

GREENHOUSE EFFECT

The greenhouse effect is the process of trapping of heat near Earth's surface by some gases known as greenhouse gases (GHGs). The greenhouse gases are named so because these act like the glass walls of a greenhouse. A greenhouse is a structure used to grow plants under controlled environmental conditions. The phenomenon of greenhouse effect can be explained as (Fig. —)

1. Solar radiation: The sun emits the solar radiation which passes through the atmosphere and reaches to the surface of the earth.
2. Absorption: Some of the solar radiation is absorbed by the Earth's surface including water bodies and vegetation. This absorption warms the surface of earth.
3. Radiative Heat Transfer: After warming, the earth's surface emits longwave Infrared (IR) radiations.
4. Thermal Trapping: The greenhouse gases (GHGs) present in the earth's atmosphere absorb some of the emitted longwave IR radiations. The absorbed energy causes these GHGs to vibrate and these become energized and start re-emitting this absorbed energy in all directions and back towards surface of the earth.

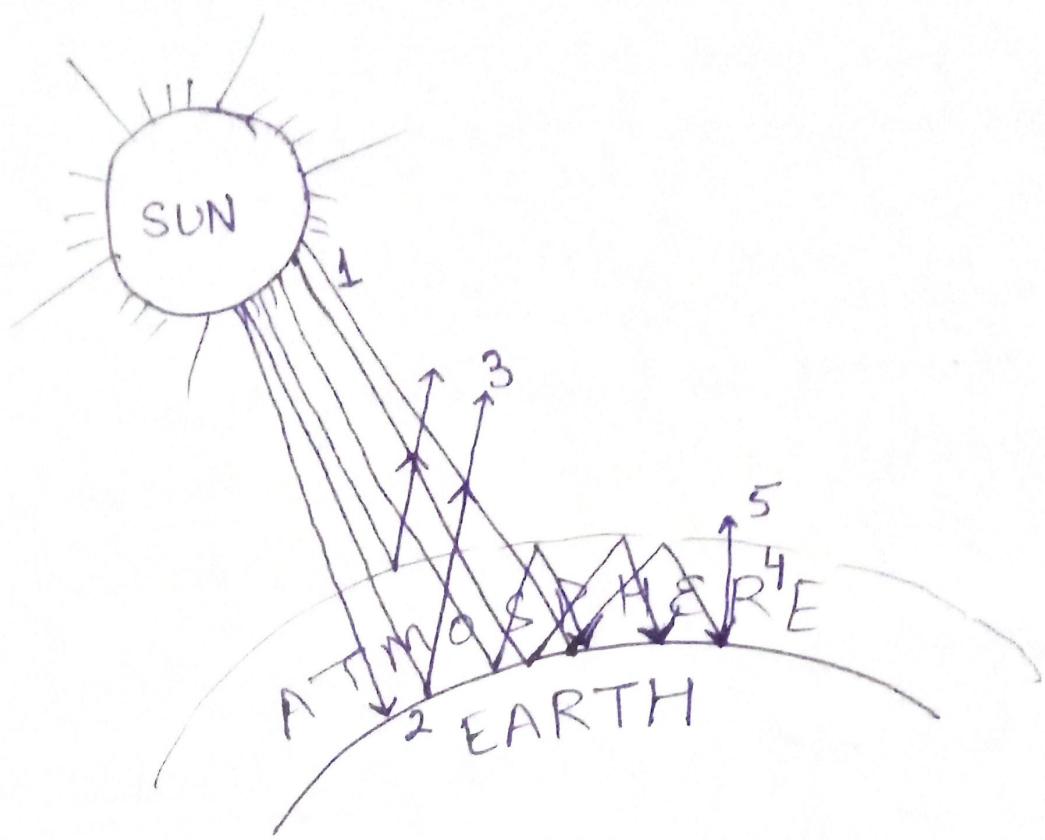


Fig. The Greenhouse Effect

5. Heating Effect: The re-emission of these IR radiations by these GHG's adds to the warming/heating of the Earth's surface. Thus, these GHG's trap heat near the earth's surface and leads to global warming.

GREENHOUSE GASES AND THEIR SOURCES

Greenhouse gases (GHG's) are present in the Earth's atmosphere and they have the ability to trap heat. The main greenhouse gases are:

- a) Water vapour: evaporated from oceans, rivers etc.
- b) Carbon dioxide: burning of fossil fuel, transportation, deforestation, industrial processes etc.
- c) Methane: released by livestock, agricultural practices, wetlands, waste management activities etc.
- d) Nitrous oxide: released by agriculture, combustion of fossil fuel, industrial processes etc.
- e) Fluorinated gases: These gases are emitted in smaller quantities into the atmosphere and have longest lifespans and are often described as "high global warming potential (GWP) gases". These are main four types of fluorinated gases - hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃). These are released during some manufacturing processes.
- f) ozone: released from its precursors during industrial emissions.

