

ENVIS-IITM NEWSLETTER

Indian Institute of Tropical Meteorology, Pune
Acid Rain and Atmospheric Pollution

(The project of Ministry of Environment, Forest & Climate Change, Govt. of India)



Air Pollution & Forest



EDITORIAL TEAM

Gufran Beig, (ENVIS Co-ordinator)

Neha S. Parkhi, (Senior Program Officer)

Aishwarya Purwant, (Information Officer)

Gaurav Shinde, (I. T. Assistant)

Volume No.: 16

Issue No.: 1

January - March

2017

Contents

<i>Editorial.....</i>	<i>Page 2</i>
<i>Air Pollution and Forest cover.....</i>	<i>Page 3</i>
<i>Effects of Acid Rain on Forests.....</i>	<i>Page 4</i>
<i>Ozone has shown negative effects on forest cover.....</i>	<i>Page 5</i>
<i>Green house gases affect the ecosystems.....</i>	<i>Page 6</i>
<i>Particulate Matter causes severe damage to Forests.....</i>	<i>Page 7</i>
<i>A step towards forest conservation.....</i>	<i>Page 8</i>

Editorial

Air pollution has almost become a destructive part of life on Earth. The occurrence of smog every now and then, also the increasing emissions threaten us every moment. Vegetation cover and forests offer us fresh air which can help relieve from the health issues caused due to air pollution. The very same air pollution also affects the forests and functioning of it. This aggravates the degradation of forests caused by activities like hunting, poaching and deforestation. As forests are known as lungs of the Earth and a natural air conditioning system, its capacity to absorb emissions and clean the polluted air can't be underestimated. The evidence shows the level of deterioration of forests and its generation into inhabitable land. Rapid measures are needed to save our natural air conditioning systems and the first step towards is awareness of this issue to the society.



Air Pollution and Forest Cover

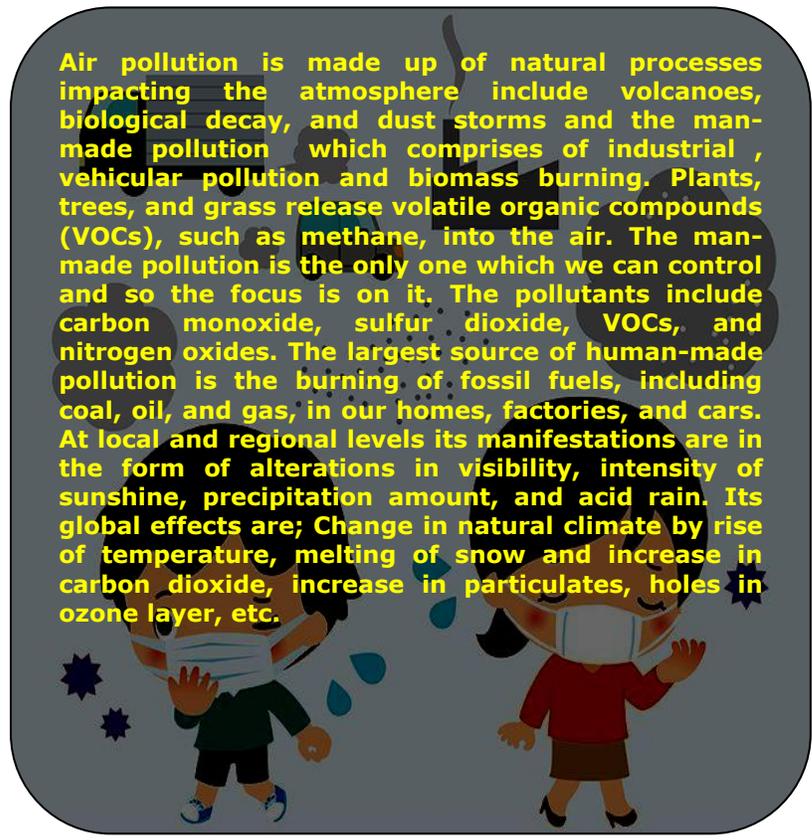


Air pollution which is a priority in the list of concerns for our planet consists of smog, acid rain, carbon monoxide, fossil fuel exhausts, and tropospheric ozone. In the midst of 13th century, people started complaining about coal dust and soot in the air over London, England. Since the industrial revolution in the late 1700s, the Earth's atmosphere and its chemistry have been constantly changing. This

