalar & Kiracı, 2011). One of the solutions of environmental problems discussed in this conference is sustainable development. Sustainable development means meeting the needs of today's generations without eliminating the possibilities of meeting the needs of future generations (United Nations, 1987). The concept of sustainable development is based on two main ideas: 1- basic requirements, 2- reconciling the needs of current and future generations, taking into account the renewal capacity of the environment (Conca & Geoffrey, 2004). Sustainable development is important for the protection of natural resources. Since the possibility of self-renewal of the natural resources stock has disappeared with human activities today, a decrease in the natural resources stock is inevitable. Here, the basic philosophy of sustainable development is to stop this decrease in natural resources stock and help nature to renew itself (Ergün & Çobanoğlu, 2017). For this reason, it is necessary to have the awareness of sustainable development both as managers and as society in order to prevent the environmental problems that we encounter. Another solution to environmental problems is to stop using fossil fuels. Fossil fuels emit large amounts of carbon to the atmosphere and this carbon release causes many environmental problems. So we should use clean renewable energy sources instead of fossil fuels. The term "renewable energy" is energy that is based on self-renewing energy sources such as wind, sunlight, earth's internal heat, flowing water and biomass such as energy crops, industrial and agricultural waste. These resources can be used for electrical energy in all economic sectors, but also for fuel in transport and heat generation in buildings and industrial activities (Bull, 2001). Other solutions can be sorted as the emergence of minimalist lifestyles, a tendency to live with zero waste, the necessity of using recycled products while producing new products, the environmentally friendly products of cleaning products to be produced and the increase in organic farming efforts (Erten, 2020). In addition, education has an important role in preventing environmental problems. With environmental education, it is ensured

that individuals both gain ecological knowledge and develop positive attitudes towards the environment. Then, these attitudes can be transformed into a positive behavior towards the environment. Environmental education addresses cognitive, affective and psychomotor learning areas of individuals. Therefore, environmental education is a process that includes the development of knowledge and skills, the formation of value judgments and attitudes, the demonstration of environmentally friendly behaviors and the results of these in individuals, in order to protect the environment (Erten, 2004; Erten, 2020). This education should be given to all levels of society, regardless of age, profession and gender.

Eco-friendly person activity

How Eco-Friendly Person You Are?

Aims of the activity: - To help students gain environmentally friendly habits.

- To help students be aware of themselves in terms of being an eco-friendly person.

Time: 30 days

Activity content: The eco-friendly behaviors chart given in Table 2 will be distributed to students. Students will perform the behaviors in the chart within 30 days and will prove them with photographs or explanations. As a result of each behavior performed, they will obtain the specified score. If students perform the specified activities more than once, they will earn points as many times as they have done. After completing the activities, students will get eco-friendly person total points. The activity period will be repeated every 30 days and an eco-friendly person of each month will be declared.

Table 2. Eco-Friendly Behaviors Chart

Activity no	Activity information	Photos and explanations of activity	Score
1	Storing household wastes in the form of plastic-glass-paper separately for recycling		10
2	Delivering glass, plastic or paper to recycling units		10
3	Planting a total of five tree saplings		10
4	Providing information to a friend or a family member about environmental problems		10
5	Using recycled products		10

6	Turning off wireless, laptop and mobile phone before going to sleep at night		10
7	Using public transport to go anywhere		10
8	Growing flower(s) in the house		10
9	Collecting garbage found in a park		10
10	Preparing a poster that will take attention to the melting of the glaciers and sharing it on a social media account		10
11	Following news regarding current environmental issues from the Internet / newspapers / scientific journals		10
12	Preparing a poster to take attention of the endangered animals and sharing them on a social media account		10
13	Preparing a poster to take attention of the endangered plants and sharing them on a social media account		10
14	Using environmentally friendly cleaning products (detergent, toothpaste and body spray etc.)		10
15	Using reusable non-plastic bags instead of plastic ones in shopping		10

References

Abbasi, T., Poornima, P., Kannadasan, T., & Abbasi, S. A. (2013). Acid rain: past, present, and future. *International Journal of Environmental Engineering*, *5*(3), 229-272. https://doi.org/10.1504/IJEE.2013.054703.

