

## CH# 7: THE ATMOSPHERE AND HUMAN ACTIVITIES

### Introduction

- The atmosphere is an envelope of gases wrapped around the Earth.
- 97% of the atmospheric mass is within 30 km of the surface.
- Atmospheric pressure decreases with height.
- Troposphere and stratosphere are two major layers which are identified by temperature characteristics.
- The troposphere is the lower layer.
- Troposphere contains most of the atmosphere's water vapours, cloud, dust and pollution.
- The Earth's cloud and weather systems are concentrated in troposphere.
- Stratosphere is dust free and cloudless.
- There is little carbon dioxide and water vapour in Stratosphere.

### Composition of the atmosphere

- Nitrogen and Oxygen make up 99% of the atmosphere by volume.
- Nitrogen 78%
- Oxygen 21%
- Argon 0.93%
- Carbon dioxide 0.03%

### Energy resources

- Sun is the source of all energy on the planet.
- Sunlight is a radiation (a wave that enters the atmosphere of the Earth).
- Some of it absorbed gases and surface and some is reflected by clouds, surface and some gases.
- The amount of solar energy reaching the surface of the Earth that is available as heat is known as **Insolation**
- Rates of insolation vary, it is highest at the equator and lowest at the poles.
- **Albedo** means that a high proportion of the sun's light is reflected of being absorbed.
- 80% of light that reaches the surface is reflected back from snow covered surfaces.
- Dry surface air is dominated by only two gases, nitrogen and oxygen
- Carbon dioxide is soaked up by plants for photosynthesis

- The ozone is concentrated in the stratosphere where many of the cancer inducing ultraviolet rays, which would otherwise harm plants, animals and humans are absorbed by it
- Water vapour and carbon dioxide absorb most strongly in the long wavelengths, therefore they mainly trap heat radiation from the land rather than light radiation from the sun that phenomenon is known as **Greenhouse effect**.

## **Atmospheric pollution: causes and impacts**

### **Causes of atmospheric pollution**

- Burning fossil fuels in power stations and exhaust from cars, trucks and buses
- Waste burnt from chemical factories and other industries
- Bare soil in agricultural areas picked up and carried by wind
- Use of chemical, especially CFCs and halons

### **Impacts of atmospheric pollution**

- Reduced visibility(haze, mist, fog and smog)
- Formation of acid rain
- Health problems such as asthma
- Depletion of the ozone layer
- Increases ultraviolet radiation
- Health problems such as asthma
- Increase risk of cancers in people
- Increasing acidity in soils reducing crops yields and killing trees
- Increased acidity in lakes leading to death of fish
- Trapping more heat leading to global warming ,hence, rising sea levels and temperature of the earth
- Less transpiration so less precipitation due to less cloud formation leading to droughts , hence, less crop yield and food supply

### **Smog: causes and impacts**

- Smog is a combination of smoke and fog
- It is always likely to be more of a problem in urban areas
- Traffic emissions are source of gases and unburnt hydrocarbons as well smoke particles
- When temperatures are high and there is strong sunlight, a photochemical reaction occurs which makes it even more unpleasant for city people
- The chemical soup from car exhausts .especially nitrogen oxides and hydrocarbons, can produce high levels of ground ozone
- When ozone presents in the lower atmosphere it irritates the bronchial passage lungs and eyes

#### ***Physical characteristics that make pollutants hung around in the atmosphere***

There are certain Physical characteristics that make pollutants hung around in the atmosphere instead of dispersing quickly

- Pollutants are trapped by the surrounding high ground.
- The climate is hot ,dry and sunny for at least half of the year, as the pressure is high the air sinks
- Without rain and wind to clear them smoke and dust particles are left to accumulate in the lower atmosphere close to the ground

#### **What is meant by inversion of temperature?**

When temperatures increase with height above the ground is known as inversion of temperature

#### **Where and when an inversion of temperature most likely to occur?**

An inversion of temperature making it less likely that pollutants can escape from the lower layers of the atmosphere .It is normal for temperatures to be highest at the surface and drop an average of 1 C for every 150 meters of height. In an inversion temperatures increase with height above the ground. When the air above is warmer, air from below is unable to rise.

Therefore, none of the pollutants are dispersed to higher levels in the atmosphere. Instead they are left to accumulate as a brownish yellow haze below the inversion.

