Green House Gases and Effects of at on the Environment

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Abstract

A series of gasses that carry some of the energy of the Sun in the Earth's atmosphere and heat up the atmosphere, called greenhouse gases. These gases include water vapor, carbon dioxide and methane oxides of nitrogen, ozone and chlorofluorocarbon. The greenhouse is a glass chamber where the sun shines through the glass and warms the greenhouse air, but the greenhouse glass does not allow this warm air to come out of the greenhouse. By the similarity of this phenomenon to the operation of a greenhouse glass, it was called the greenhouse effect.

The atmosphere or air around us is a pseudo-greenhouse, the atmospheric greenhouse gases act just like greenhouse glass. After going through the greenhouse gas layers, the sun shines upon the atmosphere. When sunlight hits the earth's surface, some of its thermal energy returns to space but greenhouse gasses return it to Earth. If the amount of greenhouse gasses in the atmosphere is higher than normal, less energy can return to space, warming the atmosphere and then increasing the temperature of the Earth.

Natural greenhouse effects on Earth keep it warm enough for us humans to live on, but if the greenhouse effect on the planet is heightened by increased atmospheric greenhouse gas emissions, global warming may increase. That we humans can't stand the heat, and the rest of animals and plants.

In short, we can conclude that global warming causes sea levels to rise through the greenhouse effect, powerful storms in coastal areas, disruption to the drinking and agricultural water resources, changes in biodiversity, changes in distribution of plants, soil moisture. And it has also increased drought, increased rainfall, floods and forest fires, which is a major threat to the environment of all living things on Earth.

Keywords: Greenhouse gases, Warming, Atmosphere, Sunlight, Radiation, Global Warming.

Introduction

Excessive greenhouse gas emissions to the atmosphere and its adverse effects on the environment are one of the most important global hot topics in today's age. The greenhouse effect is a natural phenomenon in which the energy of the sun reaches the earth by the solar radiation which passes freely through the atmosphere. But recurrent radiation from Earth is either captured or absorbed by gases in the atmosphere.

Over the centuries, this phenomenon has arisen continuously and in equilibrium, but today the earth's natural greenhouse effect is slowly becoming abnormal. We send large amounts of heat-absorbing gases into the atmosphere every day. These gases absorb a thick coating around the Earth and trap more heat waves. The damaging effects of storing these gasses in the Earth's atmosphere are the same as global warming which can increase the temperature of the present and future of the Earth.

As global warming seasons intensify, polar ice melts, seawater rises, destructive marine storms increase in coastal areas, and changes in the diversity of livestock and soils increase soil moisture. Will decrease.

Through global warming and its effect on agricultural fields, human food supplies will be limited, more water will become steam, resulting in a lack of fresh water for human beings. These changes can also have negative consequences for animals and plants. Humans will adapt to their animals and plants if these changes occur gradually, but if these changes occur too soon, wildlife will face serious risks. The projections are likely to rise by more than 6 ° C by the end of the 21st century, which would be devastating for the earth in the future.

Green House Gases

Greenhouse gases are called gasses which store some of the energy of the sun in the atmosphere and cause warming of the atmosphere. These gases are water vapor, carbon dioxide and methane, oxides of nitrogen, fluorocarbon and ozone. Among the most commonly spoken about carbon dioxide and water vapor due to its high level, which accounts for about 3% of all greenhouse gases in the atmosphere, are the most important greenhouse gases, both of which are significant hydrocarbon combustion products (Kohestani, 2014).

As you know, methane gas is a greenhouse gas and its increase in temperature increases the temperature of the earth (Council of Chemistry Department of Planning and Textbook Compilation Office, 2009).

Some scientists proposed in the mid-1970 that we could change the amount of ozone on Earth by reducing the amount of ozone in the stratosphere. Ozone rates can be lowered by raising the amount of chlorofluorocarbons used by nitrogen oxide gasses emitted by nitrogen fertilizers in sprays and air conditioners, or by direct injection of nitrogen oxide gases into the ozone layer by supersonic aircraft. A reduction in the amount of stratospheric ozone will increase human skin cancer, damage certain plants and potentially change the global climate (Miller, 2005).