Ahldom, A. & Feychting, M. (2003). Electromagnetic radiation: Environmental pollution and health. *British Medical Bulletin*, *68*, 157-165. https://doi.org/10.1093/bmb/ldg030

Akhtar, M., Ahmad, N., & Booij, M. J. (2008). The impact of climate change on the water resources of Hindukush–Karakorum–Himalaya region under different glacier coverage scenarios. *Journal of Hydrology, 355*(1), 148–163. https://doi.org/10.1016/j.jhydrol.2008.03.015

Akın, G. (2013). Yüzyılımızın temel sorunlarından biri; buzulların erimesi. *Antropoloji*, (25), 9-27. https://doi.org/10.1501/antro_0000000027

Akman, Y., Ketenoğlu, O., Evren, H., Kurt, L., & Düzenli, S. (2000). Çevre *kirliliği*. Ankara: Palme Yayıncılık.

Amor, D. (2008). *Road impact on deforestation and jaguar habitat loss in the Selva Maya*. Ph. D. dissertation. Ecology Department, Nicholas School of the Environment, Duke University.

Amor, D., & Pfaff, A. (2008). *Early history of the impact of road investments on deforestation in the Mayan forest*. Working Paper, Nicholas School of the Environment and Sanford School of Public Policy, Duke University, Durham, NC, USA.

Angelsen, A., & Kaimowitz, D. (1999). Rethinking the causes of deforestation: lessons from economic models. *The world bank research observer*, *14*(1), 73-98. https://doi.org/10.1093/wbro/14.1.73

Anonymous, (2010). *Global Forest Resources Assessment*, 2010-Main Report. FAO Forestry Paper 163. Rome, Italy.

Ashraf, M. A., Maah, M. J., Yusoff, I., & Mehmood, K. (2010). Effects of polluted water irrigation on environment and health of people in Jamber, District Kasur, Pakistan, *International Journal of Basic & Applied Sciences*, *10*(3), 37-57.

Aslan, Z., Gölbaşı, O., Koçer, D., Tunca, Z., Işık, E., Yelkenci, A., Bağdaş, D., Devlen, A., Özdemir, T., Yelkenci, K., Demirciler, T., İkizler, U., Karamahmutoğlu, A., Koçer, M., Mutlu, M., Özyar, Ü., & İpek, H., (2011). *Türkiye'de gece gökyüzü parlaklığının* ölçülmesi, 8. Ulusal Aydınlatma Kongresi, 14-15 Nisan Bildiri Kitabı s:69.4.

Barnhart, K., Miller, C., Overeem, I., & Kay, J. (2016). Mapping the future expansion of Arctic open water. *Nature Climate Change, 6*(3), 280–5. https://doi.org/10.1038/nclimate2848

Barraclough, S. L., & Ghimire, K. B. (2000). *Agricultural expansion and tropical deforestation: Poverty, international trade, and land use*. London: Earthscan.

Bayar, A. B., & Bahrend. H. (1994). *Küresel* çevre *problemleri*. Ankara: Özkan matbaası

Berglund, B., & Lindvall, T. (1995). (eds.) Community noise. *Archives of the center for sensory research, 2*(1), 1-195.

Bull, S. R. (Aug.-2001). Renewable energy today and tomorrow. In *Proceedings of the IEEE*, 89(8), 1216-1226. https://doi.org/10.1109/5.940290

Çağlar Irmak, N., & Hepçimen, A. Z. (2010). Ağır metal toprak kirliliğinin gıda zinciri ve insan sağlığına etkisi. *Akademik Gıda*, *8*(2), 31-35.

Cameron, Z., & Ward, J. S. (2020). Ozone layer depletion: Overview. *INOSR Experimental Sciences 6*(1), 36-42.

Çamurcu, H. (2005). Dünya nüfus artışı ve getirdiği sorunlar. *Balıkesir Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *8*(13), 87-105.