### **Smog: Strategies to improve urban air quality**

- Catalytic converters in cars should be fitted to reduce air pollution
- Petrol and diesel should be replaced with other fuel gases
- Cars can be banned from entering the city on high smog days according to registration plate numbers
- Natural gas power stations should be used instead of coal power stations
- Use of alternative energy sources such as HEP should be increase
- Increased planting of trees
- Improve public transport

## **Acid rain: causes and impacts**

### **Causes of acid rain**

- Caused by increased acidity in atmosphere that comes from sulphur dioxide and oxides of Nitrogen
- Vehicles, power stations and industries are main sources.
- Can be transported from one place to another through winds

### **Impacts of acid rain**

- Increase levels of acidity in soils
- Increased crop destruction
- Destruction of forests and wildlife habitants
- Soil erosion due to loss of trees
- Trees lose leaves easily and also become less resistant to droughts increased acidity of lakes ,hence, death of marine organisms
- Acid rain is a major problem in Scandinavian countries(Norway and Sweden) because prevailing westerly winds carry the oxides of sulphur and nitrogen from the UK's coal fired power stations
- Caused of bronchitis and lung cancer
- Some of the world's best buildings are rotting away in the acid atmospheres

## Acid rain: Strategies to reduce its impacts

- Add limestone in powdered forms on lakes to increase PH value(decrease acidity)
- Limestone should be used in coal power stations to convert sulphur dioxide into calcium sulphate before it leaves from the chimney and oxides of nitrogen should be reduced by using ammonia. This process is known as **desulphurization(FGD)**
- Natural gas power stations should be used instead of coal power stations
- Use of alternative energy sources

## Ozone layer depletion

### Causes

- Release of CFC's and HALONS in atmosphere.
- Use of chemicals containing CFC's such as hair sprays
- Chlorine destroys the layer by converting ozone into oxygen
- These chemicals are persist in the atmosphere for long time, this enable them to reach the ozone layer without being destroyed

### Impacts

- Increased amount of ultraviolet rays reaching surface that result into skin cancers

## Ozone depletion: Strategies for Ozone recovery

- Many governments signed up to an international agreement called **Montreal Protocol** in 1987
- They made pledges for rapid reduction in the use of CFC's and halons and to stop using those 2000.

## Enhanced greenhouse effect

### Causes

- Increase in greenhouse gases in atmosphere
- These gases include CO<sub>2</sub> released by burning of fossil fuels, wood and due to deforestation
- Methane due to deforestation and decomposition of waste

- CFC'S from different chemicals
- Oxides of nitrogen from transport system, burning of fuels and use of fertilizers
- These gases trap heat energy of the sun and does not let radiation emitted from surface escape

### Impacts

- Increase in the temperature of the earth leading to melting of ice sheets ,this results in rising sea levels
- This will lead to flooding in low lying coastal areas
- Sea defenses would be breached
- Populated areas would no longer be able to live in their habitants

### Strategies to reduce greenhouse gas emissions

- Tree plantation
- Alternative sources of energy
- Energy conservation measures
- Ban on use of CFC's in aerosols and fridges

### Managing atmospheric pollution

- Reduction of carbon footprint
- Reduced use of fossil fuels
- Energy efficiency
- Carbon capture and storage
- Transport policies
- International agreement and policies
- CFC replacement
- Catalytic converters
- Flue gas desulphurization
- Taxation
- Reforestation and afforestation

**Past Papers Questions**

**Q. Explain the problems that government have in implementing strategies to reduce air pollution in cities.**

**Ans.** difficulty of monitoring; problems catching offenders/weak law enforcement; cost implications; people difficult to convince/citizens ignore; not a priority; inadequate legislation; businesses put pressure on governments;

**Q. Why are there big differences in carbon dioxide emissions per person between different countries of the world?**

**Ans.** most carbon dioxide emissions come from burning fossil fuels, fossil fuels most used in transport, electricity, and manufacturing industry, much higher individual / domestic levels of consumption among richer people, whereas in poor countries fossil fuel use is not always a part of people's everyday lives, more work done manually in farming and industry, more limited access to electricity and private means of transport, waste of energy etc. more likely in developed world

Ethiopia is a poor country in sub-Saharan Africa with many subsistence farmers

**Q. Why some countries are more worried about the effects of global warming than others?**

**Ans.** in some cases it depends on location – low lying island countries in the Pacific and

Indian Oceans, such as the Maldives, or delta countries such as Bangladesh and the Netherlands, are at greatest risk of coastal flooding, whereas higher or landlocked countries will be unaffected; matters less in big countries than small countries

it is also depends on climate type – more difficult / marginal climates for people to make a living such as savanna and monsoon, where many people rely upon the wet season rains; areas naturally prone to flood and drought such as those near the edges of deserts, or tropical storms, may find natural disasters more frequent / more intense poverty / wealth of a country also relevant – rich countries better able to prepare and repair, poor countries have more people trapped in the poverty cycle; less chance to recover before being affected by the next adverse climatic event

**Q. Describe the significant of increases in the use of all types of alternative energy sources for world.**

**Ans.** life expectancies of fossil fuels, increasing and high oil prices, but at the same time some reluctance to give up dependence on fossil fuels, which are so useful especially in transport; will the push to move away from fossil fuels be stronger than it is now? optimistic or otherwise about research and development into new and cheaper ways to harness natural sources, about humans ability to innovate, and create new technology, especially as there is likely to be more pressure to do so pressure from green organizations, perhaps noticeably worsening effects of climate change, perhaps international summits which actually agree on meaningful carbon emissions reductions

the ease and inertia of using fossil fuels cannot be overcome; there may be big oil and gas finds in polar lands which ease the pressure to change .