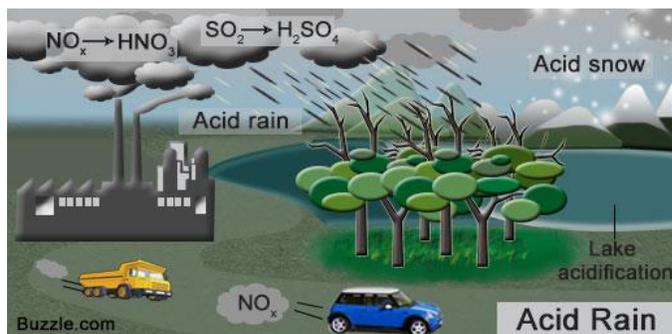
problem has a legacy of more than seven centuries and yet we haven't been able to curb it, but suffering from its effects that nearly kills the life. It damages buildings, crops, and wildlife.

The research in the this area is divided into two parts, one is to continuously understand the known and the unknown inter-relations of the changing atmospheric chemistry cause of pollution and the other is to estimate ways for prevention of air pollution. The research in prevention of air pollution states that forests are the natural air conditioning systems which help absorb the high levels of pollution and clean the atmosphere. This study gives us a hope that forests will do the cleaning and prevent us from ill-effects of pollution. However, a part of research also showcases the damage air pollution does to flora, fauna and the abiotic factors that make up a forest.

Air pollution is made up of natural processes impacting the atmosphere include volcanoes, biological decay, and dust storms and the man-made pollution which comprises of industrial, vehicular pollution and biomass burning. Plants, trees, and grass release volatile organic compounds (VOCs), such as methane, into the air. The man-made pollution is the only one which we can control and so the focus is on it. The pollutants include carbon monoxide, sulfur dioxide, VOCs, and nitrogen oxides. The largest source of human-made pollution is the burning of fossil fuels, including coal, oil, and gas, in our homes, factories, and cars. At local and regional levels its manifestations are in the form of alterations in visibility, intensity of sunshine, precipitation amount, and acid rain. Its global effects are; Change in natural climate by rise of temperature, melting of snow and increase in carbon dioxide, increase in particulates, holes in ozone layer, etc.



Effects of Acid Rain on Forests



The burning of fossil fuels emits nitrates and sulphates which are acidic in nature. When acidic air pollutants combine with water droplets in clouds, the water becomes acidic and hence the result is Acid Rain (pH <5.6). As acid rain soaks into the ground, it can make the pH of soil acidic, an unfit habitat

for many living things. Acid rain also changes the chemistry of the water in lakes and streams, causing eutrophication (algal blooms), harming fish and other aquatic life. Surface water acidification can lead to a decline in, and loss of, fish populations and other aquatic species including frogs, snails and crayfish. This has a severe effect on animals that subsist on their populations, which further intensifies the impact on the entire food chain. Acid deposition is a probable cause of declines in amphibian populations. Acid rain weakens trees by destroying their leaves, decreasing the nutrients available to them. The toxic substances released from the soil, due to reactions from acid rain also poisons the plants. Acid water dissolves nutrients and other important minerals in the soil and washes them away before they can be consumed by plants. Yellowing of leaves (chlorosis) may also be an effect of acidification. Other symptoms include mottling, bronzing, reddening and stunted growth. Air pollution has caused widespread damage to trees, fruits, vegetables, flowers and in general, vegetation as a whole. The most dramatic early instances of plant damage were seen in the total destruction of vegetation by sulfur dioxide in the areas surrounding smelters. When the absorption of sulfur dioxide exceeds a particular level, the cells become inactive and are killed,



resulting in tissue collapse and drying of leaves. There is strong evidence for effects of acidic nitrogen deposition on plants in grasslands, alpine areas, and bogs, and for nitrogen effects on forest mycorrhizae. The symptoms appear as 2-sided (bifacial)