Cohen, S., & Weinstein, N. (1981). Non-auditory effects of noise on behavior and health: *J Social Issues, 37*(1), 36–70. https://doi.org/10.1111/j.1540-4560.1981.tb01057.x

Comiso, J. C. (2012). Large decadal decline of the Arctic multiyear ice cover. *Journal of Climate, 25*(4). 1176–1193. https://doi.org/10.1175/JCLI-D-11-00113.1

Conca, K., & Geoffrey, D. D. (2004). *Green planet blues, environmental politics from Stockholm to Johannesburg.* Colorada: Westview Pres.

Day, J. J., Hargreaves, J. C., Annan, J. D., & Abe-Ouchi, A. (2012). Sources of multi-decadal variability in Arctic sea ice extent. *Environmental Research Letters, 7*(3). http://dx.doi.org/10.1088/1748-9326/7/3/034011

Dedegil, Y. (2007). Dünya ısınıyor mu? Buzullar eriyor mu? Denizler yükseliyor mu? Gerçekse neden ve ne kadar? *EMO Enerji 3*,30-33.

Demirtaşlı, E. (1967). Jeolojinin ana prensipleri ve temel konuları. *Bilimsel Madencilik Dergisi, 6*(4), 259-267.

Díaz, S., Fargione, J., Chapin III, F. S., & Tilman, D. (2006). Biodiversity loss threatens human well-being. *PLoS Biol, 4*(8), 1300-1305. https://doi.org/10.1371/journal.pbio.0040277

Dojlido, J., & Best, G. A. (1993). *Chemistry of water and water pollution*. Ellis Horwood Limited.

Eckenfelder, W. (2000). *Industrial water pollution control*. McGraw-Hill.

Environmental Protection Agency. (2016). Noise pollution. Retrieved from https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=2000U8Y1.txt at 01.05.2021.

Erdal, M., Görçün, Ö. F., Görçün, Ö., & Saygılı, M. S. (2008). *Entegre lojistik yönetimi*. İstanbul: Beta yayınları.

Ergün, T., & Çobanoğlu, N. (2017). Sürdürülebilir kalkınma ve çevre etiği. *Ankara Üniversitesi Sosyal Bilimler Dergisi*, *3*(1).

Ermol, C. (2008). *900 ve 1800 mhz mobil telefonların oluşturduğu elektromanyetik alanın tendon iyileşmesine etkisi: ratlard*a deneysel çalışma. Yüksek Lisans Tezi. Süleyman Demirel Üniversitesi, Tıp Fakültesi, Isparta.

Erten, S. (2004). Çevre eğitimi ve çevre bilinci nedir, çevre eğitimi nasıl olmalıdır? Çevre *ve* İnsan *Dergisi,* Çevre *ve Orman Bakanlığı Yayın Organı, 65*-66.

Erten, S. (2020). *Fen ve teknoloji uygulamalarının* çevreye *etkileri. Teknoloji ve elektromanyetik dalgalar*. Güven Yıldırım, E. & Önder, A. N. (Ed.) *Senaryolarla desteklenmiş fen ve teknoloji uygulamaları*. Ankara: Anı Yayıncılık.

European Public Health Alliance, (2009). *Air, Water Pollution and Health Effects*. Retrieved from http://www.epha.org/r/54 at 30.04.2021.

Fereidoun, H., Nourddin, M. S., Rreza, N. A., Mohsen, A., Ahmad, R., & Pouria, H. (2007). The effect of long-term exposure to particulate pollution on the lung function of Teheranian and Zanjanian students. *Pak J Physiol, 3*(2), 1–5.

Feychting, M., Ahlbom, A., & Kheifets, L. (2005). EMF and health. *Annu Rev Public Health, 26*, 165-189. https://doi.org/10.1146/annurev.publhealth.26.021304.144445

Firdaus, G., & Ahmad, A. (2010). *Noise pollution and human health: a case study of municipal corporation of Delhi*. Indoor and Built Environment, Sage Publications.

Fleischmann, M. (2003). Reverse logistics network structures and design. *Available at SSRN 370907*.

