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IMPACTS OF AIR POLLUTION BY TRANSPORTATION ON ENVIRONMENT

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ABSTRACT

During the last two decades India has seen an unprecedented economic growth. The number of urban centers in the country has risen sharply. There are now 53 million plus cities in the country which accommodates its residents in relatively smaller regions. Higher population densities not only lead to enormous demand for resources but also degradation of environmental quality. Air pollution generated by human activities has adversely affected the lives of millions of people and caused great economic damage to ecosystems and society. Urban air pollution is a major problem across the country. More than 80% of cities in India where air quality is monitored do not meet the standard of air quality prescribed by the Government of India. Transport sector has always been a significant contributor in emission estimates of cities. The source apportionment studies conducted in the six major cities of the country have shown that transport has significant contributions in PM2.5 and NOx concentrations. Moreover, the lower height of release of vehicular emissions leads to higher exposure. WHO has recently classified diesel exhausts as Class-I carcinogens. Air pollution in India has increased rapidly due to population growth, increase in the numbers of vehicles, use of fuels, bad transportation systems, poor land use pattern, industrialization, and above all, ineffective environmental regulations. Sulphur Dioxide, Nitrogen Dioxide, Particulate Matter are some of the pollutants which are contributing to environmental pollution. Purpose of this paper is to review the literature relating to the analysis of ambient air quality of some Indian cities and compare the same with Indian National Ambient Air Quality Standards. Also discuss of the use of Air Quality Index (AQI), seasonal variation in concentration of air pollutants. Assessment of health impacts due to increase in the concentration of air pollutants in Indian cities. With rising air pollution levels and deadly health risks, leading cities have developed clean air programs using the AQI. The AQI is the key tool in programs for protecting communities and triggering response actions. By calculating the AQI we will find the remedial measures to curb the pollution level from our Ahmedabad city zones.

Keywords: *AQI, pollution levels, Air pollution*

I. INTRODUCTION:

Air pollution is contamination of the air by noxious gases and minute particles of solid and liquid matter (particulates) in concentrations that endanger health. Air constitutes 80% of the man's daily intake of material by weight. We breathe 22000 times a day on an average, inhaling 16kg of air per day. This suggest how important fresh unpolluted air is for human beings but due to rapid industrialization, over population many air pollutants are added into the atmosphere affecting human beings, animals, plants and materials. Air pollution is the presence in ambient atmosphere of substances, general resulting from the activity of man in sufficient concentration, present for sufficient time. Air pollution is the introduction of chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or cause damage to the natural environment or built environment, into the atmosphere. The major sources of air pollution are transportation engines, power and heat generation, industrial processes, and the burning of solid waste. Toxic air pollutants, also known as hazardous air pollutants, are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. Examples of toxic air pollutants include benzene, which is found in gasoline; perchloroethylene, which is emitted from some dry cleaning facilities; and methylene chloride, which is used as a solvent and paint stripper by a number of industries. Examples of other listed air toxics include dioxin, asbestos, toluene, and metals such as cadmium, mercury, chromium, and lead compounds. The atmosphere is a complex dynamic natural gaseous system that is essential to support life on planet Earth. Stratospheric ozone depletion due to air pollution has long been recognized as a threat to human health as well as to the Earth's ecosystems. Indoor air pollution and urban air quality are listed as two of the worlds worst pollution problems in the 2008 Blacksmith Institute World's Worst Polluted Places report.

II. RELATED TO TRANSPORTATION:

Cars are the greatest contributing agent of pollution in most cities across the globe. Emissions from car exhaust contain a range of toxic substances. They include carbon monoxide, nitrogen dioxide, Sulphur dioxide, benzene, formaldehyde, polycyclic hydrocarbons lead and tiny suspended particles. These chemicals are hazardous to human health. The emissions also have a serious impact on the environment. Vehicles contain many different fluids, including motor oil, antifreeze, gasoline, air-conditioning refrigerants, and brake, transmission, hydraulic and windshield-wiper fluids. In most cases, these fluids are toxic to humans and animals, and can pollute waterways if they leak from a vehicle or are disposed of incorrectly. Many vehicle fluids are exposed to heat and oxygen while an engine is running, and undergo chemical changes. These fluids also pick up heavy metals from engine wear and tear, making them even more toxic to the environment. Most vehicles manufactured before 1994 use CFC-12 as a coolant; CFC-12 is no longer produced in the U.S. because of its detrimental effect on the ozone layer.