Carbon dioxide (CO_2)

Carbon dioxide is a colorless, odorless gas with a density higher than that of air (Geyahi, 2005).

Carbon dioxide is the main greenhouse gas that is produced daily by the activities of humans and other living things (Kohestani, 2014).

Prior to industrialization, the concentration of carbon dioxide was 280 PPm but is currently close to 390 PPm, suggesting a rise in carbon dioxide by 40 percent. Carbon dioxide gas constitutes only 0.03 per cent of the Earth's atmosphere. But it is one of the most powerful gases that can well absorb heat. Around a quarter of the greenhouse effect is due to the absorption by carbon dioxide molecules of half the thermal IR reflected in the range of wavelengths 14 to. Increasing the CO2 concentration in the atmosphere will avoid the release of excessive residual IR and will cause further air warming (Mansouri, 2011).

Steam ($H_2O_{(g)}$)

Water is one of life's unique components which consists of two hydrogen elements and one oxygen. The true, liquid water is odorless, colorless and without taste. The point of freezing and melting is 0°C and its point of boiling is 100°C (Aziz, 2000)

Water vapor is the name given to water in the earth's water in its gas phase. Water vapor is the most important atmospheric greenhouse element, and its greenhouse effect is greater than that of carbon dioxide (Mansouri, 2011).

Atmospheric water vapor plays a major role in keeping Earth's atmosphere balanced. Because water vapor absorbs long wavelength radiation. So if the water vapor is low in the atmosphere, the temperature difference becomes very high. Water vapor is the largest greenhouse gas in Earth's atmosphere and accounts for about two-thirds of this effect and usually absorbs thermal IR over the wavelength range of $5.7-5.5\ \mu m$ (Geyahi, 2005).

Methane (CH_4)

Methane is also one of the gases which has natural sources of pollution and is emitted by human activities. The concentration is calculated to be about 0.7 PPm before industrialization, while human activity has more than doubled to 1.745 PPm. This upward trend is expected to continue at a rate of approximately 1 per cent of the current value per year. The main sources are rice field production, domesticated ruminant development and proliferation, oil and gas extraction, coal extraction and processes and also anaerobic micro-organisms. Estimates show that around 600 million tons of methane come into the atmosphere from different sources annually (Mansouri, 2011).

Termites are one of the major producers of methane gas. They produce methane, carbon dioxide and other chemicals when termites eat wood. Termites are estimated to produce 165 million tons of methane and 55 million tons of carbon dioxide per annum (Council of Chemistry Department of Planning and Textbook Compilation Office, 2009).

Ozone (O_3)

The ozone layer is a region of space that is known as the Earth's natural shield from sunlight because it absorbs the sun's harmful ultraviolet radiation before it enters the Earth's surface and affects humans and other living things (Mansouri, 2011).

The oxygen element comes in the form of two ordinary oxygen and ozone allotropes. Ozone is a light blue and yellow gas with a pungent smell (Neda, 2017).

Ozone is caused by photochemical reactions induced by hydrocarbons released by nitrogen oxide and nitrogen oxide engines, so very little is present in the Earth's atmosphere (Hossaini, 2016).

At ground level, ozone is a dangerous contaminant, irritating to the eyes and respiratory system, and remains a major component of chemical fog and can also act as a greenhouse gas (Mansouri, 2011).

Chlorofluorocarbons (CFC)

Chlorofluorocarbons are one of the most important refrigerant and spray-producing ozone depleting agents. Chlorofluorocarbon manufacturers include refrigerators, household air conditioners, cars, as well as deodorants, synthetic perfumes, insecticides and fire extinguishers (Royan, 2012).

The chlorine atoms in chlorofluorocarbons are unstable and interactive, and when chlorofluorocarbon gases reach the top layers, the top layers are released by the effect of sunlight (Kohestani, 2014).

