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Environmental Pollution and consequences in Sri Lanka

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Abstract: Environmental pollution is a severe hazardous status in Sri Lanka. It affects the atmosphere, land, and water in various situations due to the intervention of humans and nature. However, with the unlimited use of resources and harmful and unrestricted control of human beings, the effects are rising daily. Therefore, severe challenges are ahead for Sri Lankans due to environmental pollution. As a developing country, Sri Lanka is moving forward in the economy as an industrial sector, which causes to increase in energy consumption. There is a proportional relationship between energy consumption and wastage. If the percentage of energy consumption is high, wastage also rises. Sri Lanka faces many environmental issues, including inland, water, and air pollution. This report will explore those issues and their impacts on humans, animals, and the environment.

Index Terms: Environment, Air Pollution, Air Quality Level, Solid Waste Pollution, Water Pollution, Sri Lanka

1 Introduction

Sri Lanka is an island that has several natural resources. Due to industrial development, energy consumption has climbed. Considering the electrical power consumption, 578 kWh is consumed. Oil consumption has increased up to 122616 barrels. As a result, significant air pollution has occurred due to non-renewable energy consumption. Improper solid waste disposal has become a big environmental issue, especially in urban areas. It has caused water pollution and solid waste pollution. Therefore, actions are needed to overcome this environmental pollution. Considering Sri Lankan context, overconsumption of natural resources has intense this situation. Attitude change needs to be improved among Sri Lankans to use energy effectively and properly dispose of waste. There are some rules and regulations available for it. Nevertheless, they need to be optimized.

2 Air Pollution

Air pollution is defined as all adverse effects of any sources contributing to the pollution of the atmosphere caused by human interventions and natural phenomena [1]. However, human activities such as fossil fuel combustion play a relatively significant role.

Air pollution has emerged in Sri Lanka due to industrial activities, the number of emission sources such as motor vehicles, and inappropriate garbage burning. Due to deforestation, natural cycles such as the carbon cycle have also been threatened [2]. The sources affecting air pollution by human activities can be categorized into four groups: transport, industry (including power generation), and domestic use. The transport sector is the primary source of Sri Lankan air pollution [3]. Most vehicles use liquid petroleum as

fuel. Road vehicle fleet has climbed from 1983 to 2019 (Fig. 1) [4].

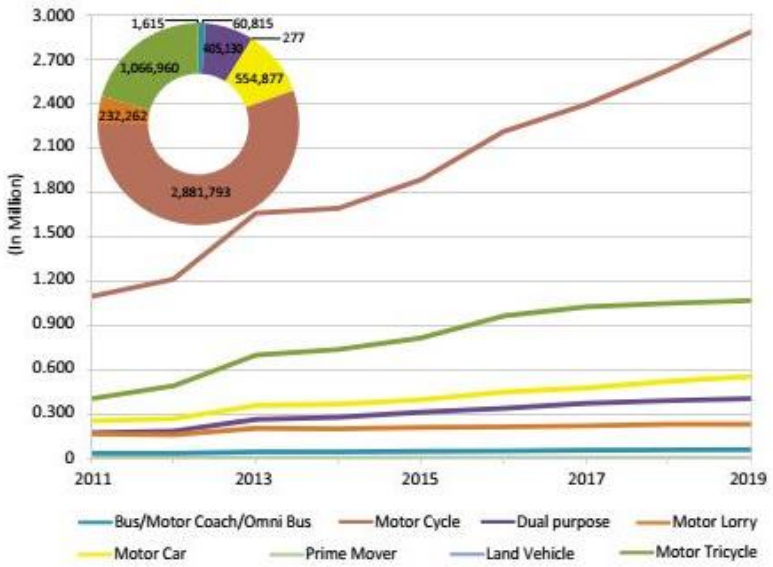

Fig. 1. Active Vehicle Fleet in Sri Lanka

The pie chart of figure 1 illustrates that the active vehicle fleet was reported in 2019 by the Air Resource Management Centre (Air-MAC) of the Ministry of Environment and Renewable Energy. The annual vehicle fleet from 2011 to 2019 was reported in the next chart in Fig. 1.

