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REVIEW ARTICLE **OPEN ACCESS**

Review on Soil Contamination of Heavy metal on the roadside due to automobile pollution

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ABSTRACT:
Contamination of the regular habitat by heavy metals is a general issue because these metals are indestructible and the vast majority of them harmfully affect living organic entities when permissible levels are surpassed. Due to exposure for a long time and at low-level Heavy metal toxicity is increasing in today's scenario. Exposure to various harmful heavy metals is related to numerous persistent illnesses and can cause a wide assortment of medical conditions. Metropolitan soils get differing contributions due to heavy metals from an assortment of versatile or point source, for example, roadways traffic, modern plants, power age offices, private oil-consuming, squander burning, development and destruction exercises, and re-suspension of encompassing sullied soils and makes a critical commitment to the contamination in the metropolitan climate. Vehicle depletes, as well as a few modern exercises discharge these heavy metals so that specks of dirt, plants, and even inhabitants along streets with heavy traffic loads are exposed to heavy metals at expanding levels. Roadside soils frequently show a serious level of pollution that can be credited to engine vehicles. The proportion of the synthesis of the dirt additionally fluctuates in various areas of the biosphere as the street side soil is more contaminated than the dirt of any park or any ranch or field. This variety is more striking in metro urban areas of India, for example, Delhi due to immense modern and car advancements. Thusly, the investigation of metropolitan soil is significant for deciding the beginning, conveyance, and level of heavy metal defilement in metropolitan conditions. Present paper deals with the review on Soil Contamination of Heavy metal on the roadside due to automobile pollution. The purpose of this paper is to create awareness among policymakers against vehicular heavy metal pollution because it is rarely monitored.
Keywords*: Heavy Metals, Roadside soil, Pollution, Urban Areas*

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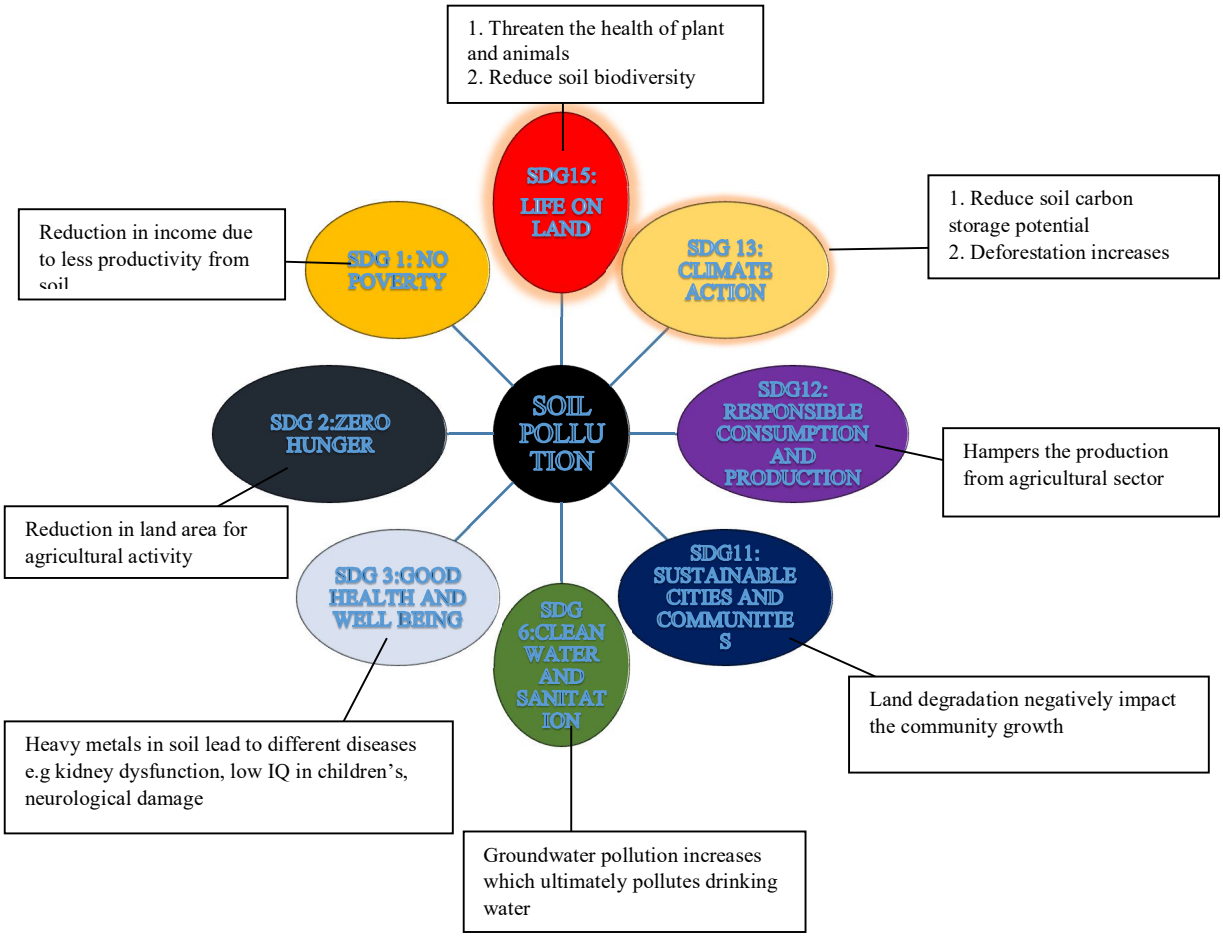
INTRODUCTION