Chlorofluorocarbons are strong greenhouse gases and most of the efforts to reduce their emissions are based on their role in the elimination of the ozone layer. These efforts also help prevent global warming (Mansouri, 2011).

Nitric oxide (N_2O)

Another significant greenhouse gas is nitrous oxide, first identified in the atmosphere in 1939 by an ambient infrared absorption spectrum and determined by the same technique at a concentration of 0.27 PPm. The concentrations of atmospheric gas have now increased slightly to about 0.314 PPm (Mansouri, 2011).

How it works or the mechanism of greenhouse gas effects

The greenhouse is a glass chamber in which sunlight shines through the glass and the greenhouse air warms up. Yet greenhouse glass does not allow the warm air from the greenhouse to come out. It seems as though the air around us is like a greenhouse. Atmospheric greenhouse gasses behave just like greenhouse glasses (Kohestani, 2014).

The Planet functions as a greenhouse, but in the atmosphere of the Earth, unlike a greenhouse with its glass enclosure, it is achieved by gases. Part of the non-thermal solar radiation is transformed into heat energy

and trapped by greenhouse gases from the Earth. Over the years this phenomenon has arisen continuously and in equilibrium, but today the Earth's natural greenhouse effect is slowly becoming anomalous. Those gasses move through the Earth like a thick shell. The damaging effects of the accumulation of these gasses in the Earth's atmosphere are the same as the Earth's warming which increases Earth's temperature (Parker, 2008).

As sunlight hits the surface of the earth, soil, water, and other species absorb part of its thermal energy. Some of it stays in the atmosphere of Earth, and the rest return to space. If the volume of greenhouse gasses in the atmosphere is higher than it is naturally, the heat in the atmosphere will be stored and less energy released to space to absorb the emitted infrared radiation from the surface of the earth. As a result, the Earth's atmosphere is warmer and global warming continues (Kohestani, 2014).

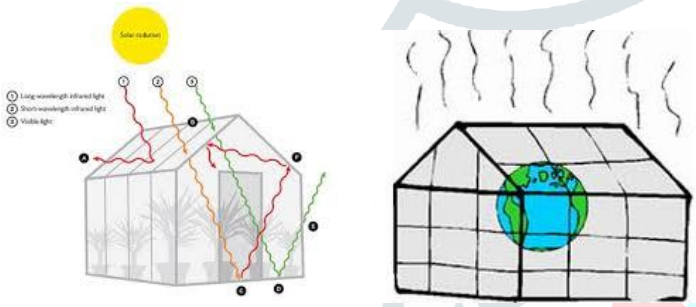

Figure 1-a: Shows the sunlight passing through the greenhouse glass into the greenhouse and returning the heat waves emitted from the plants and soil to the greenhouse. **b:** It shows the similarity of greenhouse gases around the earth to greenhouse glass.

These gases are necessary for the body's life to survive in and of itself. The reflected heat returns to space in the absence of these gases, and the air is cold enough to interrupt life. If these gasses were not in the atmosphere, the sun's returning thermal energy into space will make the Earth's climate 33°C colder than it is today. Greenhouse gas emissions and clouds capture some of the heat that is due to the Earth's surface absorbing visible infrared light and releasing it in all directions (Kohestani, 2014).

Therefore, the amount of infrared heat is redirected back to the earth's surface and reabsorbed, thereby warming the surface of the earth and the air further. This causes the average temperature on Earth's surface to reach $+15^{O}C$ instead of $-18^{0}C$ (Geyahi, 2005).

A portion of solar energy that is not heated is absorbed by the atmosphere and the Earth's surface and converted to thermal energy, increasing the overall temperature of the Earth to a certain level. Thus, the natural greenhouse effect balances the heat received and excreted (Kohestani, 2014).