The active vehicle fleet of Sri Lanka in 2019 was 5203729 vehicles. It is characterized by increased usage of motor tricycles by 21% and motorcycles by 55% [4]. Moreover, Transport fuel demand increased during the 2010 – 2019 period. This increment has impacted air pollution. (Table 1)

Table 1. Vehicle Petroleum Consumption

kt	2010	2015	2016	2017	2018	2019
Gasoline	616.5	1009.0	1463.1	1276.8	1358.7	1421.5
Auto Diesel	1433.8	1815.1	1902.6	1605.3	1568.4	1606.5
Super Diesel	11.5	46.1	86.6	91.5	101.1	81.6

Vehicles emit various kinds of air pollutants, such as Carbon Dioxide, Carbon Monoxide, Sulfur Dioxide, and Nitrogen Dioxide. Consider the power generation sector; a higher amount of electrical energy generates by using fossil fuels in Sri Lanka. 43.18% of electrical energy generates by using coal and 8.46% by other fossil fuels [5]. Thus, a significant amount of greenhouse gases is emitted.

The most common way to municipal solid waste disposal method in Sri Lanka is dumping in improper landfills. As a result of that, many pollutants and hazardous gases such as Methane (CH4), Carbon Dioxide (CO2), Hydrogen Sulphide (H2S), Carbon Monoxide (CO), and other Organic and Inorganic gases generate due to biological reactions in the decomposition of the solid wastes. The leading gases generated during these biological reactions are Methane (40 % – 50%), Carbon Dioxide (about 50 % – 60%), Carbon Monoxide, and others at trace levels [6].

Due to the photosynthesis process, Carbon dioxide, a significant air pollutant, can be converted into Oxygen gas. Since deforestation, natural forest cover has dropped dramatically from 80% to less than 16%

over the last 100 years. Some development projects were supported to demolish the natural forest cover by up to 20% in 2007 [2]. The remaining forest cover is insufficient to absorb the carbon dioxide emitted by the transport and industrial sectors.

The negative impact of air pollutants on living organisms is not limited to human and animal health but also the whole environment.

Global climate changes and environmental variations affect human civilization and wildlife. There are major air pollutants that can be identified in Table 2 [7].

Table 2. Major Air Pollutants [7]

Class of pollutant	**Example**
Oxides of carbon	Carbon monoxide, Carbon dioxide
Oxides of nitrogen	Nitric oxide, Nitrogen dioxide
Oxides of Sulphur	Sulfur dioxide, Sulphur trioxide
Particulates	Dust, soot
Photochemical smog	Ozon, Peroxy nitrates
Hydrocarbons	Benzene, Benzopyene
Inorganic compounds	Lead

According to the World Health Organization, Particle pollutants, ground-level Ozone, Carbon Monoxide, and lead are the major air pollutants that harm human health and the ecosystem [1].

In the Sri Lankan context, there are a couple of air quality monitoring stations located at Colombo Fort railway station premises and other meteorological department premises [8]. Moreover, air quality levels are also monitored by some other organizations, such as the U.S department of state and Cleco (Pvt) Limited [9]. Air quality can be measured by using the Air Quality Index (AQI). The AQI is an option for interpreting changes in the amount of pollution in the air. It uses standardized ambient pollutant concentrations to yield individual pollutant indices, which were then weighted and summed to form a single total air quality index. AQL can be tracked by five significant pollutants: carbon monoxide, sulfur dioxide, nitrogen dioxide, ground-level ozone, airborne particles, or aerosols [10].

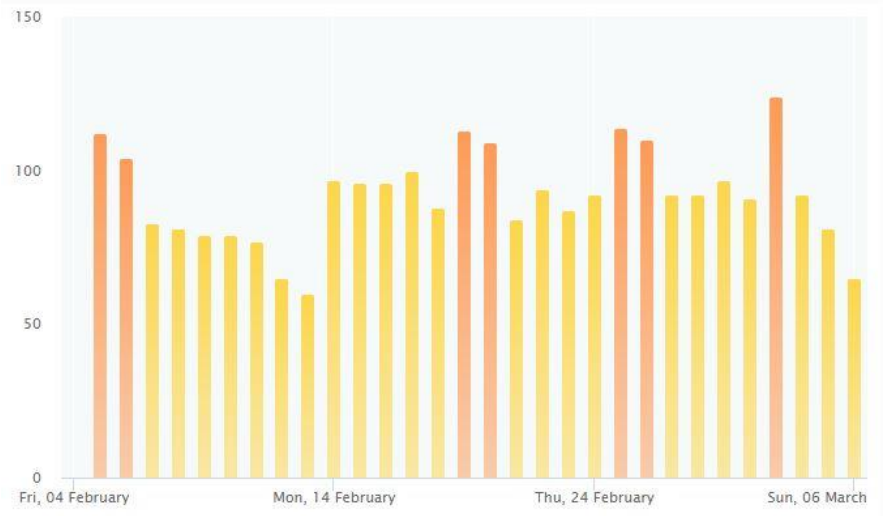

Fig.2. AQI Level in Colombo

The air quality index of Colombo (Location: US Embassy of Colombo) has been gathered and given in the following graph in Fig. 2 from 04/04/2022 to 06/04/2022 [9].