Soil is a non-sustainable asset, created at a pace of a couple of centimeters every thousand years. It assumes a basic part in supporting biological systems and human culture by giving a living space to most of the species present on Earth and as the vehicle by filling in for crop production [1]. However, soil degradation is increasing at an alarming rate due to several anthropogenic activities [2]. Even the eighth goal out of 17 Sustainable Development Goals set by the United Nations are based on soil environment (Fig. 1) [3], but due to the degradation of soil these goals are at greater risk and a major challenge also to be achieved by 2030 because the loss of agricultural soil put the major population at greater risk of poverty and malnutrition [4].

Similar to fundamental pieces of the biological systems, soils give off an impression of being the principal retention point in the natural chain that can inactivate and obliterate environmentally risky substances, can be a channel for decontaminating the waters, and after the seas be the greatest sink for CO2 and different gases. Nevertheless, its unique abilities such as higher stability and relative immobility, The contamination with toxic substances can be constantly, progressive in time, and with concentrations exceeding the acceptable thresholds, can results in deterioration of soil function and the critical loads of contaminants can lead to her fully degradation and desertification (*EEA Annual Report 2000 — European Environment Agency*, n.d.). The main contaminants are the heavy metals (trace metals; potential toxic elements -PTEs), particularly heavily manifested in the towns, around industrial centers and roads.

Figure 1: Interrelationship between Sustainable Development Goals and Soil health.



These metals have exceptional properties such as low radioactivity, high density, polyvalent in their chemical nature and the most problematic property is non degradability in the soil. The heavy metals persist for longer period in the soil [5].There are different sources of heavy metals in urban areas Due to high population density and intense and various types of anthropogenic activities, the source of heavy metal in urban areas are more [6].The contamination of soil occurs with heavy metals due to the transport of contaminants from the sources like industrial discharge, vehicle emissions, waste incineration, and other activities which are increasing due to the rapid development of the economy and society. Soil near the highways and local roads are most vulnerable to heavy metal pollution as dust from the roadside soil is major source of heavy metal pollution. Due to movement of vehicles and wind various components like pollen, pollen fragments, mould spores get mixed with road dust, however with fine dust which remains in the environment and can cause hazardous effects some heavy metals gets associated. Top soil from roadsides and street dusts are the indicators of heavy metal contamination from atmospheric deposition especially from urban areas. Heavy metals namely chromium (Cr), mercury (Hg), lead (Pb), copper (Cu), arsenic (As), cadmium (Cd), zinc (Zn), nickel (Ni) are major soil pollutants. Heavy metals contamination is biologically toxic, widely distributed, and persists for longer period in soil environment. Some of the sources of key heavy metals are leaded gasoline releases Pb, car components, lubricants, tyre abrasion and incinerators emits Zn,Cd and Cu [7]. Chrome plating and corrosion of cars release Ni and Cr in street [8] respectively. Due to the increasing rate of anthropogenic activities such as the pesticides use, and fossil fuel burning, industrial activities' concentration of Arsenic is also increasing in the environment [9]. A study was conducted in Delhi city for the analysis of the accumulation of some heavy metals i.e Co, Cr, Fe, Mn, Ba, Ni, Pb, Cu, and Zn in road dust samples due to different activities. The findings of this study show that the order of occurrence of metals based on concentration levels in road dust is Fe>Ba>Mn>Zn >Cr>Cu >Pb>Ni>Co [10]. It is very important to investigate the street dust because of two reasons [11]. First, people residing near the streets or roads and those traversing the streets are freely inhaled the street dust, if this dust is contaminated with metals it will cause health hazards to those people who get exposed to the street dust. Second, during the rainy season, the dust from the streets or roads gets discharged into the adjacent water body and could contaminate the drinking water. Sometimes

