

Department of Botany

Program Name: B.Sc. Botany

Program Code: BOTH

Name of the Course: AECC

Course Code: BOT AECC

Year: 2021-2022

Project Name: Study of the major sources of Air Pollution in Darjeeling Town

Introduction:

Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. Pollutants include solid, liquid and gaseous substances present in greater quantity than natural abundance. Air pollution occurs due to the presence of undesirable solid or gaseous particles in the air, in concentrations that are harmful to human health and the environment.

Air is the mixture of gases which chiefly contains two gases viz. Nitrogen (78%) and Oxygen (21%) along with other gases such as CO₂ (0.05%), Carbon monoxide, SO₂, Nitrogen oxides etc present in minute quantities. An average human requires about 12 kg of air each day which is nearly 12-15 times greater than the amount of food we eat. Therefore small changes in the concentration of pollutants in the air become more significant in comparison to similar levels present in food. For an instance if the concentration of CO₂ is increased from 0.05% to 5%, anyone could be killed within a minute. In India 'Air Pollution Control Act' in 1981 and "Motor Vehicle Act" in 1988 were passed for controlling the air pollution.

Air may become polluted by natural causes such as natural forest fire, volcanoes or by radioactive decay of the rocks present in the soil or by human activities. There are five primary pollutants that contribute 90% of total air pollution. They are:

1. Carbon Oxides: Carbon dioxide is central to everyday life and isn't normally considered a pollutant: we all produce it when we breathe out and plants utilize it for photosynthesis. However, carbon dioxide is also a greenhouse gas released by engines and power plants. Since the beginning of the Industrial Revolution, it's been building up in Earth's atmosphere and contributing to the problem of global warming and climate change. It has been estimated that in the last 100yrs its concentration has increased by 25%. Carbon monoxide is colourless, odourless and toxic gas produced when organic materials like natural gas, coal or wood and petroleum products are incompletely burnt. However it is not a persistent pollutant, it is naturally converted into other compounds that are not harmful.
2. Nitrogen oxides: Nitrogen dioxide (NO₂) and nitrogen oxide (NO) are pollutants that come out as vehicular exhaust. They play an important role in the formation of acid rain, ozone and smog. Nitrogen oxides are also "indirect greenhouse gases".

3. Sulphur Oxides: Coal, petroleum, and other fuels are often impure and contain sulphur as well as organic compounds. When sulphur burns with oxygen from the air, sulphur dioxide (SO_2) is produced. Coal dependent power plants are the world's biggest source of sulphur-dioxide air pollution, which contributes to smog, acid rain, and health problems that include lung disease.
4. Volatile Organic Compounds (VOC): These carbon-based (organic) chemicals evaporate easily at ordinary temperatures and pressures, so they readily become gases. That's precisely why they're used as solvents in many different household chemicals such as paints, waxes, and varnishes. Unfortunately, they're also a form of air pollution: they're believed to have long-term (chronic) effects on people's health and they also play a role in the formation of ozone and smog.
5. Particulate matters: These are the sooty deposits in air pollution that blacken buildings and cause breathing difficulties. Particulates of different sizes are often referred to by the letters PM followed by a number, so PM_{10} means soot particles of less than 10 microns. In cities, most particulates come from traffic fumes.

Air pollution began to increase in the beginning of the 20th century with the development of transportation systems and large scale use of coal, petrol and diesel to run the industries. Pollution due to auto-exhaust systems has become a serious environmental issue in many developed and developing countries, including India.

Effects of Air pollution:

Air pollution can harm the health of people and animals, damage crops or stop them growing properly, and make our world unpleasant and unattractive in a variety of other ways.

Human health

According to the World Health Organization (WHO), air pollution is one of the world's biggest killers: it causes around two million people to die each year. Many of these deaths happen in developing countries (over half a million in India alone), but wealthier industrial nations suffer too: in the United States, for example, around 41,000 people a year are estimated to die early because of air pollution. Because air pollution kills quietly and relentlessly, and its finger is hard to detect on the trigger, people barely seem to notice—or care.

Deaths aren't the only human consequence of air pollution. For every person who dies, hundreds or thousands more suffer problems such as lung cancer, asthma, bronchitis and emphysema. Elderly people, infants, pregnant women and people with heart disease, asthma are highly vulnerable to air pollution. Workers exposed to high levels of dust sometimes suffer years of misery before dying from illnesses such as silicosis.

Sulphur dioxide irritates tissues that may lead to bronchitis. Similarly other air pollutants such as nitrogen oxides, suspended particles and VOCs have negative impacts on human health.