It has been observed that Total Suspended Particles (TSP) levels and non-methane hydrocarbons (NMHC) have exceeded the WHO air quality standard in Colombo and Kandy areas. PM10 concentration is shown to increase and fall within 50-120 µg m-3 exceeding the Sri Lankan annual air quality standard [3].

Table 3: Standard levels of air pollutants, their sources, impact

Air pollutants	The primary source of emission	Averaging time	Standard level	Health impact target organs
Particle pollutants ($PM_{2.5}$, PM_{10})	Motor engines, industrial activities, smokes	24 h	35 µg/m^3	Respiratory and cardiovascular dysfunctions, cancer
Particle pollutants ($PM_{2.5}$, PM_{10})		24 h	150 µg/m^3	
Ground level ozone	Vehicle exhaust, industrial activities	1 h	0.12 mg/m^3	Respiratory, cardiovascular dysfunction, eye irritation
Carbon monoxide	Motor engines, burning coal, oil, and wood, industrial activities, smokes	1 h	35 mg/m^3	CNS and cardiovascular damage
Sulfur dioxide	Fuel-burning, burning coal	1 h	75 µg/m^3	Respiratory and CNS involvement, Eye irritation
Nitrogen dioxide	Fuel-burning, vehicular exhaust	1 h	100 µg/m^3	Damage to the liver, lung, spleen, and blood
Lead	Lead smelting, industrial activities, leaded petrol	3-month average	0.15 µg/m^3	CNS and hematologic dysfunction, Eye irritation
Polycyclic aromatic hydrocarbons	Fuel combustion, wood fires, motor engines	1 year	1 ng/m^3	Respiratory and CNS involvement, cancer

Globally, air pollution is a leading cause of death and disease. Ambient air pollution is responsible for an estimated 4.2 million premature deaths, primarily due to heart disease, stroke, chronic obstructive pulmonary disease, lung cancer, and acute respiratory infections in children. Air pollution is responsible for 29% of lung cancer fatalities worldwide, 25% of deaths from ischemic heart disease, and 43% of chronic obstructive pulmonary disease deaths.

Particulate matter (PM10 and PM2.5), SO2, CO, NO2, and O3 are all pollutants of public health concern.

The WHO's International Agency for Research on Cancer has now classified fine particles (PM10 and PM2.5) as a cause of lung cancer. In Sri Lanka, People who live in cities and those who live roadside expose to traffic pollutants constantly. Passengers on public buses with open windows traveling through congested urban areas also expose to the pollution emitted by vehicles [3].

3 SOLID WASTE POLLUTION

Municipal Solid Waste (MSW) is simply known as trash or garbage. Solid waste is one of the waste types consisting of everyday items discarded by the public. MSW consists of food waste, Plastics, Glass, Cardboard, and other materials that remove as trash. The composition of MSW varies from place to place and changes significantly with time. Most definitions of MSW do not include industrial waste, Agricultural waste, medical waste, radioactive waste, or sewage sludge. The MSW consists only of waste generated by household sources [11].

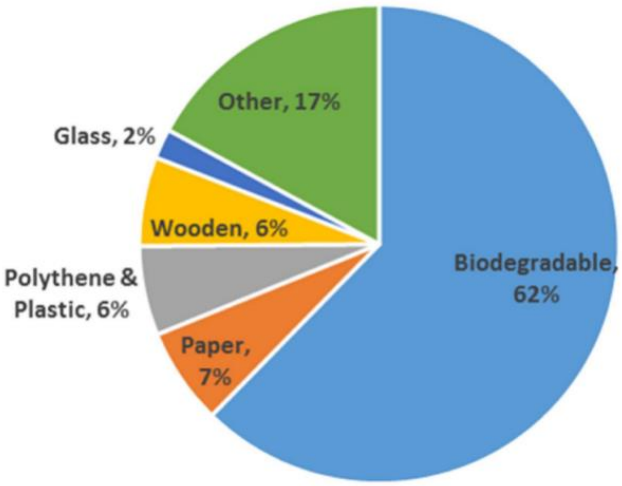

Fig.3. Waste composition in Sri Lanka [12]

Fig..4. Bloemendhal [13]

The pie chart of figure 3 shows the average waste composition generated in Sri Lanka. The MSW composition of Sri Lanka is 62 % biodegradable wastes, and the other 38 % consists of non-biodegradable materials. Currently, the reason for an increase in the generating of MSW is population growth and urbanization. The total amount of solid waste generated by Sri Lanka is around 7000MT daily. However, the municipal council collects only half of them for proper garbage disposal. Most of the waste generated in the Colombo Municipal area accounts for 0.8kg of solid waste per person [12].