it gets concentrate in the sediments of coastal area and contaminates the marine water bodies and can cause death of marine life or could have toxic effects on the health of individuals those who consume this seafood contaminated with heavy metals. Generally, high concentration of heavy metals in the environment causes health hazards such as affecting cardiovascular, nervous, blood circulation and reproductive systems. Some of the other health effects include attention deficit disorder, reduction in intelligence level, and behavioral abnormality in adult population. In recent years, there is a growing concern for the potential hazards of heavy metals in soil. Therefore, it is most imperative to understand the pollution level burden due to heavy metals in soil of urban areas especially in roadside soil and its detrimental effect on soil, plants which ultimately effects human health. Due to extent of health hazards caused by heavy metals it is the need of hour to study the heavy metal pollution in soils.

SOURCES OF HEAVY METALS IN DUST AND SOIL OF ROADSIDE

Heavy metals can be added to the environment both from natural activities as well as human activities which act as there sources. Heavy metals source from nature can be found in volcanic activities, burned vegetation, and rocky soils. Most regions around the industrial sites, traffic highways, and urban areas are mostly contaminated with heavy metals pollution(H. Li et al., 2013). A wide range of literature described that different sources like industrial areas, vehicular traffic,etc are associated with contamination of street dust [12]. Nowadays, the population living in urban areas is mostly affected by heavy metals pollution the reason is increasing in the number of motor vehicles and congestion due to it [13]. There is a significant correlation between traffic emissions and contamination of road dust and roadside soils with heavy metals (Ramakrishnaiah&Somashekar, 2002). Cu, Fe, and Cr emitted from brake wear and Pb, Mn, Co, Cd, and Ni emitted from tailpipes from vehicles are present in road dust [14].

A prominent source of Zn in roadside soil and street dust is tire wear and abrasions (Johansson et al., 2009). Due to the presence of sufficient literature, it is evident that the heavy metals concentration in roadside soil is associated with traffic but the evaluation of point sources is difficult reason beingthe presence of other non-point source like sewage sludge, industry emission, etc.

HEAVY METALS AND SOIL MICROBIAL COMMUNITY

Soil without plant biomass is a lifeless mass only left with minerals and organic residues. However, desert soils that seem to be lifeless contain microbial communities in abundance like fungi,bacteria, actinomycetes,viruses, and protozoa. Soil is the reservoir of both beneficial and pathogenic microorganisms. Due to the increasing rate of soil pollution from various sources like vehicles, and industries imbalance of this microbial community happens and ultimately it leads to soil degradation. Therefore it is the need of the hour to assess the source of soil pollution to prevent the soil and soil microbial community. The stability, resilience, and soil microbial community functioning regulate the integrity of the belowground and aboveground ecosystems (III, 2020). Only 0.5% of the soil mass is occupied by the microorganisms but their impact on soil properties and processes is much more than we think. If due for some reason soil microbial community gets destructed then it ultimately causes the death of animals and plants population associated with aboveground and belowground biomass [15]. Soil microbial community reacts to the presence of heavy metals depending on their concentration in the soil which shows the direct and indirect impact on microorganisms. For example, some metals such as Fe, Zn, Cu, Ni, and Co at low concentrations are of crucially importance for microbial activities at large. If the metal does not have any biological importance it can be tolerated in low concentrations and if it is an essential metal it can be tolerated in high concentrations [16]. Other Adverse The heavy metals effects adversely on soil microbes including reduction in soil respiration and other enzymatic activity, a decrease in soil microbial diversity, and a reduction of these major activities leading to the degradation of soil [17]. For example, soil contaminated with copper metal affects the activity of those microorganisms which take part in the nitrification and mineralization of protein compounds [18]. The microflora of soil also get affected due to increased concentration of lead in the surface layer and the source of lead is the aerial emission from combustion of petrol containing tetraethyl lead which ultimately increases the Pb content in of urban areas soils and areas which are next to the major highways and roads [19]. It is evident that microorganisms dwell in soil except fungi were lesser in number in heavy metal polluted soil than in uncontaminated soil [20]. So it is revealed that the sensitivity to bacterial community is more to heavy metal pollution in compare to fungal community. Heavy metal pollution brings about a decrease in microbial biomass and regardless of whether they are root to the decrease in their number, or they diminish the local biodiversity and by upsetting the local area structure.