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science advances*, *3*(7), e1700782. https://doi.org/10.1126/sciadv.1700782

Gibbard, P., & Cohen, K. M. (2008). Global chronostiatigraphical correlation table for the last 2,7 million years. *Episodes Journal of International Geoscience, 31*(2), 243-247. http://dx.doi.org/10.18814/epiiugs/2008/v31i2/011

Graham, C., Cook, M. R., Cohen, H. D., & Gerkovich, M. M. (1994). Dose response study of human exposure to 60 hz electric and magnetic fields. *Bioelectromagnetics, 15*, 447–463. https://doi.org/10.1002/bem.2250150508

Güler, Ç., & Çobanoğlu, Z. (1996). *Sağlık açısından* çöp. Ankara: Tıbbi Dokümantasyon Merkezi Toplum Sağlığı Dizisi, 14.

Güler, Ç., & Çobanoğlu, Z. (1997). *Toprak kirliliği*. TC Sağlık Bakanlığı *Çevre* Sağlığı Temel Kaynak Dizisi, *40*.

Hays, J. (2008). Deforestation and desertification in China. Retrived from http://

factsanddetails.com/china.php?itemid=389&catid=10&s ubcatid=66 at 04.05.2012.

Heywood, V. H., & Watson, R. T. (1995). *Global biodiversity assessment*. 1140. Cambridge: Cambridge university press.

https://earth.org/the-biggest-environmental-problems-of-our-lifetime/

https://ourworldindata.org/plastic-pollution?utm_source=newsletter

https://www.madr.ro/docs/ind-alimentara/risipa_alimentara/presentation_food_waste.pdf

Hunashal, R. B., & Patil, Y. B. (2012). Assessment of noise pollution indices in the city of Kolhapur, India‖. *Procedia - Social and Behavioral Sciences. 37*, 448 – 457.

IUCN. (2021). The IUCN Red List of Threatened Species. Retrived from https://www.iucnredlist.org/ in 03.05.2021.

Jepsen, E. M., & De Bruyn, P. N. (2019). Pinniped entanglement in oceanic plastic pollution: A global review. *Marine Pollution Bulletin, 145*, 295-305. https://doi.org/10.1016/j.marpolbul.2019.05.042

Jin, G., Li, G., Zhou, M., & Ni, Y. (2005). Research on allocation of gross electromagnetic pollution emission right in power quality markets. *IEEE, (1),* 320-325. *https://doi.org/10.1109/PES.2005.1489325*

Johnston, R. J. (1989). *Environmental problems: nature, economy and state*. Belhaven Press, Pinter.

Kang, G. H., Lee, C. H., Seo, J. W., Sung, R. H., Chung, Y. H., Lee, S. K., Suh, Y. H., & Chi, J. G. (1997). In vivo study on the harmful effect of the extremely low frequency unipolar pulsating magnetic field in mice. *Korean Medical Science, 12*(2), 128–134. https://doi.org/10.3346/jkms.1997.12.2.128

Karaca, A., & Turgay, O. C. (2012). Toprak kirliliği. *Toprak Bilimi ve Bitki Besleme Dergisi*, *1*(1), 13-19.

Karalar, R., & Kiracı, H. (2011). Çevresel Sorunlara karşı bir çözüm önerisi olarak sürdürülebilir tüketim düşüncesi. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, (30), 63-76.

Kattsov, V. M., Ryabinin, V. E., Overland, J. E., Serreze, M. C., Visbeck, M., Walsh, J. E., Meier, W., & Zhang, X. (2010). Arctic sea ice change: a grand challenge of climate science, *Journal of Glaciology, 56*(200), 1115–21.

Kay, J. E., Holland, M. M., & Jahn, A. (2011). Inter-annual to multi-decadal Arctic sea ice extent trends in a warming World. *Geophysical Research Letters, 38*(15), L15708. https://doi.org/10.1029/2011GL048008

Khan, M. A., & Ghouri, A. M. (2011). Environmental pollution: its effects on life and its remedies. *Researcher World: Journal of Arts, Science & Commerce*, *2*(2), 276-285.