2.I. The three main types of automotive vehicles being used in our country are:

1. Passenger cars powered by four stroke gasoline engines
2. Motor cycles, scooters and auto rickshaws powered mostly by small two stroke gasoline engines and
3. Large buses and trucks powered mostly by four stroke diesel engines.

III. SOURCES OF AIR POLLUTION:

3.1. Anthropogenic sources or human activity.

- "Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices. In developing and poor countries, traditional biomass burning is the major source of air pollutants traditional biomass includes wood, crop waste and dung.
- "Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.
- Chemicals, dust and controlled burn practices in agriculture and forestry management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest.
- Fumes from paint, hair spray, varnish, aerosol sprays and other solvents
- Waste deposition in landfills, which generate methane. Methane is not toxic however; it is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiate and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement.
- Military, such as nuclear weapons, toxic gases, germ warfare and rocketry.

3.2. Natural sources

- Dust from natural sources, usually large areas of land with little or no vegetation
- Methane, emitted by the digestion of food by animals, for example cattle
- Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer.
- Smoke and carbon monoxide from wildfires
- Vegetation, in some regions, emits environmentally significant amounts of VOCs on warmer days. These VOCs react with primary anthropogenic pollutants—specifically, NO_x, SO_2, and anthropogenic organic carbon compounds—to produce a seasonal haze of secondary pollutants.
- Volcanic activity, which produce sulfur, chlorine, and ash particulates.

IV. AIR POLLUTANTS:

- A substance in the air that can cause harm to humans and the environment is known as an air pollutant. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

- Pollutants can be classified as primary or secondary. Usually, primary pollutants are directly emitted from a process, such as ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact.
- An important example of a secondary pollutant is ground level ozone — one of the many secondary pollutants that make up photochemical smog. Some pollutants may be both primary and secondary: that is, they are both emitted directly and formed from other primary pollutants.

4.1. Major primary pollutants produced by human activity include:

- Carbon monoxide (CO) - is a colorless, odorless, non-irritating but very poisonous gas. It is a product by incomplete of fuel such as natural gas, coal or wood. Vehicular exhaust is a major source of carbon monoxide.
- Carbon dioxide (CO_2) - a colorless, odorless, non-toxic greenhouse gas also associated with ocean acidification, emitted from sources such as combustion, cement production, and respiration. It is otherwise recycled in the atmosphere in the carbon cycle.
- Volatile organic compounds - VOCs are an important outdoor air pollutant. In this field they are often divided into the separate categories of methane (CH_4) and non-methane (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhance global warming. Other hydrocarbon VOCs are also significant greenhouse gases via their role in creating ozone and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality.
- Particulate matter - Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols.
- Persistent free radicals connected to airborne fine particles could cause cardiopulmonary disease.
- Toxic metals, such as lead, cadmium and copper.
- Chlorofluorocarbons (CFCs) - harmful to the ozone layer emitted from products currently banned from use.

4.2. Secondary pollutants include:

- Particulate matter formed from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution; the word "smog" is a portmanteau of smoke and fog. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulfur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

"Fig 4.1: Accumulation of Photochemical Smog"

- Ground level ozone (O_3) formed from NO_x and VOCs. Ozone (O_3) is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer. Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities (largely the combustion of fossil fuel), it is a pollutant, and a constituent of smog.

- Peroxyacetyl nitrate (PAN) - similarly formed from NO_x and VOCs.

"Fig 4.2: Vehicles Emitting pollution"

V. Existing scenario of air pollution in India (urban area):

API or Air Pollution Index is a score between 0 and 300 that is a composite reflection of overall air quality based on 5 pollutants: sulfur dioxide (SO2), nitrogen dioxide (NO2), suspended particulates (PM10), carbon monoxide (CO), and ozone (O3). These are pollutants that mainly affect the respiratory system, not your neurological system, like formaldehyde and TVOCs, which lead to headaches, dizziness, etc. API does not account for these that are found mainly indoors.PM10 are larger particles of anything 10 microns in diameter or smaller. PM2.5 only measures smaller than 2.5microns

AHMEDABAD:

As per national standards, the maximum permissible levels of SPM and RPM are 200 and 100 particles per million (PPM) respectively. But the SPM levels in Ahmedabad during the last week have remained at an alarming high — varying between 416 to 581 PPM — two to three times higher than the prescribed limits.