During the 1970s, scientists in Sweden and Norway began noticing that acid rain was damaging their trees and fresh water. Much of the acid rain was caused by pollution that was transported through the air from other countries, primarily the United Kingdom. After that, acid rain was understood to be an international problem.

lesions that usually occur between the veins and occasionally along the margins of the leaves. The colour of the necrotic area can vary from a light tan or near white to an orange-red or brown depending on the time of year, the plant species affected and weather conditions.

Ozone has shown negative effects on forest cover

Ozone molecules wrap up near the Earth's surface as a part of air pollution. With increasing populations, more automobiles, and more industry (power plants and refineries in particular), there's more ozone in the lower atmosphere. In urban areas in the Northern Hemisphere, high ozone levels usually occur during the warm, sunny, summer months (from May through September). Typically, ozone levels reach their peak in mid to late afternoon, after the Sun has had time to react fully with the exhaust fumes from the morning rush hours. A hot, sunny, still day is the perfect environment for ozone pollution production. In early evening, the sunlight's intensity decreases and ground level ozone begins to decrease again. Ozone molecules near the ground damages lung tissues of animals, the problem may be particularly more pronounced in birds because of the distances they travel and their higher respiratory rates.

Since 1900, the amount of ozone near the Earth's surface has more than doubled.



The near ground ozone prevents plant respiration by blocking the stomata in leaves where respiration occurs. Lacking in respiration, a plant is not able to photosynthesize at a high rate, hence stunting the plant's ability to grow. Ozone is known to cause reductions in photosynthesis in many terrestrial plant species. Impact of ozone can be seen in the lesions to plants. Ozone symptoms characteristically occur on the upper surface of affected leaves and appear as a flecking, bronzing or bleaching of the leaf tissues.

Air pollutants called chlorofluorocarbons (or CFCs) have destroyed parts of the ozone. The ozone layer, located in the stratosphere layer of Earth's atmosphere, shields our planet from the Sun's ultraviolet radiation. The areas of thin ozone are called ozone holes. Ultraviolet radiation causes skin cancer and damages plants and wildlife.



Green house gases affect the ecosystems

When fuels are burned, some of the pollutants released are greenhouses gases. Through the process of photosynthesis, plants convert carbon dioxide into oxygen. However, the amount of carbon dioxide released by burning fuels is tremendous than plants can convert.

The total annual cost of plant damage caused by air pollution in USA alone has been estimated to be in the range of 1 to 2 billion dollars.

Global warming is causing changes in the ecosystems. For example: poles and glaciers are melting. This causes changes in the habitat and resources for plants and animals living there like polar bears and pine forests. Ocean warming, rising sea levels, runoff, and coral diseases are causing change in shallow marine environments such as coral reefs. Global warming is causing less rain to fall in the middle of continents. This makes these areas very dry and limits water resources for plants and animals. Emissions from automobiles and industries accumulate in the atmosphere. This, unfortunately, gets into animals' bodies through inhalation of gases and particulate matter, ingestion of contaminated food and water and in the case of certain amphibians, through skin absorption.

Particulate Matter causes severe damage to the functioning of forests

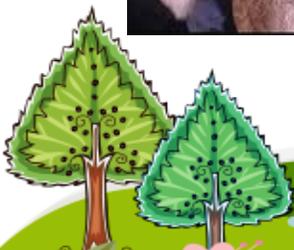
Particulate matter such as cement dust, magnesium-lime dust and carbon soot deposited on vegetation can inhibit the normal respiration and photosynthesis mechanisms within the leaf. Cement dust may cause chlorosis and death of leaf tissue by the combination of a thick crust and alkaline toxicity produced in wet weather.