SIGNIFICANCE OF THE GREENHOUSE EFFECT

- The natural greenhouse effect is required to support life on earth. The average temperature of the Earth's surface will drop from 14°C to -18°C and water on Earth will freeze and life would not exist.
- The enhanced greenhouse effect is result of anthropogenic activities and is leading to global warming and climate change(CC). Efforts are required to reduce the emission of GHG's and to mitigate its impacts.

Global WARMING

Global warming refers to the long-term increase in the average temperature of Earth's surface. Natural factors such as volcanic eruptions, fluctuations in solar radiations, tectonic movements can also contribute to it but the current trend of global warming is primarily due to the anthropogenic activities.

CAUSES OF GLOBAL WARMING

1. Fossil Fuel Combustion: The burning of fossil fuels releases carbon dioxide (CO_2) which acts as a greenhouse gas and contribute to global warming.
2. Deforestation: The cutting of trees on a larger scale leads to the higher concentration of CO_2 in the atmosphere thus contributing towards increase in Earth's surface temperature.
3. Industrial processes: Some industrial processes release greenhouse gases including CH_4 , N_2O , HFC's, PFC's etc. in the atmosphere.
4. Agricultural Practices: Practices such as paddy cultivation, livestock farming, use of synthetic fertilizers produce CH_4 and N_2O emission thus leading to global warming.

5. Waste management: Waste management processes like landfill decomposition and waste incineration produce CH_4 and CO_2 emissions.
6. Transportation: It is a major source of global greenhouse gas emissions.
7. Buildings: Both residential and commercial buildings emit lot of GHG's during heating, cooling, cooking, running appliances etc.

Impacts of Greenhouse Effect and Global Warming

The impacts of greenhouse effect and global warming ultimately leading to Climate change are as:

- i) Rise in temperature: The greenhouse effect leads to global warming resulting in an increase in earth's average temperature which affects behaviour, distribution and survival of living organisms.
- ii) Melting of Ice and Rise in Sea Level: The increased temperature results in melting of ice caps and glaciers resulting in rising sea levels. Rise in sea level poses threat to coastal areas, low lying islands as coastal erosion, saltwater intrusion and flooding become prevalent.
- iii) Extreme weather conditions: Global warming enhances the frequency and severity of extreme weather events like floods, droughts, wildfires etc. Such events cause damage to infrastructure, agriculture and ecosystems leading to economic losses and displacement.
- iv) Changes in precipitation: There are changes in precipitation distribution. Some areas get increased rainfall while others regions face droughts and water scarcity.
- v) Disruption in Ecosystems: Shifts in habitat of species and altered migration patterns have increased the risk of extinction. The loss of biodiversity has affected ecosystem functions and services.

vi) Ocean Acidification: Increased absorption of CO_2 by the oceans lead to ocean acidification resulting in low pH of seawater which can harm marine life.

vii) Impacts on Human Health: Human health is impacted directly or indirectly due to extreme weather events and spread of certain pests and diseases.

Control measures of Greenhouse Effect and Global Warming:

- It involves:
- i) Transition to renewable energy and adopting of energy efficient technologies.
 - ii) Reduction in deforestation can help to mitigate these environmental effects of concern.
 - iii) Sustainable agriculture can help in reducing emissions from agriculture.
 - iv) Reduction in waste generation and proper waste management
 - v) Public awareness and education will lead to reduction of carbon footprint.

vi) KYOTO PROTOCOL: It is an international treaty adopted in 1997 to reduce emission of GHG's that contribute to global warming.

vii) PARIS AGREEMENT: Adopted in 2015 and replaced Kyoto protocol. It aims to limit global temperature increase due to GHG's.