Khomenko, S., Cirach, M., Pereira-Barboza, E., Mueller, N., Barrera-Gómez, J., Rojas-Rueda, D., ... & Nieuwenhuijsen, M. (2021). Premature mortality due to air pollution in European cities: a health impact assessment. *The Lancet Planetary Health*, *5*(3), e121-e134. https://doi.org/10.1016/S2542-5196(20)30272-2

Kimani, N. G. (2007). Environmental pollution and impact to public health. *Implication of the Dandora Municipal Dumping Site in Nairobi, Kenya. A pilot study report In cooperation with The United Nations Environment Programme (UNEP)*.

Kingsland, S. (1995). *Modeling nature: Episodes in the history of population ecology*. Chicago: University of Chicago Press.

Kinnard, C., Zdanowicz, C. M., Fisher, D. A., Isaksson, E., de Vernal, A., & Thompson, L.G. (2011). Reconstructed changes in Arctic sea ice over the past 1450 years. *Nature, 479*(7374), 509–512. https://doi.org/10.1038/nature10581

Köklükaya, A. N. (2013). Öğrencilerin *elektromanyetik kirliliğe sebep olan bazı teknolojik cihazların bilinçli kullanımına ilişkin farkındalık düzeylerinin incelenmesi ve geliştirilmesi.* Yüksek Lisans Tezi, Gazi Üniversitesi Eğitimm Bilimleri Enstitüsü, Ankara.

Köklükaya, A. N., & Selvi, M. (2015). Elektromanyetik kirliliğe sebep olan teknolojik cihazların bilinçli kullanımına ilişkin farkındalık ölçeğinin geliştirilmesi. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, *16*(3), 105-121.

Köklükaya, A. N., Yıldırım, E. G., & Selvi, M. (2017). The relationship between pre-service teachers' awareness levels of electromagnetic pollution and other environmental problems. *Eurasian Journal of Educational Research, 16*(67), 17-35. http://dx.doi.org/10.14689/ejer.2017.67.2

Kromm, D. E. (1973). Response to air pollution in Ljubljana, Yugoslavia. *Annals of the Association of American Geographers*, 63(2), 208-217. https://doi.org/10.1111/j.1467-8306.1973.tb00919.x

Kumar, A., Sivakumar, R., Reddy, Y. S. R., Raja, B., Nishanth, T., & Revanth, V. (2016).

Preliminary study on marine debris pollution along Marina beach, Chennai, India. *Regional Studies in Marine Science*, *5*, 35-40. http://dx.doi.org/10.1016/j.rsma.2016.01.002

Longcore, T., & Rich, C. (2004). Ecological light pollution. *Front Ecol Environ, 2*(4), 191–198. https://doi.org/10.1890/1540-9295(2004)002[0191:ELP]2.0.CO;2

Lowe, S. S. & Walker M. S. C. (1999). *Reconstructing quaternary environments*. England: Longman Group.

Mäler, K. G. (1990). International environmental problems. *Oxford Review of economic policy*, *6*(1), 80-108.

Manisalidis, I., Stavropoulou, E., Stavropoulos, A., & Bezirtzoglou, E. (2020). Environmental and health impacts of air pollution: A review. *Frontiers in public health*, *8 (14)*. https://doi.org/10.3389/fpubh.2020.00014

Mather, A. S. (1991). *Global forest resources*. International Book Distributors, Dehra Dun.

Mato, Y., Isobe, T., Takada, H., Kanehiro, H., Ohtake, C., & Kaminuma T. (2001). Plastic resin pellets as a transport medium for toxic chemicals in the marine environment, *Environmental Science and Technology, 35*(2), 318-324. https://doi.org/10.1021/es0010498

McIntosh, R. P. (1985). *The background of ecology*. Cambridge: Cambridge University Press.

Menz, F. C., & Seip, H. M. (2004). Acid rain in Europe and the United States: an update. *Environmental Science & Policy*, *7*(4), 253-265. https://doi.org/10.1016/j.envsci.2004.05.005

Miri, M., Alahabadi, A., Ehrampush, M.H., Rad, A., Lotfi, M.H., Sheikhha, M.H., & Sakhvidi, M. J. Z. (2018). Mortality and morbidity due to exposure to ambient particulate matter. *Ecotoxicol. Environ. Saf. 165*, 307–313. https://doi.org/10.1016/j.ecoenv.2018.09.012

Mitman, G. (1992). *The state of nature: Ecology, community and American social thought, 1900–1950*. Chicago: University of Chicago Press.