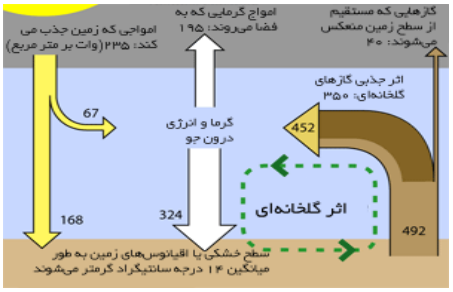

Figure 2. Mechanism of greenhouse effect

The incoming light of the sun has all the wavelengths of the effect of the earth, about 50 per cent of which enters and is absorbed by the atmosphere. 20% by gases (UV by stratosphere ozone and infrared absorbed by carbon dioxide and water) and by fall of water in the air. Clouds, ice, snow, sand and other objects which reflect light as they are absorbed reabsorb the remaining 30 per cent. They are brightened up by open space (Geyahi, 2005).

Although water vapor has the most important greenhouse effect in the atmosphere, it is not considered to be a natural component of the atmosphere and has been in the atmosphere for a long time and can not be regulated. Both efforts have focused on reducing carbon dioxide, of all the significant greenhouse gases. The greenhouse gas contribution of water vapor is projected to be 36-72% carbon dioxide 9-26% methane 4-9% and ozone 3-7%. Further moderate contributions from other greenhouse influences (Mansouri, 2011).

The fact that our planet is not completely covered by a thick layer of ice is due to the natural role of the greenhouse effect. The earth's surface is also warmed by the greenhouse effect mechanism just as much as it is directly heated by energy received from the sun (Geyahi, 2005).

Figure 3 - Picture of the Greenhouse Effect on Earth's Atmosphere

On the left side of the figure above, the surface of the earth has a temperature well below freezing point and something other than its current average. The right side of the figure above shows that since the nineteenth century, and especially in recent decades, human activity has increased this, along with numerous other greenhouse gases, resulting in a huge greenhouse effect (Silberberg, 2011).

The Effects of Greenhouse Gases on the Environment

You have all heard forecast that the 21st century and beyond greenhouse effect will affect the climate of various countries around the world. The word greenhouse effect simply means that due to the increase of carbon dioxide and other greenhouse gases in the atmosphere the average air temperature will rise by several degrees. Yes, many scientists believe that global warming has been going on for a long time due to rising greenhouse gases, primarily due to rising temperatures of around two-thirds of a degree Celsius after 1860 (Geyahi, 2005).

Obviously, reducing greenhouse gases by eliminating or limiting the sources of greenhouse gases can prevent the effects of the greenhouse gas and its associated risks (Hossaini, 2016).

Global Warming

When the sun shines on the earth several high-energy rays of the sun are penetrating and heating it. A warmed earth is sparkling like an iron or any hot rock. This energy is less energy than the absorbed solar radiation, which is called electromagnetic radiation. Such reflected rays from the planet are easier to absorb by greenhouse gasses than by solar lights, and this is a global warming effect (Council of Chemistry Department of Planning and Textbook Compilation Office, 2009).

We know that the Planet is warmed by the sun naturally, but here we mean another warming trend, a relatively new phenomenon of increasing Earth's temperature due to human activity which is different from natural change. Global warming has not been today's scientists ' concern for the past decade, and it has not worried scientists and researchers alike. Human beings were thinking of getting beyond the galaxies to other galaxies so they started building a number of more advanced tools. But not long ago, he realized the globe air's current heat shifts and the issues that were being caused to mankind. Climate change in the past has been a speculation, and now it appears in front of our eyes. Humans are causing these changes by coalescing and burning large quantities of coal, oil, fossil fuels and natural gas, which releases billions of tons of greenhouse gases into the air every year (Kohestani, 2014).

