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Air Pollution Tolerance Index and Heavy Metals Accumulation of Tree Species for Sustainable Environmental Management in Megacity of Lahore

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Abstract: Urban air and soil quality has been deteriorating during the past few years due to urbanization, industrialization and increased number of vehicles. The goal of the current study was to assess the Air Pollution Tolerance Index (APTI) and heavy metal absorption (Pb, Cd, Zn, and Ni) potential by ten selected trees planted along the roadside in the metropolitan city of Lahore, Pakistan. APTI was estimated on the basis of biochemical parameters (chlorophyll content, ascorbic acid, pH and relative water contents) of plant extract, while heavy metals (HMs) accumulation potential was measured by a digestion method. The highest APTI was estimated in *P. longifolia* (78.9), followed by *A. scholarils* (75.9) and *M. indica* (71.9). Overall, these three species have significant closeness among the higher pollution-tolerance results. The poor APTI result was determined in *F. religiosa* (19.5) and *E. citriodora* (14.9). The highest Pb contents were observed in *P. longifolia* and *M. indica* i.e., 135 and 132 mg/kg, respectively. Similarly, the highest Zn contents were found in *P. longifolia* and *S. cumini* with 130 and 132 mg/kg, respectively. The Ni concentration was observed highest in *P. longifolia* (34 mg/kg), but in the remaining species, it is almost the same trend of Ni accumulation. Combining these trees can be useful for fostering green-belt growth along roadsides to reduce air and soil pollution and achieve environmental sustainability. But unfortunately, these species are not planted well across the roadside as they have very little biodiversity index, as compared to other species. These species should be planted in urban areas to enhance biodiversity in the urban ecosystem and make them sustainable cities and communities.

Keywords: urban ecosystem; urban greening; pollution control; sustainable cities; environmental management

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1. Introduction

In recent years, urbanization has been increasing rapidly and emitting CO_2 emissions, pollution load and toxic heavy metals (HMs) into the environment. In the context of highly urbanized and industrialized regions, Pakistan, as the most urbanized nation of South Asia, contributes very little to global warming but is extremely susceptible to climate change. Urban air pollution is mainly caused by the release of gaseous pollutants from urban transportation and industrial activities containing heavy metals, air pollution, including SO_x, NO_x, CO, heavy metals and especially particulate matter (PM). In the soil, organic materials, carbonates, and minerals frequently absorb heavy metals. Therefore, emissions from industrial facilities and automotive exhaust could have an impact on the composition of the soil and air [1–3]. This leads to a rise in soil pollution along with air pollution; therefore, monitoring air quality is a significant indicator to enhance urban life and shift towards sustainable urban development [4].

The Air Quality Index (AQI), which is based on the measurement of main pollutants (ground-level ozone, CO, NO_2, $PM_{2.5}$, $PM_{10,}$ and SO_2), states that the air quality in Lahore is among the worst in the world and reaches unhealthy levels on most days. Lahore is ranked as the second-most polluted city in the world in terms of $PM_{2.5}$ and PM_{10}, according to pollution level [5]. Road traffic is also the main cause of severe air pollution in Lahore city as reported by [6]. Road traffic was found to be closely linked with particulate matter (PM). Heavy traffic on the road causes emissions of nitrogen oxides (NO_2) and carbon monoxide (CO). The city of Lahore's air quality has been declining with each passing year. Therefore, it is essential that all key institutions and stakeholders work together to find a solution before the problem develops into permanent harm to both people and the environment [7].

Roadside trees offer many environmental advantages which include the safety of nearby watersheds, improvement of hurricane water management, mitigation of the city heat island effect, reduction of noise pollution and supplying social benefits [8–10]. Roadside vegetation absorbs nine times greater pollution than avenue-remote timber and converts harmful gases back into oxygen [11]. Therefore, the right mechanism with careful interest is needed in deciding for selection of suitable trees along roadsides for greenbelt development [12–15]. Air Pollution Tolerance Index (APTI) is a critical parameter for contamination alleviation and it depends on the biochemical constituent of plants, such as pH, chlorophyll substance, relative water content and ascorbic corrosive. APTI communicates the capacity of plants to counter the unfavorable impacts of air contamination. Moreover, APTI is helpful to screen and identify the plant species that are more suitable for the mitigation of air pollutants, as to balance the social-aesthetic aspect [16–20]. In a study, APTI of various tree species was studied, out of which the Peepal tree was found to be most tolerant to PM10 [21]. APTI value shows the capacity of plants to counter air pollutants. Air-contamination control is complex than managing other ecological problems. No physical or compound strategy is known for controlling air contamination. Appropriate choices might be utilized to foster an organic technique by developing green belts in and around metropolitan regions [22].

