



Air We Breathe:

An Investigation into Air Quality

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Air is a mixture of gasses consisting of nitrogen, oxygen, water vapor, carbon dioxide, and inert gasses and several other minor constituents. This mixture creates a protective envelope around the earth surface which is known as the atmosphere. Atmosphere is not uniform. The density of gasses present at the earth surface is highest at lower levels, but gets thinner with elevation or altitude. You may have experienced this phenomenon when you are climbing a mountain. At higher elevations breathing is difficult due lack of oxygen. At the sea level;

- ◆ nitrogen and oxygen are the two most abundant gasses in air contributing to 99.0% of atmospheric constituents.
- ◆ water vapor composition varies from place to place and from time-to-time, and it accounts for rain and weather.
- ◆ abundance of carbon dioxide

and other emissions have elevated significantly with the industrialization.

- ◆ inert gasses and other atmospheric constituents are in minute quantities.

As a composite, air introduces a blend of stability and reactivity to the atmosphere which is essential to maintain life on earth. However, the atmosphere undergoes dynamic changes due to the inputs from natural processes and human activities.

- ◆ *Inputs from natural processes:* Volcanic eruptions as well as wild forest fires and wind introduce gasses and particles to the atmosphere. Since the quantities are relatively low, atmosphere can cope up with the inputs and the overall impact is often negligible. In some cases, massive inputs can make significant impacts locally but they gradually diminish with the dispersion of inputs.

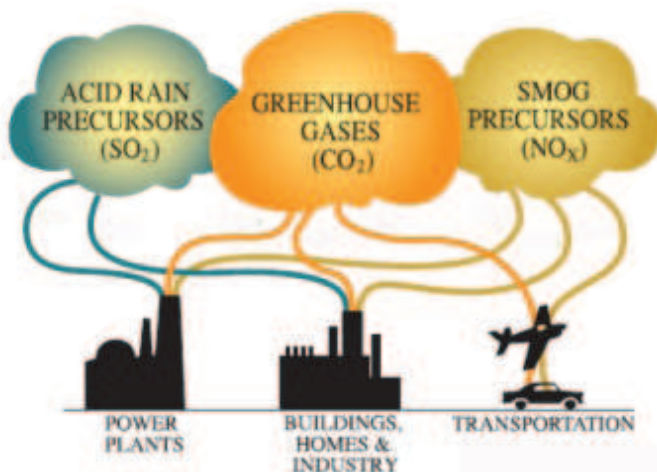
- ◆ *Inputs from human activities:* The human activities often release chemicals perturbing the atmospheric composition. The consequences are significant creating local problems as well as global problems. The gravity of the problem depends not only on how much is in the air, but also on the chemical nature of the released materials.

Air, without any of these inputs or emissions, is considered to be quality air. Air becomes polluted or its quality gets degraded when the amount of unwanted substances present in air increases beyond threshold values.

Atmospheric Inputs

Let's understand the processes which deteriorate the air quality.

- ◆ *Industrial emissions:* Though Sri Lanka is not an industrialized country, use of relatively out dated technologies, poor maintenance of the industrial equipments and impurities of the fuels contribute to significant releases of greenhouse gasses and hazardous chemicals to the atmosphere.



- ◆ *Motor vehicle emissions:* Significant number of our vehicles are used-vehicles and they are operating on poorly maintained roads. Most of the vehicles do not have facilities to control the emissions. Tampering the combustion mechanisms, impurities in the fuel and poor vehicle maintenance, continuously



deteriorate the air quality. The five senses in you enable you to recognize the level of emissions from the motor vehicles especially diesel emissions. Go to a busy road in a city and you can smell the diesel fumes, taste the diesel, feel the carbon from

diesel fumes deposited onto your body, see the smoke in air and hear the noise from the vehicles.

- ◆ *Household activities:* Perhaps you may have thought that

the home is the safest place to live. In fact, it is the best place if you can control the air quality in your home. Unfortunately, we neglect the air quality without understanding that we are spending 80-90% of the time indoors. The issue of air pollution due to household

activities will be discussed separately.

- ◆ *Agricultural practices:* We often introduce chemical pesticides and fertilizers in excessive quantities to get better

yields. In most of the cases, these added chemicals get into air and ground water polluting them.

Through all these processes the air quality is degraded and people are compelled to breathe the polluted air or they

are exposed to poor air quality conditions. These exposures not only degrade the health of the people but they damage the materials that belong to the people.