Short Answer Questions

Q. Write a note on global warming. [AKTU, 2014-15, 2M]

Refer

Q. Differentiate between natural greenhouse effect and enhanced greenhouse effect.

Refer

Q. What is global warming? Name the gases responsible for global warming. [AKTU, 2022-23, 2M]

Refer

Q. Define Kyoto Protocol.

Refer

Q. Write the role of Paris Agreement.

Refer

Q. Differentiate between tropospheric ozone and stratospheric ozone.

Hint [Tropospheric ozone acts as GHG's]

[Stratospheric ozone acts as a protective layer]

Q. Write the impacts of rising greenhouse gases on our environment.

Refer:

Long Answer Questions

Q. What is greenhouse effect? What are greenhouse gases? How this causes the global warming?
[AKTU, 2017-18, 7M]

Refer:

Q. What is global warming? What are its causes and effects? Discuss the measures to control it.
[AKTU, 2017-18, 7M]

Refer

Q. What is Green House Effect? Name four greenhouse gases. Discuss the causes, effects and remedies of greenhouse effect.
[AKTU, 2022-23, 7M]

Refer

Q. What are "greenhouse gases"? Discuss their contributions to global warming. What can be the effects of global warming? What are remedial measures?
[AKTU, 2022-23, 7M]

Refer

Q. Provide a detailed explanation of the greenhouse effect and role of greenhouse gases in trapping heat in Earth's atmosphere.

Refer

CLIMATE CHANGE

Climate Change (CC) refers to the atmospheric changes over longer period of time usually defined as 30 years or more. Thus, Climate Change is the long term alteration of temperature and typical weather patterns in a place.

ROLE OF IPCC IN CLIMATE CHANGE

The Intergovernmental Panel on Climate Change (IPCC) is the UN body for assessing the science related to the Climate Change. It was established by United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988.

The aim of IPCC is to provide periodic scientific assessments related to climate change, its implications and risks as well as to put forward adaptation and mitigative measures.

IPCC headed by Chairman Prof. R.K. Pachauri and Albert Arnold (Al) Gore jointly received the Nobel Peace Prize in 2007. Prof. R.K. Pachauri is also the founder of 'The Energy Resources Institute (TERI), New Delhi.

Short Answer Questions

Q. Define weather.

Ans. Weather occurs in a place within a short period. Weather is the condition of the atmosphere in a specific place and time. The scientific study of weather is called meteorology and an individual who studies weather conditions is called meteorologist.

Q. Explain climate.

Ans. Climate is the average weather conditions of a place over a period of 30 years or more. The scientific study of climate is called climatology and an individual who studies the climatic conditions is called as climatologist.

Q. Write the role of IPCC.

Refer

Long Answer Questions

Q. What are the pieces of evidence of Climate change? Also write the effects of Acid Rain.
[AKTU, 2023-24, 7M]

Refer

Q. How does global warming affect climate change? Also write the effects of global warming.
[AKTU, 2023-24, 7M]

Automobile Pollution (Vehicular Pollution)

It is the release of harmful pollutants into the environment because of the operation and use of motor vehicles (automobiles).

Causes: The major cause is the rapidly growing number of vehicles.
→ Other causes include poor fuel quality, old vehicles, inadequate maintenance, congested traffic etc.

Major Vehicular Pollutants and their Impacts

- i) Hydrocarbons: They are a class of burned or partially burned fuel and are known toxins and impact air quality and public health.
- ii) Carbon monoxide (CO): It is a product of incomplete combustion which reduces the ability of blood to carry oxygen.
- iii) Nitrogen Oxides (NO_x): It is formed when nitrogen in air reacts with oxygen at high temperature and pressure inside the engine. It causes lung irritation and weaken body's defense against respiratory infections.
- iv) Particulate matter: Soot or smoke particles pose the threat by penetrating deep into lungs.
- v) Sulphur Oxides (SO_x): A general term for oxides of sulphur are liberated by burning sulphur-containing fuels and contributes towards particulate matter posing threat of reduction in ability of lungs.

Impact of Vehicular/Automobile Pollution on Environment

- i) Global warming: Emission of greenhouse gases into atmosphere leads to global warming.
- ii) Poor quality of air due to the presence of particulate matter.
- iii) Tourism: Reduction in number of tourists and thus loss of foreign exchange income.
- iv) Noise pollution: Increased honking will add to noise pollution.
- v) Smog and Acid rain: Nitrogen oxides contribute to the formation of corrosive smog speeding up rusting of vehicles. When nitrogen oxide dissolves in rain acidic rain is formed.

Control of Vehicular/Automobile Pollution

- i) Vehicle maintenance: It can help in repairing or replacing worn out parts.
- ii) Carpooling: It can reduce traffic jams, save money on maintenance and contribute towards clean earth.
- iii) Progressive Policies: These help in reducing pollution e.g., discarding of old vehicles.
- iv) Use of catalytic converters: It converts hydrocarbons carbon monoxide and nitrogen oxides into less harmful gases using combination of palladium, sodium and platinum as catalysts.
- v) Purchase automobiles with high fuel efficiency ratings.