Trees are known to be bio-monitors, especially in urban areas which monitor the concentration of heavy metals by accumulating them in various organelles present in roots, fruits, barks and leaves. Trees can improve the mental health of communities and relieve stress [23,24]. Apart from this, plants are also capable of absorbing the metal contaminants in soil into their aboveground biomass [25]. However, different species of the plant offer the varying potential for heavy-metal accumulation, and thus, determination of the exact plants capable of heavy metal accumulation in an area is necessary. For instance, in a study, Zinc (Zn), Copper (Cu), Lead (Pb) and Cadmium (Cd) were identified as bio-accumulators through leaves of various selected tree species [26,27]. HMs accumulation by trees can give valuable data for checking networks and can streamline the logical assurance of HMs. Also, trees can reflect the aggregate effects of HMs pollution on the surrounding air and soil. The presence of heavy metals is crucial for the growth of plants, but their extreme quantity employs toxic impact on trees [28]. No doubt, a major tactic to reduce air pollution is to properly plant trees along roadways and across industrial zones. However, throughout the previous ten years, the air quality in metropolitan places around the world has been progressively worse. After a significant scientific discussion over the best tree species for pollution mitigation, there is a lack of maintained trees that meet the recommendations.

In light of environmental sustainability, the objective of the current study was to assess the Air Pollution Tolerance Index (APTI) and heavy-metal-accumulation potential of ten selected tree species planted along the roadsides of five major roads of a highly urbanized and polluted city of Lahore. A comparison was conducted to identify the best species towards the three-pollution monitoring and mitigation parameters; thus, the plantation in urban areas with similar climatic conditions, such as the study area, can be properly managed with more focus on planting appropriate species for pollution mitigation rather than a plantation of random species. This study will be significant and useful for policymakers and urban planners in recommending relevant and suitable tree species for sustainable urban development.

2. Materials and Methods

The current study was carried out in Lahore, Pakistan's second-largest metropolis after Karachi and the capital of the Punjab province. Lahore has an extremely hot, semi-arid climate (Köppen BSh), with a diverse spectrum of public outdoor places. In Lahore, the average yearly temperature is 30 °C. June is the hottest month of the year, with an average temperature of 37 °C. January is often the coldest month in Lahore, with an average temperature of 21 °C. The temperature difference between the warmest month, June, and the coldest month, January, is 16 °C. Lahore has a semi-dry climate, with an average annual precipitation of 838.8 mm. Lahore's air-quality index is 161, with $PM_{2.5}$ as the predominant pollutant, and the air is considered bad by the US AQI. Lahore's air pollution is generated by a combination of automobile and industrial pollutants, as well as smoking [29]. Lahore is a fast-growing city having a huge population and a network of forty-two major and busy roads across the city [30]. Based on traffic volume, five major roads were chosen where the majority of vehicles travel and release hazardous substances, such as CO_2, CO, NO_x and SO_x, as well as some heavy metals including, Pb, Cd, Zn and Ni, which are harmful to the environment. There are no large industrial enterprises in the urban areas (study area) of Lahore. Trees were taken into account because these are the most vulnerable to air pollution. Figure 1 explains the GIS map of the study area, and selected roads with sampling sites are presented, while Table 1 comprises the selected target tree species for the present study. Moreover, among all the selected tree species, most of the species are exotic, while three species (Sheesham, Safaida and Peepal) are invasive and are planted along the major roads of Lahore.