RPM, which can prove more dangerous due to their smaller size, have remained between 132 PPM to 203 PPM!

DELHI:

According to the national ambient air quality standards, the normal annual average for PM10 is 60 microgram per cubic meter. In the last three years, pm10 in Delhi has gone up from 198 in 2008 to 243 in 2009 and 259 in 2010. Even cities surrounding Delhi such as Faridabad and Meerut where the air quality is monitored, saw an increase in pm10 levels.

HYDERABAD:

The total suspended particulate matter (TSPM) in the air should be 200 milligram per cubic meter but the average value being recorded in the twin cities is 280 milligram per cubic meter.

The traffic-intensive areas like Panjagutta, Charminar, Paradise Circle and Abids have recorded a staggering TSPM rate of 300-400 on any given day.

CALCUTTA:

The average SPM (Suspended Particulate Mater) concentrations during the winter in 1992, 1993 and 1994 were 982 µg/m3, 1007 µg/m3 and 1181 µg/m3 respectively. High SPM in the city air also showed high BSOM (Benzene Soluble Organic Mater). High BSOM was associated with high value of PAH (Polynuclear Aromatic Hydrocarbons). Twelve PAH compounds were identified and quantified in the city air and some of them are suspected carcinogen.

MUMBAI:

Mumbai Kars have been breathing in an average of about 172 micrograms of SPM per cubic meter this January-with the maximum limit even touching 235 microgram/cubic metre.

"Anything above 100 micrograms of SPM in 1 cubic metre of air is bad for health," said an official from the Maharashtra Pollution Control Board.

KANPUR:

World ranking: 10

Annual mean PM10 (ug/m3): 209

Population: 4,572,951

Kanpur is one of the largest cities in India and one of the most polluted in the world.

Worst still, the levels of air pollution in the city, which is the 10th most polluted city in the world, are on the rise.

LUDHIANA:

World ranking: Four

Annual mean PM10 (ug/m3): 251

Population: 3,487,882

Ludhiana is a highly industrial city with manufacturing plants that produce everything from textiles to auto parts.

Unfortunately, this industry, paired with vehicular pollution, has made Ludhiana one of the most polluted cities in the world. It currently has the fourth most polluted air in the world. There are about 200 premature deaths each year in the city due to air pollution.

VI. IMPACTS OF AIR POLLUTION DUE TO TRANSPORTATION ON THE ENVIRONMENT:

- **THE VARIOUS ENVIRONMENTAL ELEMENTS INCLUDES:**

1. Animals:

- Toxic pollutants in the air, or deposited on soils or surface waters, can impact wildlife in a number of ways. Like humans, animals can experience health problems if they are exposed to sufficient concentrations of air toxics over time. Studies show that air toxics are contributing to birth defects, reproductive failure, and disease in animals.
- Persistent toxic air pollutants (those that break down slowly in the environment) are of particular concern in aquatic ecosystems. These pollutants accumulate in sediments and may bio magnify in tissues of animals at the top of the food chain to concentrations many times higher than in the water or air.

2. Vegetation, Plants and Agriculture:

Air pollution can damage crops and trees in a variety of ways. Ground-level ozone can lead to reductions in agricultural crop and commercial forest yields, reduced growth and survivability of tree seedlings, and increased plant susceptibility to disease, pests and other environmental stresses (such as harsh weather). As described above, crop and forest damage can also result from acid rain and from increased UV radiation caused by ozone depletion.

1. Leaf structure affects diffusion of gases (oxygen and carbon dioxide) for photosynthesis.
2. Root system supports transpiration of water and nutrients from soil.
3. Visible injuries:
    - Chlorosis (reduction in chloroplasts)
    - Glazing or silvering (damage to epidermal layer)
    - Flecking or stippling (spotty damage to epidermal layer)
    - Early senescence (leaf drop)
    - Chlorosis - chlorophyll destruction
    - Necrosis - killing of tissues
    - Growth abnormalities
    - Reduced growth
    - Accelerated senescence
    - Bolting of flower buds
    - Abscission of plant parts
    - Curvature of leaf petiole (epinasty)
4. Structural or changes in shape of structures.
    - Physiological changes
    - Net photosynthesis
    - Stomata response
    - Metabolic activity
    - Reproduction