Short Answer Questions

Q. What is the role of a catalytic converter?

Refer

Q. Define vehicular pollution.

Refer

Q. Write the name of some vehicular pollutants.

Refer

Long Answer Questions

Q. What are the major emissions from transportation activities? Explain the causes and effects of transportation activities. How can they be controlled? [AKTU, 2022-23, 7M]

Refer

Q. What are three major sources of emission in an automobile? Describe the direct control technologies that are used to reduce the emission rates from each of these sources. [AKTU, 2022-23, 7M]

Refer

OZONE LAYER FORMATION AND DEPLETION

Ozone Layer: The ozone layer is located in the stratospheric region of the atmosphere approximately between 17 Km to 35 Km above Earth. This layer absorbs 93-99% of the ultraviolet radiations coming from Sun. The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson. Its properties were studied by the British meteorologist G.M.B. Dobson. The thickness of ozone layer varies seasonally and geographically and can be expressed in terms of Dobson Units.

Ozone when present in stratosphere acts as a protective shield by protecting the earth from harmful UV radiations. But, ozone in troposphere acts as a pollutant and is a component of photochemical smog. Ozone in troposphere acts as a greenhouse gas and contributes to greenhouse effect.

Ozone Hole: Many people have used the term ozone hole to describe the ozone depletion, no matter how minor the depletion is in the ozone layer. Technically, the term "ozone hole" should

be applied to the regions where ozone depletion in Stratosphere is so severe that levels fall below 200 Dobson Units (DU). Normal ozone concentration is about 300 - 350 D.U.

OZONE LAYER FORMATION

Ozone layer is really not a layer, it is formation of ozone gas in the Stratosphere. A theory for the origin of this ozone formation was proposed in 1930 by a British scientist, Sydney Chapman and is known as Chapman mechanism. It lays the foundation for current understanding of stratospheric ozone.

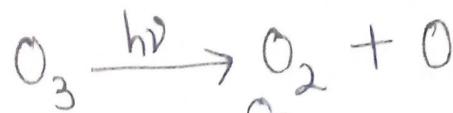
Stratospheric ozone. Ozone is formed in the stratosphere by photolysis of atmospheric oxygen (O_2). Oxygen molecule (O_2) during photolysis absorb an ultraviolet photon (UV photon) having wavelength less than 240nm, resulting in formation of two oxygen (O) atoms.



The atomic oxygen then combines with oxygen (O_2) to form ozone (O_3).



Ozone molecule formed absorbs UV photons less than 320nm and photolyze to produce an oxygen molecule (O_2) and oxygen atom (O).



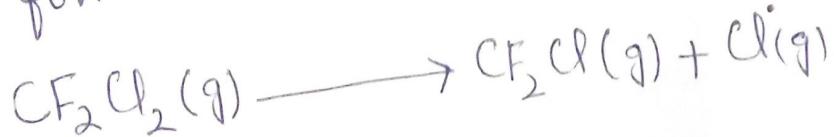
$O + O_2 \rightarrow O_3$
The oxygen atom then combines with O_2 to regenerate ozone. This is a continuous natural process and there is a balance between the rate of creation or formation and destruction.

CAUSES OF OZONE DEPLETION

In 1974 M. Molina and S. Rowland reported that chlorofluorocarbons (CFC's) were likely to be the main cause of ozone depletion. However, this was not taken seriously until the discovery of the ozone hole over Antarctica in 1985. The discovery by the British Antarctic Survey (1985) led by scientists (J. C. Farman, B. G. Gardiner and J. D. Shanklin) provided an early warning of the dangerous thinning of the ozone layer worldwide and triggered international efforts to curb the production of CFC's. The substances having the capacity to deplete the ozone layer are called as Ozone depleting substances (ODS) and their potential or capacity of depletion is known as ozone depleting potential (ODP).

CFC's were originally developed as refrigerants (coolants) during 1930's. Some were used as aerosol spray propellants, solvents and foam blowing agents. CFC's are also called as Freons. When CFC's also contain hydrogen in place of one or more chlorines, they are called Hydrochlorofluorocarbons (HCFC's). The other examples of ODS are halons (used in fire extinguishers), carbon tetrachloride (used commonly in fire extinguishers and cleaning agent), methyl chloroform (used as solvent in cleaners), methyl bromide (used as fumigant).

The main ozone depleting substances are CFC's. In stratosphere when CFC's are subjected to UV-radiations free chlorine is produced. This free chlorine atom reacts with ozone molecule and forms ClO and oxygen molecule.



