

Air Pollution due to Transportation: A Case Study for Sri Lanka

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1. Background

Oil-based road transport system is the main source of ground level urban concentrations of air pollutants that harm human health and the environment because these pollutants are emitted near nose height and in proximity to people. All the motor vehicles in the world consume large amounts of fuel and emit large amounts of pollutants. International shipping also causes health and environmental impacts.

The pollutants emitted by motor vehicles include carbon monoxide (CO), nitrogen oxides (NO_x), hydrocarbon (HC), particulate matter (PM), carbon dioxide (CO₂), water vapor, organic compounds produced from petrol, lead compounds and carbon particles in the form of smoke. Sulfur oxides (SO_x), NO_x and fine-particle emissions are major shipping pollutants. Ship emissions may also contain carcinogenic particles.

On occasions, these components of the exhaust gas may react with each other to produce unpleasant secondary products such as 'smog'. Smog is formed by the reaction of the oxides of nitrogen and some of the hydrocarbons. Smog formation is affected by bright sunlight and



How smog is seen in the atmosphere

the topography of the region. Through chemical reactions in the air, SO₂ and NO_x are converted into fine particles, sulphate and nitrate aerosols. NO_x comprises a mixture of nitric oxide (NO) and nitrogen dioxide (NO₂). In the air, NO is rapidly converted to NO₂, which will also react in the air to form nitrate particles and ozone

(O₃). NO₂ is a toxic gas harmful for health. NO_x emissions also contribute to acidification and heavy growth of unnecessary microscopic plants, causing serious damage to ecosystems. In addition to the pollutants directly emitted by motor vehicles, these secondary

particles increase the health impacts on human beings. Tiny airborne particles are linked to premature deaths. The particles get into the lungs and are small enough to pass through tissues and enter the blood. They can then trigger inflammations, which eventually cause heart and lung failures.

2. The transportation sector in Sri Lanka

2.1 Introduction

Road and rail are the main transport systems in Sri Lanka. Air transport and water transport are insignificant compared to road and rail transport systems. The transport sector accounts for about 60% total fuel consumption in Sri Lanka. Sri Lanka's land transport system

is predominantly road transport (93%), which is based mainly on a road network centered in Colombo. The transportation categories include normal and trade goods transportation, international goods transportation and necessary items transportation. Foods, electronic items, textiles, different products, chemicals and medicines, minerals like crude oil are considered as the goods being transported frequently. The existing rail network will no longer meet the modern transportation requirements of the country. Over years, uncontrolled roadside development as well as poor road maintenance have decreased travel speeds, hindering the economic growth of regions outside the Colombo Metropolitan Area (CMA). Past investments in the road sector have focused mostly on the rehabilitation of the existing road network and have not been addressing the rapidly growing freight and passenger traffic.

2.2 Air pollution issues due to transportation in Sri Lanka

More recent data revealed that current air pollution levels in Colombo have exceeded recommended values for Sri Lanka. Emissions from motor vehicles are the most significant contributor to air pollution in Sri-Lanka like in most newly-industrialized countries. PM is the primary air pollutant of concern in Sri Lanka because it has consistently exceeded WHO guidelines. SO₂ has shown increasing trends. The results of a monitoring carried out by the Central Environmental Authority (CEA) showed that NO₂ concentration in the CMA is far above the safety levels, whereas

CO concentration is below the minimum level even during peak traffic hours. Another research showed a high correlation between the levels of total suspended particles and traffic density in Colombo. Overall, it can be expressed that the Colombo city is very unhealthy in terms of its particulate pollution. Findings of a research conducted in 1994 gave clear evidence of significantly higher lead levels in blood in some members of the tested population who are exposed to vehicle emissions than the control group. Traffic policemen were the worst affected.

In Sri Lanka, the air pollution problem in the transport sector arises due to the following factors together with sharp increase of vehicle population: Poor maintenance of vehicles that increases the air pollution by airborne particles from diesel vehicles and carbon monoxide and volatile organic compounds from petrol vehicles; high traffic congestion because of not having a proper road network and a traffic control system; poor maintenance of roads (especially in urban areas); and the absence of a proper and well-planned public transport system. Normally engines of most of the passenger transport buses are kept started and idling at the bus halts polluting the air environment. Long and heavy

vehicles like containers travelling in the day time create huge congestion, especially in urban areas. That has caused a great deal of fuel consumption on the national level and an increase of the working time of the workforce, enhancing the air pollution. The standardization and efficiency have not been undertaken properly, thus carbon is released to the environment with toxic smoke. The heavy vehicles, of which the maximum speed limit is 40 kmph causes other vehicles capable of surpassing this speed to be trapped by the traffic congestion leading to more emissions. A lot of carbon can be seen having deposited on tree-leaves interfering the process of photosynthesis. It also inhibits the process of transpiration. This alteration to the natural processes has posed adverse impacts on plant growth. Carbon particles have caused the increase of hearing problems in human beings. Motor vehicles having large capacities causes rapid depreciation of tires and large consumption of fuel leading to enhancement of air pollution, i.e from the residuals left by the rapidly depreciated tires etc.

The low educational level of drivers and their assistants contributes to air pollution significantly. They lack in knowledge of the speed limit, vibration, as well as the safety of the goods. Most of the drivers have no proper training of technical knowhow, and dangers associated with their occupation. On top of all, most of them are addicted to alcohol. They misunderstand the traffic signals, speed limits and capacities. Most of the agencies providing transportation facilities to harbors and aviation services companies are not up to the



standard. They are agencies with lack of training and technical knowhow, and under the control of political intimidation. Most of the motor vehicles provided by these service providers are not suitable for the demanded transportation service. These vehicles are frequent targets of accidents and breakdowns due to not being assessed timely. These contribute to air pollution. Employing workers having lack of knowledge on the safety of the goods being transported also provides contribution to the air pollution indirectly. Unnecessarily coloring of vehicles causes the release of chemicals to the atmosphere.