Agricultural effects

Farming is as much of an art as a science; crops can thrive—or fail—for all sorts of reasons. One of the things that characterized the 20th century was the huge growth in industrial agriculture—using fertilizers, pesticides, and so on to increase crop yields and feed the world's ever-growing population. These aren't the only chemicals that crops are exposed to, however. We know that air pollution can seriously affect the growth of plants. These pollutants can breakdown the waxy coating of plants making them vulnerable to water loss, pests, pathogens etc. At one end of the spectrum, it's easy to find chemical residues in plants that grow alongside highways. At the opposite extreme, the huge increase in atmospheric carbon dioxide now causing global warming and climate change is expected to have a major impact on the world's agriculture (reducing crop yields in some places but potentially increasing yields elsewhere).

Effect on materials:

Air pollution cause damage to the exterior coat of the buildings that is why they look dirty even in the areas where there are no factories or power plants. Exhaust fumes from traffic are generally to blame. Apart from blackening buildings with soot, they also contribute to acid rain that can wear away stonework in a matter of years or decades.

Ozone holes

Air pollution has been to be responsible for the depletion of Ozone layer in the stratosphere which protects the earth from harmful radiation of sun. During the 20th century, people started using large quantities of chemicals called chlorofluorocarbons (CFCs), because they worked very well as cooling chemicals in refrigerators and propellant gases in aerosol cans. In 1974, scientists Mario Molina and Sherwood Rowland suggested that chlorofluorocarbons attacked and destroyed the ozone layer, producing holes that would allow dangerous ultraviolet light to stream through. In the 1980s, huge "ozone holes" started to appear over Antarctica, prompting many countries to unite and sign an international agreement called the Montreal Protocol, which rapidly phased out the use of CFCs. As a result, the ozone layer—though still damaged—is expected to recover by the end of the 21st century.

Acid Rain:

When rain falls through polluted air, it can pick up some of the pollution and turn more acidic—producing what's known as **acid rain**. Simply speaking, the air pollution converts the rain into a weak acid. When acid rain accumulates in lakes or rivers, it gradually turns the entire water more acidic. That's a real problem because fish thrive only in water that is neutral or slightly acidic (typically with a pH of 6.5–7.0). Once the acidity drops below about pH 6.0, fish soon start to die—and if the pH drops to about 4.0 or less, all the fish will be killed. It also causes the death of forests, reduces the fertility of soil, and damages buildings by eating away stonework. One of the biggest difficulties in tackling acid rain is that it can happen over very long distances. In one notable case, sulphur dioxide air pollution produced by power plants in the UK was blamed for causing acid rain that fell on Scandinavian countries such as Norway, producing widespread damage to forests and the deaths of

thousands of fish in acidified lakes. The British government refused to acknowledge the problem and that was partly why the UK became known as "the dirty man of Europe" in the 1980s and 1990s.

Smog:

Smog (a combination of the words "smoke" and "fog") forms when sunlight acts on a cocktail of pollutant gases such as nitrogen and sulfur oxides, unburned hydrocarbons, and carbon monoxide; that's why it's sometimes called **photochemical smog**. One of the most harmful constituents of smog is a toxic form of oxygen called ozone, which can cause serious breathing difficulties and even, sometimes, death.

Study Site: Darjeeling Town

***** Insert Google map of Darjeeling Town**

Darjeeling Municipal Town is located between 26°31' and 27°31' N latitude and between 87°59' and 88°53' E longitude and altitude varies from 1981.20 m to 2286 m above sea level. The town covers an area of 10.6 sq.km having 32 wards with a population of nearly 1.5 lakhs. The town is mainly tea industry and tourist oriented commercial activity based town. Around the municipality there are some 36 tea gardens. The town is the main market for the villages and tea gardens surrounding it.

Tourism is the most prospective industry here. The annual inflow here had always remained divided into clearly demarcated on seasons with deep off seasons in between. Around 35% of the domestic tourists visit Darjeeling during pre monsoon slot from March to June and 45% visit during festive season from September to Mid November. These two slots generate almost 80% of around Rs 350 crore worth annual tourism business. With around 6,500 hotel rooms, Darjeeling receives around 50,000 foreign and 12 lakhs domestic tourists per year.

Major sources of pollution in Darjeeling Town:

Vehicles:

The town has 56 taxi syndicates, almost at every bend of the road. The major syndicates of them are those which provide taxis for the transport to Siliguri, Kurseong, Kalimpong, Gangtok, Mirik, Sukhiapokhari, Mungpoo, Takdah etc. They provide around 80% of the total taxis whose number may be more than 5000. There are around 800 trucks, buses which ply in the road for the supply of various needs of the people. In addition there are around 1200 private vehicles, 30-40% of which ply on the road on daily basis.