Moss, B. (2008). Water pollution by agriculture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *363*(1491), 659-666. https://doi.org/10.1098/rstb.2007.2176

Myers, N. (1992). *The primary source: Tropical forests and our future*. New York: Norton.

Myers, N. (1994). *Tropical deforestation: rates and patterns*. In: Brown, K., Pearce, D.W. (Eds.), *The Causes of Tropical Deforestation*., London: University College London Press.

Newman, P. A., Daniel, J. S., Waugh, D. W., & Nash, E. R. (2007). A new formulation of equivalent effective stratospheric chlorine (EESC). *Atmospheric Chemistry and Physics*, *7*(17), 4537-4552. https://doi.org/10.5194/acp-7-4537-2007

Noss, R. F., & Cooperrider, A. (1994). *Saving nature's legacy: protecting and restoring biodiversity*. Washington: Island Press.

NRC. Advancing the Science of Climate Change. (2010). *National research council*. The National Academies Press: Washington, DC, USA.

Önder, A. N. & Güven Yıldırım, E. (2020). *Teknoloji ve elektromanyetik dalgalar*. Güven Yıldırım, E. & Önder, A. N. (Ed.) *Senaryolarla desteklenmiş fen ve teknoloji uygulamaları*. Ankara: Anı Yayıncılık.

Öztürk, İ. (2010). Katı atık yönetim ve AB uygulamaları. İstanbul: İSTAÇ Teknik Kitaplar Serisi 2.

Palabıyık, H. (2001). *Belediyelerde kentsel katı atık yönetimi: İzmir Büyükşehir Belediyesi* Örneği. DEÜ Sosyal Bilimler Enstitüsü, Doktora Tezi, İzmir.

Pearce, D., & Brown, K. (1994). S*aving the world's tropical forests. In the causes of tropical of tropical deforestation*. Brown, K., & Pearce, D. (eds.). *The economic and statistical analysis of factors giving rise to the loss of the tropical forest*, UCL Press.

Plutynski, A. (2018). *Ecology and the Environment*. The Oxford Handbook of Philosophy of Biology (Ed: Michael Ruse). Retrieved from https://core.ac.uk/download/pdf/295732117.pdf 30.04.20201.

Rajkhowa, R. (2014). Light pollution and impact of light pollution. *International Journal of Science and Research*, *3*(10), 861-867.

Rampal, P., Weiss, J., Dubois, C., & Campin, J. M. (2011). IPCC climate models do not capture Arctic sea ice drift acceleration: Consequences in terms of projected sea ice thinning and decline. *Journal of Geophysical Research: Oceans*, *116*(C8). https://doi.org/10.1029/2011JC007110

Read, A. D. (1999). A weekly doorstep recycling collection, I had no idea we could!: Overcoming the local barriers to participation. *Resources, Conservation and Recycling, 26*, 217 -249. https://doi.org/10.1016/S0921-3449(99)00008-7

Redl, R. (2001). Electromagnetic environment impact of power electronics equipment. *Proceedings of the IEEE, 89*(6), 926-938. http://dx.doi.org/10.1109/5.931490

Repetto, R. (1988). *The forest for the trees? Government policies and the misuse of forest resources*. World Resource Institute, Washington DC.

Ring, M. J., Lindner, D., Cross, E. F., & Schlesinger, M. E. (2012). Causes of the global warming observed since the 19th century. *Atmospheric and Climate Sciences*, *2*, 401-415. http://dx.doi.org/10.4236/acs.2012.24035

Rodrigues, J. M. (2008). The rapid decline of the sea ice in the Russian Arctic. *Cold Regions Science and Technology. 54*(2),124–142. http://dx.doi.org/10.1016/j.coldregions.2008.03.008

Rowe, R., Sharma, N. P., & Bowder, J. (1992). *Deforestation: problems, causes and concern*. In: *Managing the world's forest: looking for balance between conservation and development*, ed. Sharma, N. P. Pp 33-46. Kendall/Hunt Publishing Company, Iowa.