Current atmospheric problems due to degradation of air quality are,

- ◆ *Global warming:* This is the elevation of ambient temperature due to the excess of greenhouse gasses.
- ◆ *Acid rain:* Precipitation of acidic components released to the atmosphere.
- ◆ *Ozone Layer Depletion:* Thinning the ozone layer that protects us from hazardous ultra-violet solar radiations
- ◆ *Smog:* Smoke and fog that are released from industries and from motor vehicles which deteriorate the visibility and health.
- ◆ *Health issues:* Aggravation of existing health problems and causing new health problems.
- ◆ *Material Damage:* Corrosion of metallic and limestone structures.

Indicators of outdoor air pollution

Even without air quality measurements, one can sense the poor quality of air. Following are some of the indicators.

- ◆ One can sense the airborne pollutants (smell, taste, feel etc.)
- ◆ Haze formation and reduced visibility due to particles
- ◆ Reddish sunset (airborne

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- particles scatter the light)
- ◆ Heat stress and sunburns
- ◆ Health problems including asthma, breathing difficulties, headache, burning sensation in nose, eye and throat

Indoor air quality

So far the focus was on outdoor air quality but the problem in indoors is severe than in outdoors. To understand the exposure to pollutants or chemicals in outdoors and indoors one can do a simple test. Release a drop of perfume in your house (indoors) and find out the duration of smell. Do the same at a location outside the house which is open (outdoors). It will be noticed that the odors lasts longer indoors than outdoors. This is because mixing of air in the indoor is poor, and the chemical vapour stays longer, causing a higher exposure. But, in outdoors such chemical vapour get dispersed and diluted quickly resulting in a low exposure.

In many peoples minds air pollution is associated with contamination of urban air from automobile exhausts and industrial emissions. The following evidences will show how greater is the problem in indoor situations where we spend 80-90% of our time. Here, the term indoors refers to all the locations which have limited or restricted air circulation than where a free movement

of air exists as in the outdoors. Most of the houses, schools, offices and vehicles belong to this category. Based on World Health Organization studies it is known that

- ◆ A pollutant released indoors is one thousand times more likely to reach people's lung than a pollutant released outdoors.
- ◆ Health problems due to air quality have direct correlations with indoor pollutants than outdoor pollutants
- ◆ Five hundred million people, mostly women and children in developing nations are exposed to levels of indoor air pollution that are above the safe levels.
- ◆ Three million of women and children die each year from indoor air pollution in developing nations primarily due to exposure to the smoke from cooking activities.
- ◆ As far as health is concerned, indoor air pollution is second in importance to sanitation for developing countries.
- ◆ It is estimated that indoor air pollution accounts for 4-6 % of the burden of disease, placing it above exposure

to tobacco smoke, sexually transmitted diseases, alcohol and homicides as a leading causes of ill health and death.

- ◆ It has been estimated that unprocessed solid biomass fuels release at least 50 times more noxious pollutants than gaseous fuels.
- ◆ Poor air circulation in indoors elevates infection disease transmissions.
- ◆ 95% of low birth weight infants are born in developing nations. Both malnutrition and indoor pollutants account for the low birth weights.

In Sri Lanka, respiratory diseases are the second most leading cause of hospitalization over the last two decades. This is due to high exposures to the pollutants both at indoors and outdoors. Yet, only few attempts have been made to correct the problem. The current research findings of the few investigations carried out so far have established that indoor air pollution has contributed to aggravate the asthmatic conditions, to the development of chronic obstructive pulmonary diseases, to cataract formation, and to the low birth weights of the infants.



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Vulnerable groups

- ◆ *Infants:* Since the immune systems of infants are not fully developed, their small airways are more susceptible to the effects of inflammation.
- ◆ *Young children:* Young children with developing lungs breathe faster than adults, elevating the intake of pollutants. Children breathe a greater volume of air relative to their body weight making them more susceptible.
- ◆ *Infirm and elderly people:* They are also more susceptible to chronic conditions resulting from frequent and long periods of exposure.
- ◆ *Expectant women:* Poverty and indoor air quality which goes hand in hand worsens the growth of the babies.

Knowingly or unknowingly we are engaging in large number of indoor activities which result in releasing the pollutants. When these pollutants are confined to lower air volumes in indoors, airborne concentrations elevate, damaging health and materials kept in indoors. In addition to the indoor sources, some of the pollutants infiltrate to indoors and get entrapped in the air volume worsening the condition. This is more significant for the people who are living in industrialized areas and who are living closer to busy roads.

Indoor sources

Let's try to identify some of the

indoor sources which can elevate indoor pollution levels.