The mechanism of global warming is due to a phenomenon called the "greenhouse effect" and these gasses are considered greenhouse gases in this context. Greenhouse gases are in fact the drivers and preservers of the Earth's surface temperature and atmosphere. Because they are permeable to the visible light of the sun, and impermeable to the radiation of infrared (IR), they absorb and return to the planet. Nevertheless, the greenhouse effect has always existed in the atmosphere, and is essential to maintaining its temperature. But what has implicated this phenomenon in public minds and scientists call it a deluge, the excessive accumulation of greenhouse gases in the atmosphere, and the over-balancing effect of this phenomenon on Earth's thermal preservation, resulting in an increase in the average thermal degree. Since the beginning of the industrial era and with the increasing use of fossil fuels, deforestation and the use of

chlorofluorocarbons, greenhouse gas emissions have been steadily increasing, and as a result, the Earth's climate has been gradually warmer, causing climate change. As the emissions continue to rise, the Earth's temperature will rise by about 1.5°C to 4.5°C over the next 60 years, which is a

Disaster for Earth (Mansouri, 2011).

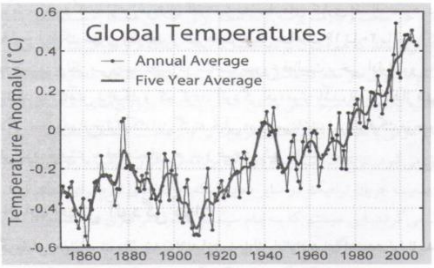

Figure 4- The trend of global average temperature change over the past 150 years

Analyzes of the degrees of heat recorded over the past 150 years in some studies show that the average temperature of the earth's surface has increased by about $0.3^0C - 0.6^0C$. What is nowadays referred to as global warming is, in fact, the rise of the Earth's average temperature near its surface. Scientists' research shows that over the past hundred years the average temperature of the air near the surface has increased between 0.18° C and 0.74° C (Mansouri, 2011).

Researchers see the effects of global warming in the rings of trees and plants on land and in the seas, with the deaths and deformation of old corals and seagrasses, as well as bubbles forming in the ice cores, all of which prove it. That the earth hasn't been that hot for centuries. Although most studies show only the consequences of global warming by 2100, scientists believe that although greenhouse gas emissions remain constant, their impact will last until the end of the third millennium (Kohestani, 2014).

The Effects of Global Warming

Global warming has many disagreeable impacts on both human and animal life. The global warming causes polar ice to melt, sea levels to rise, and seasons to intensify. That is, scientists see the effects of global warming in the rings of trees and plants on land and in the oceans with the deaths of old corals and seabirds and their deformation, as well as bubbles in the ice cores, all of which suggest that the earth hasn't been so hot for centuries. Although most studies only display global warming results by the year, scientists believe that the effects will last until the end of the third millennium, even if the greenhouse gas emissions remain constant. The winters will be colder than ever and summers warmer and drier than the past. This has an unpleasant impact on agriculture, which is one of the most important industries on earth. Scientists have been predicting the effects of global warming so far that the gradual warming of the earth will soon change the type of agricultural crops (Pour, 2005).

1. Rising Seas and Oceans

The most noticeable effect of rising global temperatures is the increase in the melting of polar ice and ice buoys resulting in rising seawater (Mansouri, 2011).

When Montana's glaciers were recorded in 1910, there were limits to glaciers. There is less left over than the fridge today. The legendary snowfall of Kilimanjaro has melted by about a percent since 1912 and is likely to be completely eliminated by 2020 (Kohestani, 2014).

The sea level is projected to rise in the next 100 years to between 30 cm and 1.5 cm above sea level, which in turn will cause some of the island's water to vanish or become uninhabited and disrupted infrastructure and the lives of people in ports. The low-risk regions include the Brunei monarchies, parts of Bangladesh and other East Asian countries, parts of the Netherlands and the southern United States. As the waters rise, there will be about 46 million people vulnerable to coastal flooding triggered by storm surges. For example, by 2100, 16 per cent of the land in the coastal areas of Bangladesh will be submerged (Mansouri, 2011).

2. Freshwater Restriction

Water is the most significant mixture of hydrogen and oxygen on earth, the most common and abundant compound. About 3.4% of the World is covered by water and about 97.3% of that is found in the seas, 2% in the form of polar ice and glaciers, and 0.6% underground. Freshwater seas and lakes constitute less than 0.1 per cent of all water. Oceanic and seawater are not ideal for drinking and farming as there are about 35 kg of dissolved salts in every 1 kg of it. Sodium chloride is the most common salt in oceans and seas but there are over 60 other minor elements. Waters that contain less than 1 gram of salt are called fresh water or drinking water, and if more salt is present in the water, it is called saline (Neda, 2017).