The ClO formed thus reacts with oxygen atom which sets chlorine free to repeat the process of attacking ozone molecule.

EFFECT OF OZONE LAYER DEPLETION

The effects of ozone layer depletion are as:

1. Effects on Human and Animal Health: UV radiation is known to damage the cornea and lens of the eye. Chronic exposure could lead to cataract of eyes. It is likely to develop nonmelanoma skin cancer (NMSC) and can adversely affect the immune system resulting in a number of infectious diseases. Studies on other animals show that UV exposure decreases the immune response to skin cancers and other infectious agents.

2. Effects on Terrestrial Plants: It is found that the physiological and developmental processes of plants are affected by UV-radiation. In forests and grasslands it has resulted in changes in species composition (mutation) thus altering the biodiversity in different ecosystems.

3. Effects on Aquatic Ecosystems: The UV exposure can affect the distribution of phytoplankton. A recent study has indicated 6-12 percent reduction in phytoplankton production due to UV exposure. It can also cause damage to

the early development stages of fish, shrimp, crab, amphibians and other animals, the most severe effects being decreased reproductive capacity and impaired larval development.

4. Effects on Bio-geochemical Cycles: Increased solar UV-radiation could affect terrestrial and aquatic bio-geochemical cycles thus altering both sources and sinks of greenhouse and important trace gases.

5. Effect on Materials : UV radiations can cause discolouration or loss of tensile strength of synthetic polymers and naturally occurring biopolymers.

Preventive Measures to Ozone Layer Depletion

1) Avoid using ozone depleting substances (ODS)

2) The Montreal Protocol: It is a global agreement to protect ozone layer by phasing out ODS and came into force in 1989, in Montreal, Canada.

3) The Kigali Amendment: It is amendment to the Montreal Protocol aiming to phase down production and consumption of hydrofluorocarbons (HFC's). It was adopted in 2016 in Kigali, Rwanda.

4) The Copenhagen Amendment (1992): Under it CFC's, carbon tetrachloride, halons and methyl chloroform were targeted for phaseout in developed countries.

Short Answer Questions

Q. What do you mean by the term ozone hole?

Refer

Q. Differentiate between Kyoto Protocol and Montreal Protocol.

Hint - Kyoto Protocol [related to reduction in CO_2 emission in global warming and Montreal Protocol to phase out CFC's (ODS).]

Q. Name some international ~~agreements~~ agreements aimed at protecting the ozone layer.

Refer

Q. What are ozone depleting substances. Give examples. [AKTU, 2023-24, 2M]

Refer

Long Answer Questions

Q. Explain ozone formation and its depletion and the role of CFC's in ozone depletion.

[AKTU, 2015-16, 7.5M]
AKTU, 2014-15, 6M]

Refer

Q. What is ozone layer formation and depletion? Explain its various effects on human health.

[AKTU, 2014-15 6M]

Refer

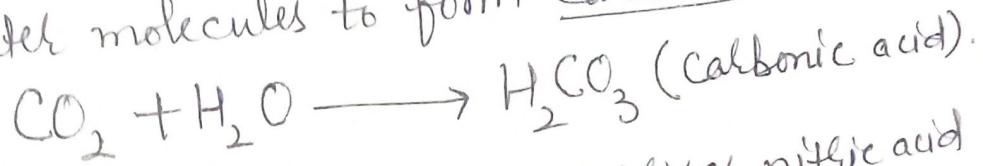
Q. What do you mean by term ozone hole? Discuss the reactions involved in the formation and depletion of ozone layer. Also explain causes, effect and control of ozone layer depletion.

[AKTU, 2022-23, 7M]

Acid Rain

Acid rain is any form of precipitation with acidic components such as sulphuric acid and nitric acid which fall on the earth's surface from atmosphere. The term was first used by Scottish chemist Robert Angus Smith in 1852.

Normal Rain: Pure water has pH of 7.0 (alkaline) but normal rain has pH of 5.6 and is slightly acidic because carbon dioxide in atmosphere combines with water molecules to form carbonic acid.