Effects of various pollutants on Plants:

1. Peroxyacetyl Nitrate (PAN) Injury:

- Responsible for “smog injury” on vegetable crops
- Injury appears on lower surface as “glazing”

2. Fluoride injury

- May occur from
- Uptake of gaseous fluoride
- Uptake of fluorides from the soil
- Results from transport and accumulation of fluorides
- In leaf margins-broad-leaved species
- In leaf/needle tips-narrow leaved and coniferous species

3. Ethylene injury

- Natural plant maturation hormone controls ripening, fruit maturation
- Types
- Dry sepal of orchids
- Premature bud break
- Inhibition of flowering
- Accelerated flower aging

4. Effects of acidic deposition

- Leaching of plant metabolites and inorganic nutrients
- Leaching of soil nutrients
- Mobilization of toxic metals

5. Forest Decline

- Declines in forests and changes in composition (species in the forest)
- Interaction with other factors (drought, temperature)
- Eastern White Spruce
- Foliar damage, reduced growth
- Red Spruce and Fraser Fir
- Dieback and reduced growth
- Most significant at higher elevations
- Associated with acid rain as well
- Decline-describes processes by which large numbers of trees die
- Death occurs progressively; trees are weakened and become less vigorous
- May be due to natural or anthropogenic stress factors
-

3. Water

- Transport activities have an impact on hydrological conditions. Fuel, chemical and other hazardous particulates discarded from aircraft, cars, trucks and trains or from port and airport terminal operations, such as de-icing, can contaminate rivers, lakes, wetlands and oceans. Because demand for shipping services is increasing, marine transport emissions represent the most important segment of water quality inventory of the transportation sector.
- The main effects of marine transport operations on water quality predominantly arise from dredging, waste, ballast waters and oil spills. Dredging is the process of deepening harbor channels by removing sediments from the bed of a body of water.

4. Environmental Climate:

- **Acid rain** is precipitation containing harmful amounts of nitric and sulfuric acids. These acids are formed primarily by nitrogen oxides and sulfur oxides released into the atmosphere when fossil fuels are burned. These acids fall to the Earth either as wet precipitation (rain, snow, or fog) or dry precipitation (gas and particulates). Some are carried by the wind, sometimes hundreds of miles.

- In the environment, acid rain damages trees and causes soils and water bodies to acidify, making the water unsuitable for some fish and other wildlife. It also speeds the decay of buildings, statues, and sculptures that are part of our national heritage. Acid rain has damaged Massachusetts lakes, ponds, rivers, and soils, leading to damaged wildlife and forests.
- **Eutrophication** is a condition in a water body where high concentrations of nutrients (such as nitrogen) stimulate blooms of algae, which in turn can cause fish kills and loss of plant and animal diversity.
- Although eutrophication is a natural process in the aging of lakes and some estuaries, human activities can greatly accelerate eutrophication by increasing the rate at which nutrients enter aquatic ecosystems. Air emissions of nitrogen oxides from power plants, cars, trucks, and other sources contribute to the amount of nitrogen entering aquatic ecosystems.
- **Haze** is caused when sunlight encounters tiny pollution particles in the air. Haze obscures the clarity, color, texture, and form of what we see. Some haze-causing pollutants (mostly fine particles) are directly emitted to the atmosphere by sources such as power plants, industrial facilities, trucks and automobiles, and construction activities. Others are formed when gases emitted to the air (such as sulfur dioxide and nitrogen oxides) form particles as they are carried downwind.

5. Ozone layer:

- Ozone is a gas that occurs both at ground-level and in the Earth's upper atmosphere, known as the stratosphere. At ground level, ozone is a pollutant that can harm human health. In the stratosphere, however, ozone forms a layer that protects life on earth from the sun's harmful ultraviolet (UV) rays.
- Thinning of the protective ozone layer can cause increased amounts of UV radiation to reach the Earth, which can lead to more cases of skin cancer, cataracts, and impaired immune systems. UV can also damage sensitive crops, such as soybeans, and reduce crop yields.
- Ozone is not emitted directly from any human-made source. It arises from chemical reactions between various air pollutants, primarily NOX and Volatile Organic Compounds (VOCs), initiated by strong sunlight. Formation can take place over several hours or days and may have arisen from emissions many hundreds, or even thousands of kilometers away.