Roy, S. (2020). Ozone depletion and global environment. *Adv Earth & Env Sci. 1*(1), 1-5.

Rye, J., & Rubba, P. (2000). *Student understanding of global warming: Implications for STS education beyond 2000*. Kumar, D., & Chubin, K. (Ed). *Science, Technology, and Society: A Sourcebook on Research and Practice* New York: Plenum 193-230.

Saad L. (2009). Water pollution Americans' top green concern. Retrieved from http://www.gallup.com/poll/117079/waterpollution-americans-top-green-concern.aspx at 01.05.2021.

Sands, R. (2005). *Forestry in a global context*. CABI Publishing.

Schell, L. M., Gallo, M. V., Denham, M., & Ravenscroft, J. (2006). Effects of pollution on human growth and development: An introduction. *Journal of Physiological Anthropology*, *25*(1), 103-112. https://doi.org/10.2114/jpa2.25.103

Schlesinger, M. E., & Ramankutty, N. (1994). An oscillation in the global climate system of period 65-70 years. *Nature, 367*, 723-726. https://doi.org/10.1038/367723a0

Schulz, T. J. (1978). Synthesis of social surveys on noise annoyance: *J Acoust Soc Amer, 64*, 377–405. https://doi.org/10.1121/1.382013

Scipeeps, (2009). *Effects of water pollution*. Retrieved from http://www.scipeeps.com/ at 01.05.2021.

Şengül, Ü. (2010). Atıkların geri dönüşümü ve tersine lojistik. *Paradoks Ekonomi, Sosyoloji ve Politika Dergisi*, *6*(1), 73-86.

Singer, S. F. (1970). Global effects of environmental pollution. *Eos, Transactions American Geophysical Union*, *51*(5), 476-478. https://doi.org/10.1029/EO051i005p00476

Singh, R. L. & Singh, P. K. (2017). *Global environmental problems.* Singh, R. L. (Ed.). *Principles and applications of environmental biotechnology for a sustainable future*. (E-Book). Singapore: Springer.

Smith, R. A. (1872). *Air and rain. The beginnings of chemical climatology*. London: Longmans, Green.

Staff, S. (2010). *Mining deforestation nearly tripled between 2000-08*. Archives, Wednesday October 13 2010.

Steinberg, F. (2007). Jakarta: Environmental problems and sustainability. *Habitat International*, *31*(3-4), 354-365. https://doi.org/10.1016/J.HABITATINT.2007.06.002

Sternberg, R. (2010). Hydropower's future, the environment, and global electricity systems. *Renewable and Sustainable Energy Reviews, 14*(2), 713–723. https://doi.org/10.1016/j.rser.2009.08.016

Sümer, G. Ç. (2014). Hava kirliği kontrolü: Türkiye'de hava kirliliğini önlemeye yönelik yasal düzenlemelerin ve örgütlenmelerin incelenmesi. *Uluslararası İktisadi ve İdari İncelemeler Dergisi*, (13), 37-56.

The Royal Society. (2010). *Climate change: A summary of the science*. London: The Royal Society Science Policy Centre.

Thiel, M., Luna-Jorquera, G., Álvarez-Varas, R., Gallardo, C., Hinojosa, I. A., Luna, N., Urbina- Miranda, D., Morales, N., Ory, N., Pacheco, A. S., Portflitt-Toro, M., & Zavalaga, C. (2018). Impacts of marine plastic pollution from continental coasts to subtropical gyres—fish, seabirds, and other vertebrates in the SE Pacific. *Frontiers in Marine Science, 5*(238). https://doi.org/10.3389/fmars.2018.00238

Tokgöz, M., & Sarmaşık, N. (1982). Çöp *sorunu ve sağlık*. Çevre 82 Sempozyumu. İzmir.

U.K. Met Office. (2011). *Warming: A guide to climate change*. Exeter, U.K.: Met Office Hadley Centre.