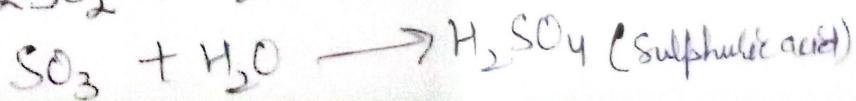
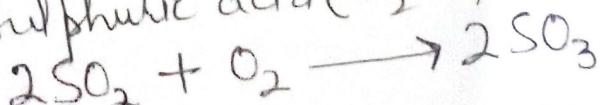


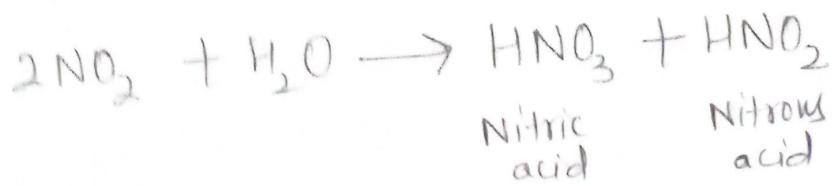
Acid Rain: When the rain water comprises nitric acid (HNO_3) and sulphuric acid (H_2SO_4) falls on earth's surface. It has pH between 4.2 and 4.4.

Causes of Acid Rain: Acid deposition may either be wet or dry.

i) Wet deposition: Rain, snow, dew, frost, mist represent wet form of deposition

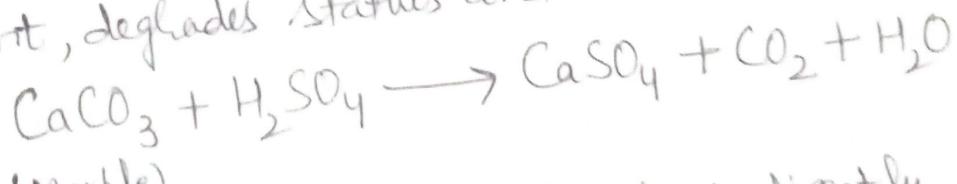
ii) Dry deposition: It refers to acidic gases and particles. Acid deposition occurs when oxides of Nitrogen NO_x (from vehicles, burning coal) and Sulphur dioxide SO_2 (burning coal, volcanoes) released in atmosphere react with water (rain) to form nitric acid (HNO_3) and sulphuric acid (H_2SO_4).





Effects of Acid Rain: It includes

- (i) Soil degradation: Acid rain alters pH of soil making it more acidic leading to decreased crop yield.
- (ii) Effect on plants: Acid rain results in reduced photosynthesis and stunted growth of plants.
- (iii) Harm to aquatic ecosystems: Water bodies become acidic due to lower pH resulting in disruption of physiological functions of many organisms.
- (iv) Effect on buildings and Infrastructure: Acidic rainwater corrodes metal structures, stone, concrete, discolours paint, degrades statues and monuments (e.g., Taj Mahal)



(Marble)

- (v) Impact on human health: Acid rain indirectly affect human health through consumption of contaminated water and crops.

Control of Acid Rain: The ways for mitigation are:

- i) Reduce the emission of SO_2 and NO_x .
- ii) Promote use of renewable energy resources.
- iii) Flue gas desulphurization (FGD) to remove sulphur containing gases.
- iv) Liming to neutralize acidic soils using limestone etc.

Short Answer Questions

Q. Define acid rain.

Refer

Q. Differentiate between normal rain and acid rain.

Refer

Q. What does the term 'liming' mean.

Refer

Long Answer Questions

Q. Explain source, cause and effect of acid rain.

How it can be controlled. [AKTU, 2015-16, 7.5M]

Refer

Q. What is acid rain? Name the gases responsible for acid rain? Discuss the causes, effects and remedies of acid rain on environment and ecology.

[AKTU, 2022-23, 7M]

Refer

Q. Differentiate between clean rain and acid rain. Name the principal species of acid rain. How they are formed and what are their effects?

[AKTU, 2022-23, 7M]

Refer:

Hint: [Principal species of acid rain - HNO_3 and H_2SO_4 in the form of dry and wet deposition]

Q. In what ways does acid rain contribute to the degradation of cultural heritage sites and what measures can be taken to preserve and protect these valuable assets?

Hint: $\text{CaCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{CaSO}_4 + \text{CO}_2 + \text{H}_2\text{O}$
Effect on buildings and infrastructure and explanation of mitigative measures.

STUBBLE BURNING

Stubble burning is a process of setting on fire the straw stubble left after harvesting of paddy, wheat etc. Stubble burning also known as Paroli in local language is done in the areas where combined harvesting methods are used. It is a common practice in October and November across North West India mainly in Punjab, Haryana, Delhi and Uttar Pradesh. As a result, the particulate matter and gases from burning paddy stubble get carried towards North West India when north-westerly winds start blowing.