HEAVY METALS AND PLANTS

Like each living organic entity, plants are many times delicate equally to the inadequacy and to the overabundance, accessibility of a few heavy metal ions e.g Cd, Hg, etc as vital micronutrients, however the

same with higher concentrations are toxic to the activities especially metabolic. Research has been conducted throughout the world to determine the effects of toxic heavy metals on plants. Some of the heavy metals are essential for the growth of plants and are present in the soluble form or solubilized by root exudates. When heavy metals are present in high concentrations the plants uptake they along with essential metals and then they cause direct or indirect effects on some growth parameters direct effects such as inhibition of cytoplasmic enzymes and oxidative stress and indirect effects such as disturbance of cation exchange process [21]. The effects of vehicular pollution can be visible on various physiological parameters of plants [22]. Absorption of heavy metals by soil alters its pH which ultimately affects the anatomical, reproductive, and physiological attributes of plants [23]. Studies also show that heavy metals from automobile emissions adversely affect the reproductive parts of plants [25]. [24] Studied that Heavy metal pollution affects seedling growth and germination of roadside vegetation. The toxicity due to the presence of Pb decreases the seed germination rate (Wang et al., 2020).
Plants require heavy metals at optimal conditions for their growth but when the concentration of heavy metals exceeds the optimal level then they adversely affect the plant both directly and indirectly as shown in table 1:

Table 1: Heavy metals and their phytotoxic effects

S.No.	Metalspecies	Symptoms of Phytotoxicity	Reference
1.	Cd	Chlorosis, necrosis, growth inhibition, and browning of root tips	[32]
2.	Pb	Inhibition of chlorophyll biosynthesis, photosynthesis, and enzymatic activities	[33]
3.	Cu	Leaf Chlorosis, Oxidative stress, ROS, root malformation	[13]
4.	Zn	Causes Phosphorous deficiency, reduces chlorophyll, carotenoids, and amino acids	[19]
5.	Hg	Effects the mitochondrial activity, disruption of biomembrane lipids, causes chlorosis	[34]
6.	Cr	Induction and activation of superoxide dismutase (SOD) and antioxidant catalase, decrease in plant nutrient acquisition	[28]
7.	As	educes fruit yield, decreases the leaf fresh weight, stunted growth, chlorosis, and wilting	([2]

HEAVY METALS AND HUMAN HEALTH

Contamination of soil, air, dust, and plant by heavy metals is a worldwide problem that adversely affects the population's health [26]. Generally, the heavy metals accumulation in urban soils shows its effects on human health and the extent of health effects depends on the factors such as concentration of metals, bioavailability, socioeconomic and personal health status, etc.[27]. Therefore, it is important to establish the limits and levels of heavy metal contamination in roadside dust as well as identification of sources of heavy metals and their profound impact on human health.For instance, in a study in Guangdong Province, China, it was revealed that the major source of heavy metals i.e Pb, Zn, and Cu is emission from vehicles, and the source of Hg and Cu is industrial effluents and urban wastes [28] According to the WHO, increasing Nickel concentration in humans may lead to respiratory and nasal tract cancer and may lead to cardiovascular disease and kidney defects. Many research discussed the pollution problem in Iraq, and it was found that levels of heavy metals increased in soil, air, and water due to anthropogenic activities such as agricultural and industrial activities, as a result, there was an increase in several health disorders e.g emphysema, asthma, bronchitis, cancer, pneumonia, etc.[29]. It is also studied that long-term exposure to soil heavy metals (toxic metals) has mainly caused an acute threat to environmental pollution and they have proven health effects as they enter the human body through ingestion, dermal contact, and inhalation [30]. In India, the major heavy metals are As and Cr that cause potential health risks in town region residents, which draws attention and needs to take care off by initiating control measures [31].

CONCLUSION

It is clear from the current review that street residue and side-of-the-road soils are getting polluted progressively as heavy metals are persistent in soil and even in numerous nations, their concentration has crossed the acceptable limits. A few urban communities all over the planet have been unfavorably impacted by heavy metals like Cd, Cu, Cr, Ni, Co, Pb, Zn, and Fe, particularly because of heavy traffic in metropolitan regions as opposed to nonindustrial regions. There is a need for monitoring of soil near the

highways and roads to reduce the heavy metal pollution environmental issue. It is evident from this review that the concentration of heavy metals has a close relation with road traffic i.e high concentration of heavy metals was found near the road and concentration decreases as the distance increase from the highways. These assessments of roadside soil for heavy metals will be used to raise awareness of the pollution in the vicinity of highways which is very important because the contamination of soil will ultimately harm the population residing near the highways as these heavy metals transfer throughout the foodchain. Thus, an easement must be taken into account to avoid such contamination.

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