Virtually all of them are powered by petrol and diesel engines that burn petroleum to release energy. Petroleum is made up of **hydrocarbons** (large molecules built from hydrogen and carbon) and, in theory, burning them fully with enough oxygen should produce nothing worse than carbon dioxide and water. In practice, fuels aren't pure hydrocarbons and engines don't burn them cleanly. As a result, exhausts from engines contain all kinds of pollution, notably particulates (soot of various sizes), carbon monoxide (CO, a poisonous gas), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and lead—and indirectly produce ozone.

Tea factories:

There are around 36 tea gardens in the vicinity of the town. Most of the factories in the garden are run by energy powered by burning coals. Most plants that pollute release small amounts of pollution continually over a long period of time, though the effects can be cumulative. However during the harvesting period they consume a lot of coal producing large amount of pollution in the atmosphere.

The extent of use of coal in these factories can be estimated from the data collected from Happy Valley Tea garden which is located 1 km from the town. The annual usage of coal in this factory is 1,20,000 kg per annum. During the normal season the use of coal is 17,000 to 18,000 kg/ month while the amount increases to 25,000 to 30,000 kg/ month.

**** **Insert photo of Happy Valley Tea Factory**

Train:

Darjeeling Himalayan Railway (DHR) also known as 'Toy Train', is a 2 ft narrow gauge railway that runs between New Jalpaiguri and Darjeeling. It was built between 1879 and 1881, now operated by Indian railways supported by Darjeeling Himalayan Railway Society. Four modern diesel locomotives handle most of the scheduled services; however the daily Kurseong-Darjeeling return service and the daily tourist trains from Darjeeling to Ghum are handled by the vintage British-built B Class steam locomotives. The average coal consumption per mile is 39 lbs and the water consumption is 45 gallons. The engine has the capacity to carry 800 kg of coal and 1818 liters of water.

**** **Insert photo of Steam Engine**

Garbage:

There is very pathetic situation in Darjeeling for the collection of garbage. Garbage generated from households, markets and other sources are usually dumped in the vats of

the sized around 6 ft X 4 ft X 4 ft, constructed on the roadside areas. The garbage from the vats are not collected in a regular basis. In addition to that vats are receiving more garbage than their capacity, most of the time we see garbage being littering outside the vat. As a result garbage is decayed in the vats only which results into foul smelling causing air pollution.



Effects:

Over a period of last 10 years many changes in the weather of Darjeeling can be seen.

Temperature:

As told by the local people of Darjeeling large extent of fluctuation in temperature in Darjeeling has been felt in the last few years. According to them there used to be a regular snowfall during the winter season (last week of December) even if not water stored in the container used to freeze during night but this has become a rare happening nowadays. This may be largely due to increase in the carbon dioxide concentration in the air which is a major component of Global Warming.

Rainfall:

In earlier days Darjeeling used to get rainfall throughout the year with a total of around 2500 mm/ year. According to the people of local areas what they are experiencing is that may be the total rainfall is same or different (they do not have the data) but the ratio of rainfall that used to occur throughout the year has certainly changed. Nowadays there is almost no rainfall in winter; meteorological department has confirmed that there is about

56 % less rainfall during winter. Similarly the decrease in the rainfall in different seasons has been recorded which according to 2011 data are as follows:

Winter: decrease by 56 %

Pre-monsoon: decrease by 19 %

Monsoon: decrease by 7 %

Post-monsoon: decrease by 77 %

Another adverse situation that is being felt by the people is that rainfall here is not regular but very irregular. The total amount of rainfall that used to occur in a whole month sometime is occurring over a night or a day, making other days of the month dry. Decrease in the total annual rainfall along with the irregular type of rainfall is the main cause of drying up of the stream and landslide.



Photo courtesy: Praful Rao, STH



Biodiversity:

The effect of air pollution has become pretty obvious with respect to the loss biodiversity. According to the experiences felt by the local people that there are many local plants which are not seen nowadays or they are in the verge of extinction. Most of the local crops such as orange, cardamom, ginger etc are suffering from either fungal or viral diseases. The rise in temperature and humidity has been found to be the probable reasons for the occurrence of such diseases.

***** Insert photo of some diseased plants**

Conclusion:

Write yourself

Photo courtesy: Praful Rao, STH