REASONS/CAUSES OF STUBBLE BURNING

1. Lack of time: There is a maximum of 20 days between two successive crops. So, farmers burn the stubble and then prepare the land for sowing wheat crop in November month.
2. Silica Content: The paddy residue (rice residue) as fodder is not a popular practice mainly because of the high silica content in it.
3. Lack of Knowledge in Stubble Management: There is unawareness of residue management within short span. Even sometimes unavailability of labour and escaping from labour cost also plays a role.

4. Cheapest Method: Stubble (Parali) burning is being considered as a cheap, quick and efficient way to get rid of the stubble.

5. Lack of Awareness: The farmers have limited awareness about the environmental and health impacts of stubble burning which is thus, contributing to its continued practice.

IMPACTS / EFFECTS OF STUBBLE BURNING

The impacts are listed as:

1. Increase in Soil temperature: Stubble burning increases the soil temperature upto 42.2°C .

2. Reduction in Nitrogen Content: Stubble burning results in the reduction of 27 to 73% of nitrogen in soil.

3. Effect on Soil bacteria: The burning of stubble leads to the reduction of the beneficial soil bacterial population by 50%.

4. Effect on Soil: Damage to the properties of soil is also a result of stubble burning.

5. Greenhouse Gas Emission: Burning of stubble leads to emission of gaseous pollutants like CO_2 , nitrogen oxides (NO_x), methane etc. as well as particulate matter. Emission of greenhouse gases contribute in global warming.

6. Reduced Visibility: The smoke produced by burning of the stubble decreases visibility which can effect transportation.

7. Impact on Human Health: The harmful impacts of exposure to stubble burning range from skin and eye irritation to severe neurological, cardiovascular, and respiratory diseases.

MANAGEMENT PRACTICES OF STUBBLE

The best management approach is to tackle the problem by adopting some practices which are:

1. In situ Treatment of Stubble: Microorganisms can be used for the degradation of cellulose and lignin present in the straw. This effective decomposition will restore the fertility of soil. IARI (Indian Agricultural Research Institute), New Delhi has developed an effective microbial solution PUSA decomposer (both in liquid and capsule form) for decomposition of stubble (paddy straw).

2. Ex situ Treatment of Stubble: The off-site treatment of stubble can be done by ways like use of stubble in roofing in rural areas, mushroom cultivation, packing materials, biomass energy, biochar, composting

3. Use of Technology for managing time and Stubble: The farmers can also manage the stubble by

employing agricultural machines like:

- i) Happy Seeder: It is used for sowing of crop in standing stubble.
- ii) Rotavator: It is used for land preparation and incorporation of crop stubble in the soil.
- iii) Baler: It is used for collection of paddy straw and making bales of the paddy stubble.

4. Awareness: Awareness campaigns and training programs can be conducted to educate farmers about the harmful effects of stubble burning and the benefits of alternative practices.

Short Answer Questions

Q. Define stubble burning.

Refer.

Q. Cite the reasons of burning stubble.

Refer.

Long Answer Question

Q. Write the solution of paddy straw burning.
Also write the adverse effects on the environment of paddy straw burning. [AKTU, 2023-24, 7M]

Refer

POPULATION: A group of individuals of the same species that live in the same area at the same time.

Population dynamics: It is the study of how populations of a species change over time.

Population Growth: It is the increase in the number of people in a population over a period of time. It is influenced by some factors leading to fluctuations in the population in a given area. The factors include:

- i) Natality (Birth Rate): It is the number of live births per 1,000 individuals in a population per year.
- ii) Mortality (Death Rate): It is the number of deaths per 1,000 individuals in a population per year.
- iii) Migration: Population migration is the movement of people from one place to another and settling temporarily or permanently at the new location. Migration is of two types:
 - a) Immigration (in migration): It involves moving of individuals or groups to a new country where they are called as Immigrants.
 - b) Emigration (out migration): It involves moving out of individuals or groups from their home country and are called as Emigrants in their home country.

It is clearly understood that Natality(N) and Immigration(I) increases the population whereas, Mortality(M) and Emigration(E) decreases the population. Thus, the population growth at a given point of time can be represented as:

$$P_t = P_0 + (N + I) - (M + E)$$

where P_0 = Starting population.

CENSUS: It is an official count or survey of a population.

OVERPOPULATION: Overpopulation or overabundance can be defined as an increase in the population of a species more than the carrying capacity of its environment.

DEMOGRAPHY: It is the study of the characteristics of human populations. The word demography was first used by a French writer Achille Guillard in 1855.

GROWTH CURVES: We measure the size of a population over time and the graph form a curve called as population growth curve.

There are two types of population growth curves:

i) Exponential/J-shaped growth curve:

Unrestrictive growth results in exponential growth represented by J-curve (Fig—).