Due to improper waste management practices, several open dumpsites are available in almost all urban areas in Sri Lanka. Figure 4 shows that the Blumendhal open dumpsite is located in the western province of Sri Lanka.

Fig.5. Meethotamulla [13]

Fig. 5 represents Meethotamulla open dumpsite which was a strategic disaster that occurred. It was an unfortunate result of improper waste management. Therefore, it is essential to take sustainable action on waste management. Solid waste management is an essential part because the generated solid waste pollutes the environment and affects humans. Most countries use landfilling methods to manage MSW. Solid waste management helps to reduce improper disposal of MSW, and better management of MSW reduces environmental pollution. Solid waste management processes are used in different ways [11].

Fig.6. Improper ways of disposing of solid waste [13]

Fig. 6 shows one of the improper municipal solid waste disposal practices in the Gampaha district, Sri Lanka. A technological approach to solid waste management began to develop in the latter part of the 19th century. Initially, watertight garbage cans were introduced, and sturdier vehicles collect and transport solid waste. As a disposal method, use open dumping on land or water. Technological advances continued during the first half of the 20th century; open dumping replaced sanitary landfilling because open dumping causes pollution. Recycle, Reusing and Refusing are the other ways to manage solid waste.

Fig. 7. First Sanitary Landfill at Dompe, Gampaha

As a pilot project, Korea International Cooperation Agency (KOICA) granted LKR 600 million as an aid for the program, and it was implemented through the "Export Development Cooperation Fund" (EDCF) for sanitary landfills and small-scale composting plants. The second landfill is constructed at Dompe, shown in figure 7, at the US $ 4.5 million as a grant with a counterpart funding of US $ 1.5 million. Project Started operation in 2014 (5-10 T/d and recently increased to 50 t/d) [13].

4 WATER POLLUTION

Pollutants in water Organic matter, nitrates, and phosphates are discharged directly into water sources by industrial and agricultural activities. It causes blue or green algae to bloom (Macrocystis). Toxins released by water pollution are dangerous to both humans and animals. The following are examples of water pollutants:

-Microorganisms that cause disease
- An overabundance of nutrients (nitrogen, phosphorus, potassium)
- Cadmium, chromium, mercury, nickel, and lead are examples of heavy metals.
- Organic Pollutants (Polychlorinated biphenyls, polyaromatic hydrocarbons)
- Biodegradable Organics
- Pollutants in the microcosm (medicines, cosmetics, cleaning agents, dyes)
- Water pollution was measured using lead (Pb), mercury (Hg), arsenic (As), chemical oxygen demand (COD), ammonia-nitrogen (NH3-N), and volatile phenol concentrations.

Untreated effluents contaminate drinking water in developing countries, resulting in 14,000 deaths daily. Increased health risks are a result of water resource depletion and deterioration.

- The depletion of water resources is a significant issue affecting the country's dry zone. Due to the rising demand for agriculture, industrialization, and rapid urbanization, water resources in the wet zone are rapidly diminishing.
- One of the country's major environmental problems today is the degradation of surface and groundwater resources. A polluted well in Jaffna is shown below

Fig.8. Polluted well in Jaffna.

Fig. 8 is an image of a polluted well in Jaffna.

- Polluted water kills many fish species, especially those eaten by humans. Even living fish suffer side effects in this situation.
- Water pollution is harmful to people's health as well as the health of animals and plants.
- Disease carriers such as bacteria and viruses are transmitted to the surface and groundwater.
- Polluted water can pollute drinking water, posing a health risk.
- Algae and weed growth that is out of control (plant nutrients, including nitrogen, phosphorus, and other substances, are created by the waste and support the growth of aquatic plant organisms).
- Contaminated water is responsible for the water's scent, flavor, and color.
- A body of water's ecological balance shifts.
- Acid rain is caused by sulfur dioxide and nitrogen oxides, which decreases soil pH and carbon dioxide emissions. It contributes to the acidification of the ocean. The pH of the Earth's seas is continuously decreasing as CO2 dissolves.

In Sri Lanka, air pollution mostly happens in the transportation sector. To minimize air pollution in the transportation sector, shift to eco-friendly transportation like electric and hybrid vehicles. Avoid the travel times in the car and move to the carpool method. Regular use of bicycles and walking whenever possible improve public transport. Keep tuned car and other engines, and ensure the tires are inflated. Moreover, face mask has become essential, so promoting and wearing a high-quality face mask will avoid air pollution and help minimize diseases related to the respiratory system.