The lack of a proper air quality monitoring system to track human exposure is a major limitation. There is still very limited capacity to address air pollution and manage the air quality in districts outside Colombo. Air quality monitoring is routinely conducted only in Colombo and on an *ad hoc* basis in other areas.

2.3 The differences between Sri Lankan and international transportation systems

International service providers and their workforce are well-trained, knowledgeable and are under a set of rules and regulations and rigorous conditions. Inter-organizational coordination is a critical part of planning because most planning involves multiple interacting organizations. There is no such inter organizational coordination among the land, water and air transportation

sectors in Sri Lanka, whereas it is contrary to the rest of the world. In international goods transportation, there is a well-established methodology to follow from the acceptance of goods, loading, transporting, storing and handing over to ensure the safety and responsibility, whereas such a methodology is absent in Sri Lanka. This has damaged the faith of the general public on common transportation, and it leads for selection of individual private transportation facilities. This has



Air pollution in the Colombo city

created unnecessary congestion leading to enhanced pollution such as emissions.

3. Strategic approach to solve the air pollution issues due to transportation

3.1 Methods applied worldwide and their shortcomings

Modification of existing engines or the development of new engine types could reduce pollution from individual engines. Lead can be emitted from petrol and the same octane rating can be maintained by alternative means. More general measures that can be used to reduce exhaust pollution include: the use of smaller engines and vehicles in congested urban areas; the use

of electrically driven vehicles; the improvement of vehicle flow or ease traffic congestion; restriction on the use of private vehicles in the central areas of cities. The smoke pollution can simply be fixed during the routine maintenance of vehicles. The exhaust gas recirculation in engines is also a way of preventing emissions.

In order to reduce urban air pollution, the regulatory agencies have set limits for the maximum amount of pollution that can be emitted from vehicles. To be driven in anywhere in the world, vehicles must meet these standards. Vehicles are therefore tested in a laboratory before it can be initially sold to ensure compliance. In control of ambient air quality in Sri Lanka, it is mandatory to control source emissions as well as non-source emissions. As a

strategy for source emission control, the Central Environmental Authority (CEA) has finalized source emission control standards for Sri Lanka. However, emissions in real-life driving are much higher than emissions measured in the tests carried out in a laboratory. There is a gap between the emissions measured in the laboratory and the emissions in real-life driving conditions of around 50 %. Therefore, emissions measured are usually in non-compliance with emission limits in the real world. It has been revealed that car makers cheat by fitting devices that give different emission values between testing and driving on roads.

An island wide mobile ambient air quality monitoring program was initiated by the CEA by using automated ambient air quality monitoring station provided by Vehicle Emission Test Trust fund. Hence, the government is supposed to pay particular attention to the alarming deterioration of the environmental quality caused by transport activities. It is supposed to take steps to minimize the damage to the environment, especially with respect to air quality. It is also supposed to systematically upgrade the existing system of transport technologies that are less polluting.

3.2. Possible solutions to the air pollution due to transportation in Sri Lanka

In order to tackle air pollution by road vehicles, a number of steps can be followed at the national level. An improved laboratory test cycle has to be introduced. The only way to avoid optimizing and cheating the test cycle is to test vehicles on the road in real-world driving conditions. The real-world driving emissions tests should be implemented using portable emissions measurement systems to ensure that vehicles meet the standards on the road. A framework should be created to help cities implement non-technical measures, low emission zones, congestion charges, etc to reduce road vehicle pollution.

Following simple activities can also reduce the air pollution to a great degree To understand the nature of the goods being transported and the suitability of the packing material of the goods being transported; to control the temperature to suit the goods being

transported; to provide high safety when transporting chemicals and explosive materials; to control the pressure in the surrounding environment as well as inside the packing material of the goods being transported; to provide measures to protect goods being transported from impacts due to the vibration; to store the goods inside the vehicle to suit its capacity; to select trained drivers accordingly; and to update the maintenances of the motor vehicles. Sharing schemes is a simple method to control air pollution from motor vehicles. They cause a net reduction in car use, and thereby leading to the reduction of air pollution. A multi-modal, sustainable transport, which utilizes both public and active forms of transport (cycling and walking), should be encouraged.

Establishing a modern ambient air quality monitoring network covering the busy cities in the country, is important. Enactment of new laws and enforcing existing laws will require reliable baseline data on indoor and outdoor air quality and health impact. Modifying existing regulatory practices and strict adherence to regulations at community and household levels and identifying new mitigation strategies are vital.

According to a research study, to achieve 2035 climate goals, transport emissions should be reduced by 95 %. Further, to reach this goal, passenger cars must be zero carbon by 2050 as aviation is more difficult to be decarbonized. Hence, the replacement of the conventionally fueled vehicles by the electric vehicles should gradually take place within the next two decades.

4. Concluding Remark

In Sri Lanka, oil-based road transportation system is the major contributor to the air pollution, whereas Particulate Matter is the primary pollutant. The poorly-conditioned road network, and the absence of a well-planned public transportation network, well-established monitoring network and the improper traffic control system are the major causes of the environmental issues. Establishing a proper monitoring network to identify the problematic areas is one of the most pressing needs to upgrade the system and decrease the emissions. Changing the peoples' attitudes toward adopting to sharing schemes and the modes of transportation like cycling and walking for short distances, is also a promising approach. Revising the national transport policy towards a 'sustainable transportation system' is a timely need. A sustainable transport system can be achieved only by integrating economic development with the protection of the environment.



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