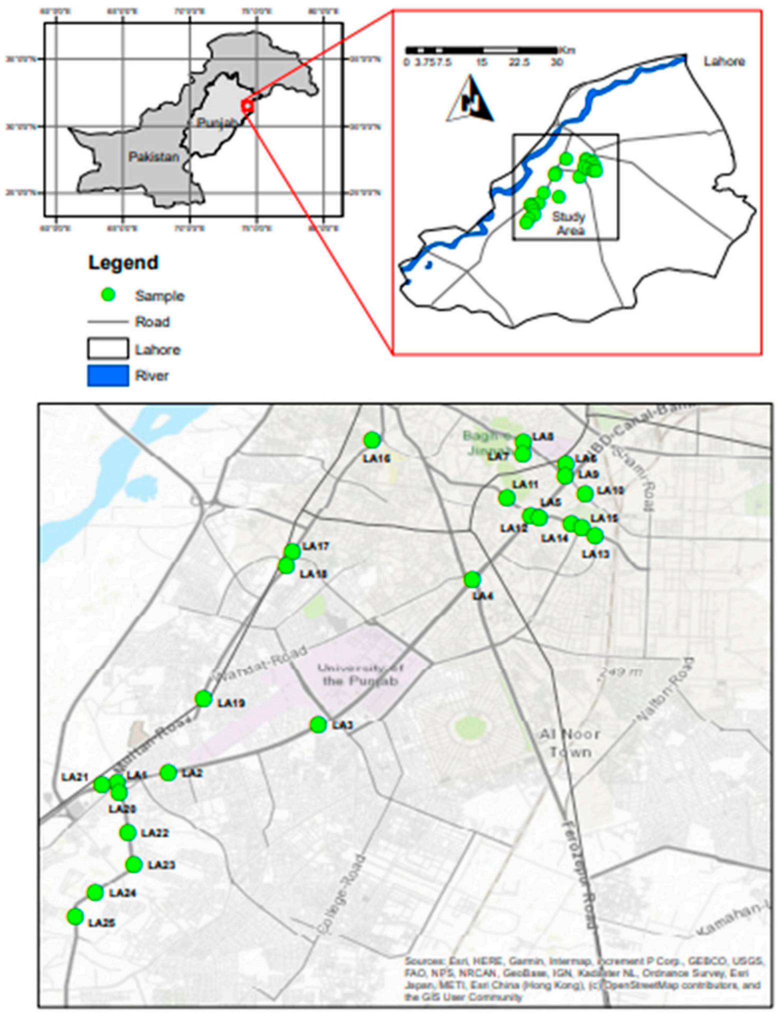

Figure 1. GIS-covered area map of Lahore showing selected roads with sampling points (Location Area, LA) in green circles.

Table 1. Commonly selected tree species with family and genus according to the guideline provided by Parks and Horticulture Authority (PHA), Lahore.

Sr. No	Common Name	Botanical Name	Family	Genus
1	Sheesham	*Dalbergia sissoo*	*Fabaceae*	*Dalbergia*
2	Amaltas	*Cassia fistula*	*Fabaceae*	*Cassia*
3	Ashoka	*Polyalthia longifolia*	*Annonaceae*	*Polyalthia*
4	Safaida	*Eucalyptus*	*Myrtaceae*	*Eucalyptus*
5	Mango	*Magnefera indica*	*Anacardiaceae*	*Magnefera*
6	Dharaik	*Melia azedarach*	*Meliaceae*	*Melia*
7	Jaman	*Syzygium cumini*	*Myrtaceae*	*Syzygium*
8	Pepal	*Ficus religiosa*	*Moraceae*	*Ficus*
9	Kachnar	*Bauhinia variegate*	*Fabaceae*	*Bauhinia*
10	Devil tree	*Alstonia schlorais*	*Apocynaceae*	*Alestonia*

2.1. Sampling of Plants' Leaves and Soil

Plants' leaves of ten target species were collected for biochemical analysis at five sites approximately 5–10 m from all selected roads. Samples were taken in triplicates (including facing the road and hidden from the road) from around 7 feet of the plants' height. All target tree species were close to each other at each sampling site. Before the biochemical examination, samples of plants were rinsed with distilled water to eliminate dust particles.