**Q. Describe some social economic changes in Arabia resulting from the discovery and extraction of oil.**

**Ans.** Effects can be positive/beneficial, or negative/disadvantages.

**Positive effects** – mainly economic; they include work on the oil wells and in the refineries, likely to be much better paid; can live in one place instead of the nomadic desert existence. Urban living with all the modern conveniences and less exposed to natural conditions and changes.

**Negative effects** – some economic because land traditionally used and crossed over by them is being taken away for irrigated farming and oil. Migration with animals made more difficult by pipelines crossing the desert. Social – disruption caused by migrations of young folk, likely in future to be short of people to carry on the traditions, and do the work as their parents get older. Once disrupted, their way of life is in danger of being lost forever.

**Q. Where are strategies for reducing traffic emissions likely to be more effective in developed world or in developing countries?**

**Ans.** Evidence of a reduction here in Los Angeles so that it shows methods used are working in this developed world city, developing world cities are growing faster/traffic and industry are increasing more than in the developed world, pollution/traffic controls are less strong/less likely to be strictly enforced, control measures are costly, examples of measures used to reduce traffic and industrial emissions –

If the answer is based on more effective in developing cities, some progress can be made with the line of argument that there is massive private car ownership and use in developed world cities, so much more traffic that even with lower emissions pollution levels are greater, public transport is more likely to run on newer cleaner fuels like natural gas.

**Q. Main sources of Methane in atmosphere**

decaying organic matter/wetlands;  
rice paddies;  
grazing animals/cattle/deer/sheep/camels, up to 2 marks if developed  
termites;  
animal waste;  
industrial air pollution;  
landfill sites;  
leaks from natural gas pipelines;  
drilling;  
coal mines;  
biomass burning;



domestic sewage treatment;  
(methane hydrate) released from the ocean;  
melting permafrost

**Q. When and where do cyclones form?**

Where – over warm ocean surfaces in the tropics / near the Equator in Atlantic, Pacific and Indian Oceans

When – late summer when the sea water temperatures are at their highest (26°C+)

Why – surface heating causes warm air to rise, which draws in air towards it, establishing a moving circulation in the atmosphere capable of developing into a cyclone.

**Q. Describe how high levels of air pollution can affect economic activity in a city?**

Ans. health issues leads to loss of work days; wealthy/wealth creators move away; e.g. of health issue (bronchitis/asthma/irritates eyes/skin irritation/breathing difficulties); transport issues caused by fog/smog; costs to industry of permits to pollute/cleaning effects of pollution;

**Q. Suggest reasons why it is difficult to reduce the amount of particulates going into the atmosphere in cities.**

**Ans.** satisfying essential domestic needs for energy; people/industries using the cheapest energy source/cost implications; people using the one most readily available to them; too engaged in survival to consider environmental effects; cannot afford alternative fuels; increasing wealth of population leads to greater fuel use (cars); (cleaner) alternative fuels not available; high density/concentrated population;

**Q. Explain how physical characteristics can lead to the buildup of high level of air pollution.**

**Ans.** high air pressure – sinking air so that pollutants are trapped in the lower atmosphere; high pressure associated with low wind speeds/calm weather; calm conditions – increasing temperature with height stops air rising and dispersing; pollutants not dispersed by winds; steep sided hills – pollutants are trapped in the basin between steep sided mountains; less able to be dispersed by winds;

**Q Describe strategies that can be used to improve the air quality in cities like Karachi and Lahore.**

An. banning cars from city centers; according to registration numbers; compulsory fitting of catalytic converters on vehicle exhausts; petrol and diesel replaced by cleaner

fuels/or named (natural gas, CNG/CBG); fitting diesel vehicles with particulate filters; facilitating electric powered vehicles; encouraging greater use of public transport/bikes; laws on emissions from vehicles; laws on emissions from industry/power stations; relocating industrial areas to down wind side of city; alternative fuels (geothermal, solar, wind, etc.); sulfur 'scrubbing'; planting trees to filter particulates

**Q. Describe three types of environmental damage caused by urban growth.**

**Ans.** River polluted, polluted lakes and seas, overuse of underground water stores destroy woodland and natural habitats, air pollution.

**Q. Describe ways in which govt. can improve protection of the environment from industrial pollution.**

**Ans.** Regulations and anti-pollution laws, monitoring by govt. officials / agencies, persecution of offenders with fines, closing down persistent offenders, govt .should support for renewable / alternative energy sources

**Q. Name some greenhouses gases. Why are they called greenhouses gases?**

**Ans.** methane, CFCs or nitrogen oxides, they enhance / increase / speed up / accelerate the natural greenhouse effect, they trap some of the heat which is radiated from the surface at night, preventing heat loss beyond the upper atmosphere into space, making the Earth's surface warmer than it would otherwise be, without 'greenhouse gases' in the atmosphere the Earth would be about 30°C colder