Afterward, burning fossil fuels could increase the percentage of greenhouse gases in the atmosphere. Avoid using fossil fuels like non-renewable energy and shift to renewable energy sources such as solar and wind. Conserve energy consumption at home, workplace, and everywhere by producing clean energy. It helps to prevent energy consumption and good habits from using more efficient devices such as conserving electricity. Such as lowering the air conditioners to 78 F degrees, switching off unnecessary lights in daylight and nighttime, and reducing fireplaces and wood stoves already in use.

Mass media should be aware and educate people about indoor and outdoor air pollutants and reduce them; mass media play a significant role in the country, so it has primary responsibility. Furthermore, regular monitoring and maintenance of a desirable level of air quality can assess air quality. Therefore, maintaining air quality is essential.

The Clean Air Sri Lanka (CleanAirSL), hosted by the Air Resource Management Center (AirMAC), was established in 2004 as a nonprofit organization against air pollution. This organization has main objectives [15],

• Assist all government agencies in implementing their mandated activities in air quality management programs and climate change mitigation/ adaptation programs
• Strengthen and build the capacity for air quality management
• Develop policies and programs for air quality management
• Promote and facilitate air quality research
• Provide advisory services for air quality management-related activities

The CleanAirSL keeps track of the factors influencing air quality and trends, impacts, and solutions that work for better air quality in Sri Lanka.

When industrial pollutants are released into the water bodies, the proper standard limitation is to discharge effluents into inland and marine water, and industries must follow them. An awareness program should be organized about water pollution among fishermen and schoolchildren. Proper monitoring and maintenance programs should be initiated to identify the water pollutants released directly or indirectly into water bodies. Actions should be taken to reduce the damage to water resources. A government should follow proper coordination between government and private sectors to minimize the effect of water pollution by basic land activities. Legislative regulations should minimize water pollution by tourism, harbors, and ports.

In the agricultural sector, pesticides and chemical fertilizers are regularly used. However, there are no limitations to using those chemicals. To gain more profit as well as get the harvest in a short time, farmers are using chemicals without proper limitations. So, the department of agriculture should give the proper standards and limitations. Instead of that, in Sri Lanka, most of the farmers are doing inorganic farming. In the agricultural sector, water pollution could happen in this section. Farmers can shift to organic farming instead of inorganic farming to minimize water pollution.

Usage reduction of plastics, reusing, and recycling can prevent water pollution. Avoid the disposal of oils into the sink, clean chemicals, do not throw away medicine dispose of it properly, reduce the use of detergents and bleaches and move to environmentally friendly detergents, clean up litter, and get organic food regularly are the method of minimizing water pollution in households.

There are government regulations under national environmental ACT No.47 of 1980 to maintain the water quality in water resources [16]. It said that,

- No person shall discharge, deposit or emit any pollutant into the inland surface waters to exceed the Ambient Water Quality Standards concerning the categories specified in the schedule hereto.
- The authority shall be responsible for maintaining the quality of inland surface waters to ensure compliance with the standards in the schedule hereto.

Trash is generated each year in Sri Lanka indoors and outdoors, so the above evidence confirms that solid waste in Sri Lanka is significantly rising daily. To minimize solid waste as a human, we have much more to do with the 3R concept: reuse, reduce, and recycle. Reduce the amount of waste that collects indoors by using reusable bags instead of plastic bags, refillable containers for filling water instead of plastic bottles, and use recycled paper and cardboard instead of using plastic and polyethylene materials. Set a goal for producing the amount of trash generated per week by clean production. Reuse clothes, packing materials, and plastic containers, and separate all recyclable items.

Waste segregation and composting are other methods for reducing collecting solid waste. Urban councils should be aware of programs and educate and supply resources to people to segregate household wastes. Give separate trash bags and bins for each plastic material, glass, paper, and perishable material. To do that properly, they enforced a policy not to collect waste that is not adequately separated. Moreover, MSW

compost in a compost plant under proper conditions. Initially, the biodegradable waste is kept in bins until it becomes naturally decomposed. Then the composted waste is moved to a machine to reserve compost. The remaining waste is going to the dump yard for the separation process. In households, composting can be done using compost bins. Afterward, public awareness programs should be organized by local authorities to encourage inventors to innovate new methods for reducing waste generation.

The national environmental ACT No.47 of 1980 mentioned the regulations of MSW.

- No person shall dump MSW along the sides of any national highway and dump solid waste at any place other than places designated for such purpose by the relevant local authority or any person or body of persons authorized by them on that behalf.

Any person contravening the provisions of these regulations shall be guilty of an offense punishable under section 31 of the Act under Sri Lankan law.

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