United Nations General Assembly. (1987). Report of the World Commission on Environment and Development: Our Common Future. https://sustainabledevelopment.un.org/

content/documents/5987our-common-future.pdf

Uygunol, O., & Durduran, S. S. (2008). Elektromanyetik kirlilik haritalarının coğrafi bilgi sistemi (cbs) yardımıyla oluşturulması. *TMMOB Harita ve Kadastro Mühendisleri Odası Ankara Şubesi I. CBS Günleri Sempozyumu.* Ankara.

Van Kooten, G. C., & Bulte, E. H. (2000). *The economics of nature: managing biological assets*. Blackwells

Varol, S., Davraz, A., & Varol, E. (2008). Yeraltı suyu kimyası ve sağlığa etkisinin tıbbi jeoloji açısından değerlendirilmesi. *TAF Prev Med Bull*, *7*(4), 351-356.

Widiyawati, Y. (2020, April). Global warming & climate change: integration of socio-scientific issues to enhance scientific literacy. In *Journal of Physics: Conference Series* (Vol. 1511, No. 1, p. 012071). IOP Publishing. https://doi.org/10.1088/1742-6596/1511/1/012071

Wilén, J., Johansson, A., Kalezic, N., Lyskov, E., & Sandström, M. (2006). Psychophysiological tests and provocation of subjects with mobile phone related symptoms. *Bioelectromagnetics, 27*, 204-14. https://doi.org/10.1002/bem.20195

Wilkie, D., Shaw, E., Rotberg, F., Morelli, G., & Auzels, P. (2000). Roads, development and conservation in the Congo Basin. *Conservation Biology 14*(6),1614-1622.

Wilson, E. O. (2002). *The future of life*. New York: Alfred A. Knopf.

World Health Organization. WHO (2009). Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks. *World Health Organization*, Geneva. https://apps.who.int/iris/handle/10665/44203

Xiong, X., Maddy, E. S., Barnet, C., Gambacorta, A., Patra, P. K., Sun, F., & Goldberg, M. (2014). Retrieval of nitrous oxide from Atmospheric Infrared Sounder: Characterization and validation. *Journal of Geophysical Research: Atmospheres*, *119*(14), 9107-9122. http://dx.doi.org/10.1002/2013JD021406

Xu, C., Chen, Y., Yang, Y., Hao, X., & Shen, Y. (2010). Hydrology and water resources variation and its response to regional climate change in Xinjiang. *Journal of Geographical Sciences, 20*(4), 599–612. http://dx.doi.org/10.1007/s11442-010-0599-6

Yazdanparast, T., Salehpour, S., Masjedi, M. R., Seyedmehdi, S. M., Boyes, E., Stanisstreet, M., & Attarchi, M. (2013). Global warming: Knowledge and views of Iranian students. *Actan Medica Iranica, 51*(3), 178-184.

Zimmermann, M. (2001). Energy situation and policy in Switzerland. *International Journal of Ambient Energy, 22*(1), 29–34. https://doi.org/10.1080/01430750.2001.9675384

Zoray, F., & Pır, A. (2007). *Küresel* ısınma *problemi: sebepleri, sonuçlar,* çözüm *yolları*. Yıldız Teknik Üniversitesi Çevre Mühendisliği Bölümü. İstanbul.

About the Authors

Ayşe Nesibe Onder, PhD, is Associate Professor in Science Education at Gazi University in Ankara, Turkey. She holds a PhD in Science Education from Gazi University. Her main areas of interest are, environmental education, electromagnetic pollution, educational films and educational games in science education and scale development studies. nkoklukaya@gazi.edu.tr

Ezgi Güven Yıldırım, PhD, is Associate Professor in Science Education at Gazi University in Ankara, Turkey. She holds a PhD in Science Education from Gazi University. Her main areas of interest are, environmental education, educational films and educational games in science education, project based learning and scale development studies. ezgiguven@gazi.edu.tr

Similarity Index

The similarity index obtained from the plagiarism software for this book chapter is 1%.

To Cite This Paper:

Onder, A. N., & Guven-Yildirim, E. (2021). Environmental Problems. In S. Erten (Ed.), *Different Perspectives on Environmental Education* (pp. 306–338). ISRES Publishing