Soil samples were taken in triplicates at depths of 0 to 15 cm. The five locations were chosen at a distance of 5 m from each of the target roads. Samples were kept in a plastic bag. Soil samples were prepared for chemical analysis in the laboratory.

2.2. Evaluation of Air Pollution Tolerance Index

The values of APTI of plants were calculated using various biochemical parameters, such as total chlorophyll (T), ascorbic acid (A), relative water content (R) and leaf extract pH (P) in the following formula [31–33].

$$\text{Air Pollution Tolerance Index} = (A\,(T + P) + R)/10 \quad (1)$$

where 'A' is ascorbic acid (mg g^{-1}), 'T' is total chlorophyll (mg g^{-1}), 'P' is the pH of leaf extract and "R" is the relative water contents of the leaf (%). Based on APTI, the plants were categorized into tolerant (30–100 APTI), intermediate (17–29 APTI), sensitive (1–16 APTI) and very sensitive (<1 APTI) plant species.

2.3. Plants' Leaves Samples Analysis

The same places where the soil samples were collected also yielded samples of plant leaves. The leaves were collected, twice rinsed in deionized water to remove adhering materials and dirt, and then put into distinct paper bags with labels on them. The leaf samples were kept in a 70 °C oven until completely dry. In order to prepare dried-plant samples for further analysis, the leaves were grounded into a fine powder using a clean electronic grinder. A 2 g sample of powdered leaves was placed in a Pyrex beaker with 10 mL of pure HNO_3 and left overnight at room temperature. The sample was then heated on a hot plate, dried out heated again, and chilled, and 5 mL of $HClO_4$ was added. The digested sample was filtered into a new volumetric flask, double-deionized water was added, and the volume was increased to 50 mL. Using an atomic-absorption spectrophotometer, the concentrations of heavy metals, such as Cd, Ni, Pb and Zn, in the acid extracts were determined (AAS) (Analytik Jena AG—novAA® 300, Germany). The analyses were performed in triplicates under standard-optimum conditions and the results were compared with standard values [34].

2.4. Soil Sample Analysis

Soil sampling was conducted in the research area at three sample sites at depths ranging from 0 to 25 cm using a stainless-steel auger. These subsamples were extensively mixed together to form a composite sample [35]. The samples were transported to the laboratory in polyethylene bags, air-dried, mechanically grounded, and passed through a 2 mm filter before being carefully stored for further analysis. The soil samples were digested using the FAO/SIDA technique [36]. In a pyrex beaker, 1 g of air-dried and powdered soil sample was placed, and 15 mL of aqua regia was added. It was left overnight before being cooked on the hotplate until there were no brown odors. Then, 5 mL of concentrated $HClO_4$ was added and the solution was cooked on low heat until it was nearly dry. The extracts were filtered, and a final amount of 50 mL of doubly de-ionized water was prepared. The amounts of heavy metals, such as Cd, Cu, Ni, Pb and Zn, in the acid extracts were measured using an atomic-absorption spectrophotometer (Perkin-Elmer A700). Under conventional-optimal settings, the analyses were carried out in triplicates by measuring the standard deviation; the findings of HMs were compared by the [37] permissible limits of HMs concentration in the soil.

2.5. Data Analysis

Mean values of heavy metals in soil samples and plant leaves samples were estimated using MS-excel. The standard deviation for all means was also calculated and represented in graphs. Concentrations of heavy metals in soil samples were compared with WHO guideline values.