Particulate matter such as mercury, fluoride, powdered ash, dioxins and furans etc. are emitted by large industrial complexes and thermal power plants. Chronic poisoning results from the ingestion of forage contaminated with atmospheric pollutants. These again enter the animals' respiratory systems and cause particulate buildup in their lungs, eventually choking them to death. Additionally, mercury is known to be a potent poisoning agent.



Fluoride is another pollutant, which causes fluorosis among animals. It is also emitted in gaseous forms, get absorbed by plants, and in



turn get transferred into herbivores and soil dwelling invertebrates. Several herbivores are known to show signs of fluoride poisoning (in the form of malformed teeth and bones). Bone lesions in animals due to excessive fluorides have also been reported.

Fluorides absorbed by leaves are conducted towards the margins of broad leaves (grapes) and to the tips of monocotyledonous leaves (gladiolus). Little injury takes place at the site of absorption, whereas the margins or the tips of the leaves build up injurious concentrations. The fluoride enters the leaf through the stomata and is

Animals are exposed to air pollutants via three pathways: 1) inhalation of gases or small particles; 2) ingestion of particles suspended in food or water; or 3) absorption of gases through the skin. In general, only soft-bodied invertebrates (e.g. earthworms), or animals with thin, moist skin (e.g. amphibians) are affected by the absorption of pollutants.

moved to the margins where it accumulates and causes tissue injury.

Smog also causes injury to plants. Similarly the leaves of plants can get clogged with the particles released from vehicle emissions making it hard for the plant to photosynthesize.

Organic and synthetic chemicals, such as dioxins and organochlorines, affect wildlife. Dioxins bioaccumulation takes place (build up in the body by concentrating in body fat) and they are resistant to biological breakdown.

A step towards forest conservation....

There are many evidences showing us the effect of Air Pollution on our valuable forests. We are dependent on forests for clean air, carbon sequestration and for many other resources. Other than the forests providing the mankind with so many services it also aids in maintaining the functioning of biogeochemical cycles which helps the life to sustain on Earth. As air pollution damages the forests, there are many other human actions which cause degradation of forests. According to India State of Forest Report 2015 released in December 2015, India's total green cover has reached 22.6% of the land mass, even as India is striving to achieve the target of having 33% land under forest cover. The actions such as deforestation, encroachment, poaching, hunting, pollution and afforestation of monocultures disturb the "ecological mix" of forests. Laws and policies do help but public awareness and their support brings out the maximum effectiveness to help in the conservation of forests. To create awareness among school children we organised an awareness event about Forest Conservation on 16th January 2017. Around 21 schools participated and 160 students participated in the activities organised. The Activities like Drawing & Essay Competition, Elocution and model making out of waste materials showcased the perspective of the young generation towards forest conservation. We invited Dr. Rahul Mungikar who is Senior Research Consultant at Maharashtra State Biodiversity Board, to expose students on the importance of



forests, its ecological value and the ill-effects of degradation on forests. He also shared some stories on how forest can be beneficial for sustainable future. His talk had many interesting short stories, which explained the complicated interactions of nature in a simpler way. The activities like elocution and essay competition showed that these young citizens of India are strong opinioned for conservation of resources and that they want to have a sustainable, harmonious future on this planet. The winners from each activity were presented with an endemic sapling and the schools were awarded with a tree sapling to plant in their school campus which they could look after and help in increasing the city's green cover.

What we can do to conserve forests.....

- ✿ Stop polluting our precious resources like air, water and land. This one step can stabilize nature and balance life on Earth.
- ✿ Reduce the use of fossil fuels and switch to renewable energy sources like solar, wind, tidal etc. Conserve energy.
- ✿ Use energy efficient technology which releases fewer emissions into air and water.
- ✿ Promote and take steps towards restoration of ecosystems and afforestation using endemic plants which could sustain and evolve wildlife.
- ✿ Make a strong stand against poaching, hunting and encroachment; cast your vote in favor of strong laws and policies which will help in protection of our finite resources.