Effects:

- **Exposure to high concentrations may cause irritation to eyes and nose. Very high levels can damage airways leading to inflammatory reactions. Ozone reduces lung function and increases incidence of respiratory symptoms, respiratory hospital admissions and mortality.**
- **Ground level ozone can also cause damage to many plant species leading to loss of yield and quality of crops, damage to forests and impacts on biodiversity.**
- **Excessive ozone in the air can have a marked effect on human health. It can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases. In Europe it is currently one of the air pollutants of most concern.**

- **Several European studies have reported that the daily mortality rises by 0.3% and that for heart diseases by 0.4 %, per 10 µg/m^3 increase in ozone exposure.**

6. GREEN HOUSE EFFECT:

- The principle greenhouse gases include water vapor, carbon dioxide, methane, nitrogen oxides, and some engineered chemicals such as chlorofluorocarbons. While most of these gases occur in the atmosphere naturally, levels have been increasing due to the widespread burning of fossil fuels by growing human populations. The reduction of greenhouse gas emissions has become a primary focus of environmental programs in countries around the world.
- One of the principle greenhouse gases is carbon dioxide. Although carbon dioxide does not trap heat as effectively as other greenhouse gases (making it a less potent greenhouse gas), the sheer volume of carbon dioxide emissions into the atmosphere is very high, particularly from the burning of fossil fuels. In fact, according to the Energy Information Administration in its December 2009 report *'Emissions of Greenhouse Gases'* in the United States, 81.3 percent of greenhouse gas emissions in the United States in 2008 came from energy-related carbon dioxide.
- Smog and poor air quality is a pressing environmental problem, particularly for large metropolitan cities. Smog, the primary constituent of which is ground level ozone, is formed by a chemical reaction of carbon monoxide, nitrogen oxides, volatile organic compounds, and heat from sunlight.
- The use of natural gas does not contribute significantly to smog formation, as it emits low levels of nitrogen oxides, and virtually no particulate matter.

6. Human beings

- People exposed to toxic air pollutants at sufficient concentrations and durations may have an increased chance of getting cancer or experiencing other serious health effects. These health effects can include damage to the immune system, as well as neurological, reproductive (e.g., reduced fertility), developmental, respiratory and other health problems.
- In addition to exposure from breathing air toxics, some toxic air pollutants such as mercury can deposit onto soils or surface waters, where they are taken up by plants and ingested by animals and are eventually magnified up through the food chain. Like humans, animals may experience health problems if exposed to sufficient quantities of air toxics over time.

People are exposed to toxic air pollutants in many ways that can pose health risks, such as by:

- Breathing contaminated air.
- Eating contaminated food products, such as fish from contaminated waters; meat, milk, or eggs from animals that fed on contaminated plants; and fruits and vegetables grown in contaminated soil on which air toxics have been deposited.
- Drinking water contaminated by toxic air pollutants.
- Ingesting contaminated soil. Young children are especially vulnerable because they often ingest soil from their hands or from objects they place in their mouths.

- Touching (making skin contact with) contaminated soil, dust, or water (for example, during recreational use of contaminated water bodies).

REFERENCES

[1] "Asbestos Litigation: Malignancy in the Courts?" *Civil Justice Forum*. No. 40 August 2002. http://www.manhattan-institute.org/html/cjf_40.htm

[2] "Vehicular Pollution Control in Delhi, India - Are the Efforts enough?" http://www.beijer.kva.se/publications/pdf-archive/Disc144.pdf.

[3] Button, K.J. and Rietveld, P. 1999. "Transport and the Environment". In: *Handbook of Environmental and Resource Economics*. J.C.J.M. van den Bergh (ed.). Edward Elgar: Cheltenham, UK. 581-589.

[4] Central Pollution Control Board, Ministry of Environment and Forests: New Delhi, India. http://www.cpcb.nic.in/Air/Air.html.

[5] Button, K.J. and Rietveld, P. 1999. "Transport and the Environment". In: *Handbook of Environmental and Resource Economics*. J.C.J.M. van den Bergh (ed.). Edward Elgar: Cheltenham, UK. 581-589.

[6] Central Pollution Control Board, Ministry of Environment and Forests: New Delhi, India. http://www.cpcb.nic.in/Air/Air.html.