3. Results

3.1. Air Pollution Tolerance Index (APTI)

APTI values of selected tree species are shown in Figure 2A. The highest APTI (78.9 ± 2.6) was estimated in *P. longifolia* followed by A. scholars (75.9 ± 2.6). *M. indica* was also observed at a higher APTI content (71.9 ± 1.1). Overall, these three species have significant closeness among the higher pollution-tolerance results. The poor APTI result was determined in *F. religiosa* (19.5 ± 1.0) and *E. citriodora* (14.9 ± 0.4) respectively, but the whole trend indicates that all the ten tree species performed better regarding air-pollution-abatement results. The APTI results of all the species uncovered the inconstancy among different plant species regarding the vulnerability to air contamination. Findings clearly show that the plants shift their reactions to comparative air pollution, and variety in air-contamination resistance might happen because of the variety in any of the four biochemical boundaries used to work out the APTI. Air Pollution Tolerance Index (APTI) is a significant parameter for pollution mitigation, and it is based on the biochemical parameters of plants, such as pH, chlorophyll contents, relative water content and ascorbic acid. Equation (1) was used to calculate the APTI results of all the tree species. The higher APTI value represents the high tolerance of air contaminants from the plants. Ascorbic acid (A) is an antioxidant that is found in new components of the plant and prevents plants from oxidative harm. It is a vital pointer to determine the APTI values in the plants. It provides protection from unfavorable climatic conditions and, is therefore, valued by plants. Increased ascorbic acid levels in plants indicate a high resistance to air pollution. The higher levels of ascorbic acid in stressful conditions protect the chloroplasts against SO_2-induced H_2O_2, O_2 and OH accumulation. It is an antioxidant whose concentration is increased with auto exhaust and industrial-pollution rates [38–40]. Pollutants are made more difficult to enter an area with high chlorophyll content. Under conditions of water stress, the total chlorophyll content (T) decreases the generation of reactive oxygen species (ROSs) in the chloroplast (ROS is a very low reactive molecule that may cause damage to cellular bodies during environmental stress). The defense against ROS produced by the photosynthetic machinery is aided by higher chlorophyll concentrations [41–43]. Due to the fact that different pH (P) ranges are necessary for the enzymes to operate properly, the physiological and biochemical activities of the plant are dependent on pH (P). Hexose sugar is controlled by pH level to produce ascorbic acid, which aids in its ability to withstand harsh environmental conditions. Numerous researchers claim that pH has a substantial influence on how effectively plants use light for photosynthesis; in other words, low pH causes plants to use less light for photosynthesis [15,44]. As a result, a higher pH value in the leaf extract improves the ability to tolerate pollution. Because water governs numerous physiological processes under high stress from pollutants, relative water content is another crucial factor in a plant's ability to withstand pollution.

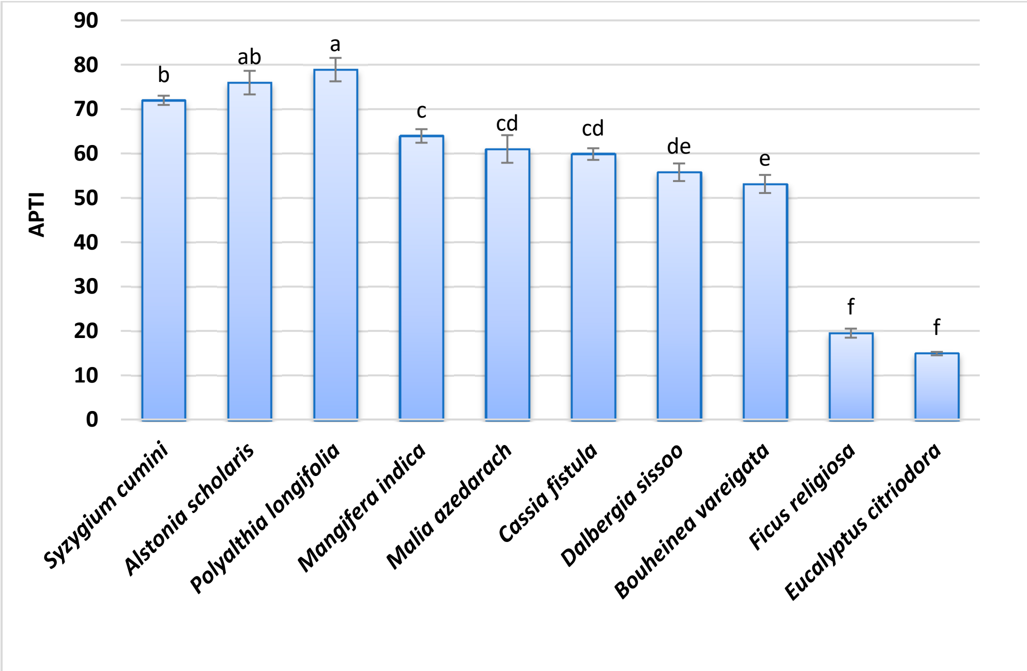

Figure 2. Air pollution tolerance index (APTI) of all tree species. Values are mean ± SD at n = 3. The letters show the values are significantly different at $p < 0.05$.