- ◆ *Combustion processes including cooking, smoking, candle burning, oil lamps, mosquito coils:* All these combustion processes release various chemicals to indoors. The level of risk depends on various factors including the combustion process, ventilation and the nature of the chemicals. You may recognize that the control of combustion (some of these combustion processes can be completely avoided indoors) is the best way to improve air quality.
- ◆ *Off gassing from building materials:* Most of the building materials including paints, furniture and linen release chemicals. Not only that they can collect the pollutants onto those surfaces when the airborne concentration is high. You may have noticed the smell from these building materials. But people often ignore them assuming they do not contribute to health.
- ◆ *Bio effluents:* Dust mites (small animals in dust as well as on animals), fungi, bacteria, viruses, human and animal dander's are abundant indoors. Most of them are abundant in indoors due to



our negligence. Most of these bio effluents are respirable and they can be transported to the lungs aggravating the health problems.



◆ *Cleaning activities:* It is good to live in a clean house but the cleaning itself can pose a risk. For example, all the cleaning activities including sweeping, dusting, and vacuuming release the settled particles onto air subjecting them to inhalation. Hence, cleaning should be done with covered breathing zone under proper ventilation in the absence of people around.

Poor ventilation

When a house or building is constructed, local authorities inspect the premises to assess the ventilation requirements, which include a minimum window area for each room. Once people occupy the building, the windows and doors are kept closed to prevent intrusion of insects, dust particles and other nuisances from the outdoor. Thus the



restrictions to the natural ventilation make the air to be stagnant, and concentrate the pollutants indoors. This is a common mistake in most households and even in public places. In the night we further restricts the ventilation, and in addition introduce new pollutant sources such as smoke emanating from mosquito coils, joss sticks, oil lamps etc. The pollutants generated from these sources have lesser chance of escaping from the indoors.

Cooking

From cooking we expect to preserve the food, to enhance the nutritional value, to improve the appetite (taste, smell and appearance) and to destroy pathogens (bacteria and fungi). Inadvertently, during cooking we release pollutants indoors, and through negligence worsens the quality of indoor air. In early days, the kitchen was a separate entity from the main house. People cooked food in the kitchen and brought the cooked food to the table leaving the smoke outside. Now in modern middle-income houses,

the kitchen is near the living room. Inhabitants are compelled to inhale the smoke during cooking (may be as an appetizer for the food). After

the meal, often a mosquito coil or a cigarette is lit emitting smoke (may be the desert). This situation is very much similar to low-income families as well. Their kitchen may be only a corner of the living area of the house. Perhaps you may not believe that cooking is the biggest contributor that deteriorates the indoor air quality. It is known that,

◆ Solid fuels such as wood and biomasses produce 10 to 100

- times more pollutants than the gaseous and liquid fuels.
- ◆ About half of the households use unprocessed solid fuels (biomasses including cow dung and agricultural waste) for cooking in the world.
- ◆ In Sri Lanka, 85-90% of the people use unprocessed solid fuels for cooking
- ◆ Smoke emanating from stoves is released at the breathing level elevating the health risk.
- ◆ Most of the stoves are not properly vented.
- ◆ Most of cooking is done while people are present.

It is estimated that smoke from indoor fires kill one person every 20 seconds in the developing world. Further, it is noted that inefficient stove can be as bad for health as smoking two packs of cigarettes per day. These evidences are more than adequate for us to correct the problem rather than sacrificing our health.

Your role in improving the indoor air quality

All of us are spending longer hours indoors, and we need to maintain the air quality to safeguard our health. Following guidelines enable us to improve the indoor air quality.

- ◆ Educate people about air quality and related health issues
- ◆ Open the doors and windows to bring and circulate fresh air (do not stagnate the air)
- ◆ Minimize the indoor

- combustion activities
- ◆ Ensure combustion appliances are properly vented and receive enough air supply
- ◆ Avoid procedures and products that can deteriorate air
- ◆ Avoid bringing products into the building that could release harmful or bothersome odors or contaminants
- ◆ Integrate air quality into purchasing decisions
- ◆ Buy limited quantities and do not store volatiles
- ◆ Give away partially full containers or surplus chemicals
- ◆ Choose non chemical methods for pest control
- ◆ Do not smoke and discourage others to smoke in indoors
- ◆ Do not block air vents
- ◆ Do not cut, rip or sand asbestos containing material
- ◆ Do not remove lead paint
- ◆ Do not idle the vehicles inside the closed garage

Final thoughts

In a world full of real and apparent risks, we often assume that the air we breathe is safe. Unfortunately, there are instances when dramatic episodes of air pollution have been documented to impair health and increase mortality rates. The above narration is an attempt to discuss the issues pertaining to air quality and it paves the way to appraise the health concerns and environmental impacts. The continuous degradation of the

air quality prompts us to take immediate action in controlling the air quality. If we ignore the facts or fail to comprehend the gravity of the problem we may have to pay the consequences in terms of our health and wealth.



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