Drinking water does not smell and should not be tasteless. Different salts give different flavors of water which sometimes have a pleasant and sometimes unpleasant taste (Azizi, 2000).

As seawater rises, saline water infiltrates coastal freshwater sources and changes its quality. Many freshwater sources that are a short distance from the high seas become non-potable (Mansouri, 2011).

3. Increasing the Number and Strength of Marine Storms and Tornadoes

The storms form when the oceans rise, in tropical areas such as the Caribbean Sea, China's coast and Japan. Increasing atmospheric heat, in effect, increases the heat of the oceans, increasing the chance of storms (Kohestani, 2014).

Because of the cold water, the melting of polar ice allows a stream of pure cold water to flow into the warm waters and generate strong ocean currents in the great ocean. Such currents are caused by the movement of salts between fresh water (from the polar ice) and the salty waters, creating more storms, hurricanes and

more damaging tornadoes. The reports of these storms and tornadoes have risen over the last 150 years, as the temperature of the Earth has increased (Mansouri, 2011).

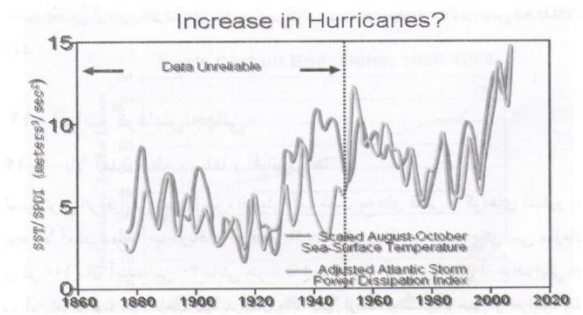

Figure 5. Statistics of marine storms and tornadoes in the past 150 years

4. Effects on Biodiversity

Diversity of life forms on Earth, including organisms, biomes, or habitats, and worldwide species recognition. The number and species of organisms vary from one location to another on the planet and depend on the variety of environments, the amount and type of food, natural geographical variations and environmental conditions (Royan, 2012).

The warming trend will destroy more than a million plant and animal species by 2050 according to numerous studies. Many of us are starting to understand just what the measurements are. Scientists from around the world, from Australia to South Africa, studied different species and the climate effect on them and then simulated the situation with computer models. In 2050.15 to 35 per cent of the 1103 species surveyed are predicted to be extinct from an optimistic perspective (Kohestani, 2014).

Despite global warming many of the strongest polar bear populations in the north, polar bears and lions will be extinct. As the polar ice melts in the north it will kill the algae that lives beneath the ice. Algae are at the heart of the food chain and many fish, seabirds, and jaws rely on them for their lives. On the other hand, global warming alters ocean currents and the aquatic biological environment which causes some fish to be killed. That is not in a position to adapt to new circumstances. The increase in thermal seawater levels also affects the lives of certain migratory species (Mansouri, 2011).

Biodiversity is a right for future generations and serious consideration must be given to preserving the natural environment (Royan, 2012).

5. Effect on Forests

Growth of all kinds of plants depends entirely on air temperature. For instance, wide leaf trees with permanent leaves tend to grow where temperatures are at least 15 ° C. Conifers and trees with non-permanent leaves, on the other hand, can grow to a maximum temperature of 40 ° C. Thus the temperature of the Earth has a great effect on the distribution of green plants on the Planet, so that its vegetation can

move north from 100 to 160 km equator by one degree of rise in the temperature of the Earth. The effect of elevated temperatures on the northern garlic cold forests, where low temperature will act as a growth limiting agent, will have a favorable effect on the tropical forests in the southern latitudes where the thermal degree The former is more suitable for plant growth, will have a negative effect (Mansouri, 2011).