3.2. Heavy Metal Concentration in Soil and Plant Leaves

Heavy metals in the soil as well as in plants are significantly present due to massive traffic flow across the urban area. Each site's value showed significant variations in the concentration of HMs studied. Figure 3 shows the soil concentrations of Pb, Cd, Zn and Ni at each of the study sites i.e., S1, S2, S3, S4 and S5 at each road. The highest concentration of lead and cadmium was 151.56 and 75.45 mg/kg, respectively, found in Multan Road, while Canal Road was the most contaminated with nickel varying from 20.37 to 25.68 ± 3 mg/kg at 0–50 m from the roadside. All zinc values were below the [45] allowable limit, except for the Raiwind road of 60.40 mg/kg. The heavy metal-content sequences in the soil sample were found in the following order: Pb > Cd > Ni > Zn. With respect to the permissible limits of heavy metals in soil and according to the WHO, the contents of Pb and Cd were above the limits at all five locations along each road, ranging from 88.42 to 151.56 mg/kg, and from 36.97 to 75.45 mg/kg, respectively, relative to the WHO requirements of 85 and 0.8 mg kg^{-1}. However, the concentration of Zn, except for the Raiwind Road, was found to be within the recommended limit of 60.40 mg/kg, compared to the WHO limit (50 mg/kg). In contrast with the WHO value (10 mg/kg), Canal Road was the most polluted with nickel varying from 14.97–25.68 mg/kg. The roadside soil is a major source of heavy metal related to traffic. The soils and plants found along roadsides are frequently contaminated with heavy metals, especially Pd and Cd, according to recent and prior studies. The vehicular emissions can change soil-quality parameters, including metal concentrations. The findings indicated that the amount of traffic had a significant impact on the concentrations of heavy metals in roadside soils because Cd and Pd concentrations in roadside soils may be influenced by vehicle emissions from the burning of fuel and diesel as well as auto shops [32,46,47].

In contrast, Zn and Ni are necessary heavy metals that are needed in modest amounts for a plant's regular growth. In excess, they might be fatal [48,49]. These metals could have come from a variety of sources, including the burning of fossil fuels, tyre wear and tear, metals used in catalysts and the deterioration of other car parts, particularly paints [50–54]. Long-term exposure of transport pollutants to heavy metals could be caused by higher concentrations of Pb, Cd, Zn and Ni in soils near the roadside. Meteorological factors, such as rainfall, tides, profiles or traffic volume impact the dispersion of pollutants.