As the population grows exponentially, it

eventually exhausts the available resources leading to a population crash.

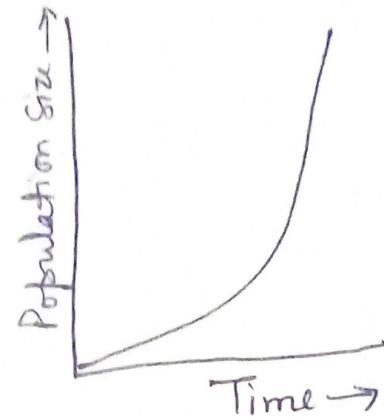


Fig. — Exponential (J) shaped growth curve

(i) Sigmoid/Logistic/S-Shaped growth Curve

It is also called as the Verhulst Logistic Growth Curve as it was published by Pierre Verhulst (1845, 1847). It comprises of following phases:

a) Lag phase: when population growth begins slowly

b) Exponential phase: when maximum/exponential growth is reached. Also known as Log phase.

c) Transitional phase: when growth rate slows down because factors like food, water, space become limiting.

d) Plateau phase: when population number becomes stable and is also referred as Stationary phase.

e) Decline phase: when a change in environment can no longer support population and result in decline e.g., drought causing food shortage effects population growth.

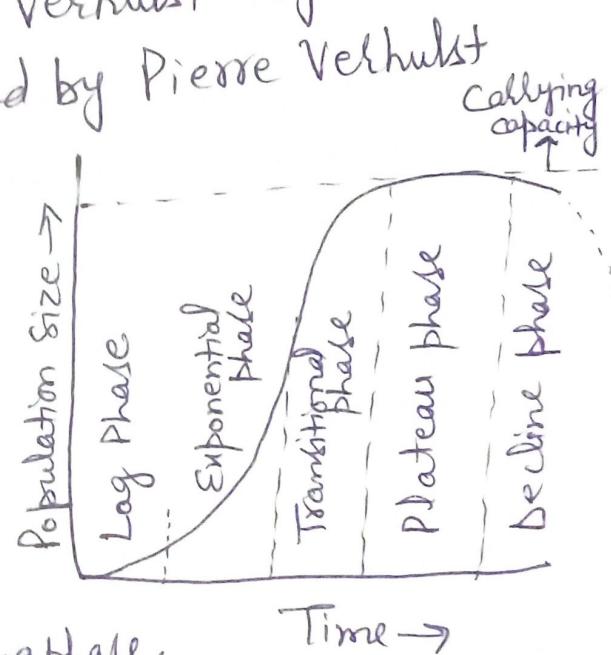


Fig. — Sigmoid (S) shaped growth curve

POPULATION EXPLOSION

Population explosion is a sudden increase in the number of individuals in a species.

Causes of Population Explosion: It includes

- i) Enhanced birth rate: Unawareness about the birth control methods leads to accelerated birth rate.
- ii) Decrease in Infant Mortality Rate: Improvement in medical science and technology leads to reduction in infant mortality rate.
- iii) Life Expectancy: Life expectancy has increased due to improved living conditions, better nutrition etc.
- iv) Good quality food: Populations grow well when they receive proper nutrition.
- v) Immigration: It also contributes to population explosion.

Effect of Population Explosion: It involves:

- i) Food Problems: Rapid growing populations face food shortage.
- ii) Unemployment: Many people find no work to do as less number of jobs are available.
- iii) Poverty: Low standard of living leads to poverty, an outcome of high birth rate.
- iv) Illiteracy: In many countries people engage their children in economic activities other than education which is the key reason for illiteracy.

v) Environmental Impacts: Enhanced population growth leads to some environmental issues of concern like pollution, greenhouse effect etc.

Control: It involves creating awareness and educating people to control birth rates.

Short Answer Questions

Q. What is migration? Give its types. [AKTU, 2015-16]

Refer:

Q. Give the difference between immigration and emigration. [AKTU, 2015-16]

Refer:

Q. Explain reasons of migration. [AKTU, 2015-16]

Ans: Reasons of migration are

- i) Better opportunities for education, career etc.
- ii) Displacement due to environmental factors e.g., flood
- iii) To escape persecution or human rights violation

Long Answer Questions

Q. Discuss population explosion in Indian context. What are the major causes and effects of population explosion? [AKTU, 2017-18, 7M]

Refer

Q. Describe the population growth and factors influencing it.

Refer

Q. Define a growth curve. Explain sigmoid growth curve in detail.

Refer