As we said earlier, a large part of the heat from the sun is absorbed through the coronal trees, while the other part is reflected in the atmosphere. Additionally, the forest trees ' crowns protect the soil from cold and heat loss, especially during clear nights. In the trees canopy area and in the lower and higher open area areas, the heat regime often varied. It is here that the forest ecosystem produces a different atmosphere. The effect of the elevated forest regime on heat regimes depends on mass formation, growth, relief, plant resources, soil, etc. Additionally, the effect of the forest on the thermal regime of the area also depends on the climate (Pearce David, 1998).

6. Effect on Soil Moisture Change

The water flow on the forest floor surface is smaller than the one on the open area. The rainfall hitting the forest floor is much smaller still. Moisture evaporation from the forest surface was less than that of the open area, but moisture was higher, providing a nice and enjoyable environment for breathing, and the impact of the forest on soil moisture was not the same everywhere. It has to be said that all parts of the forest have had different humidity. A lot of snow had collected under the pine trees during the winter, bringing a lot of moisture. Whether the snow of the trees in the open areas and the area is cut off by the wind or melted by the sun, a large amount of water flows over the surface. In mountainous conditions, as much research has been done in Switzerland, the soil of the forest trees is very wet compared to the bare forest areas. Here, the reason for the high soil moisture in the forest area is that the forest increases the amount of rainfall during the day wastes reduces the amount of water and prevents wet soil erosion (Leqa, 2002).

Forest habitats are thought to be experiencing major changes as warmer and drier climates develop. According to the new climate models, temperatures in North and Central America will be around 3°C in winter and about 2°C in summer as atmospheric carbon dioxide concentration doubles to pre-industrial levels, and precipitation will become colder. Winter will grow by 20% and fall by 5-10% in the summer. So the soil loses 10 to 20 per cent of its humidity. The decrease in soil moisture in the plant community would result in changes that remove dehydration-sensitive plants and replace resistant plants (Mansouri, 2011).

Conclusion

A collection of gasses that retain some of the energy of the Sun in the Earth's atmosphere and heat up the atmosphere, called greenhouse gases. Other emissions include water vapor, carbon dioxide, and phosphorus, oxides of ammonia, ozone and chlorofluorocarbons. The greenhouse is a glass chamber where

the sunlight shines through the glass and warms the greenhouse air, but the greenhouse glass does not allow this warm air to escape from the greenhouse.

The Earth acts like a greenhouse, but unlike a greenhouse with a glass enclosure, it is caused by gases in the atmosphere. Part of the non-thermal solar radiation is converted into thermal energy and trapped by the Earth's greenhouse gases. The damaging consequences of accumulating these gases in the Earth's atmosphere are the same as global warming, which has raised the Earth's temperature.

The process of global warming is due to a phenomenon called "greenhouse effect" and in this sense these gases are called greenhouse gases. Greenhouse gases are essentially the regulators of the Earth's surface temperature and its atmosphere. Because they are impermeable to the sun's visible light and impermeable to infrared light, they absorb and reflect to the earth. In fact, the greenhouse effect has always existed in the atmosphere and is essential for maintaining its thermal temperature. But what has implicated this phenomenon in the public mind and scientists call it a deluge, the excessive accumulation of greenhouse gases in the atmosphere, and the over-balancing effect of this phenomenon in maintaining global warming and thus raising the average temperature.

With global warming the seasons have intensified, polar ice has melted, sea levels have risen, destructive marine storms have increased in coastal areas, and changes in the diversity of animal and plant life have occurred and soil moisture has also decreased.

With global warming and its impact on agricultural farms, human resources are reduced, more water becomes steam and, as a result, humans suffer from a shortage of fresh water, and these changes also affect animals and plants negatively. If these changes occur slowly, humans will adapt to their animals and plants, but if these changes occur too quickly, wildlife will face serious risks. By the end of the 21st century, global warming is projected to rise to 6°C, which would be a catastrophic increase for the Earth in the future.

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