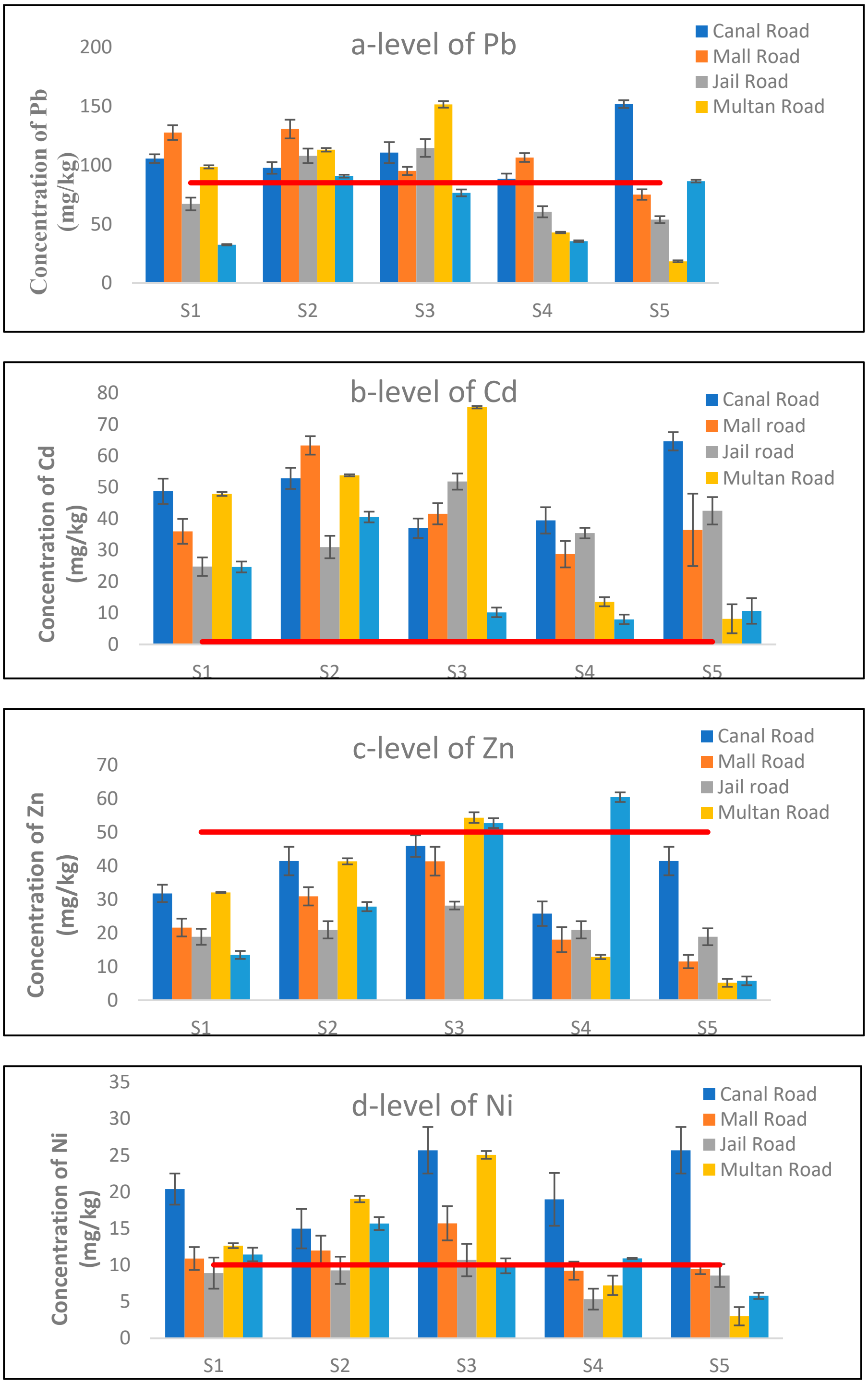

Figure 3. Soil HMs contents at various sites along each road in which (**a**) concentration of Pb, (**b**) concentration of Cd, (**c**) concentration of Zn, and (**d**) represents the concentration of Ni. Further, results are also compared with the WHO Standards (red line) for soil with the red line indicating, respectively.

The mean concentrations of Pb, Cd, Zn and Ni in plant leaves, as obtained from ten species of plants, such as *D. sissoo*, *C. fistula*, *P. longifolia*, *Eucalyptus*, *M. indica*, *M. azedarach*, *S. cumini*, *F. religiosa*, *B. variegate* and *A. schlorais*, are shown in Figure 4. *Dalbergia sissoo*, at Canal Road, absorbed the highest cadmium content of 25 ± 3 (mg/kg) followed by *P. longifolia* 12 ± 1.5. *M. indica* and *C. fistula* also accumulated Cd contents. The highest Pb contents were observed in three species i.e., *P. longifolia*, *M. indica*, and *Eucalyptus*, respectively, while the lower contents were found in *Ficus religiosa* across all the roads. The highest Pb contents were observed in *P. longifolia* and *M. indica* i.e., 135 ± 5 and 132 ± 2 mg/kg, respectively. Similarly, the highest Zn contents were found in *P. longifolia* and *S. cumini* with 130 ± 4 and 132 ± 3, respectively. The Ni concentration was observed the highest in *P. longifolia* (34 ± 2.5) but in the remaining species, it is almost the same trend of Ni accumulation. All of these selected species of plants have a natural absorbance capacity of HMs, as shown in the above.

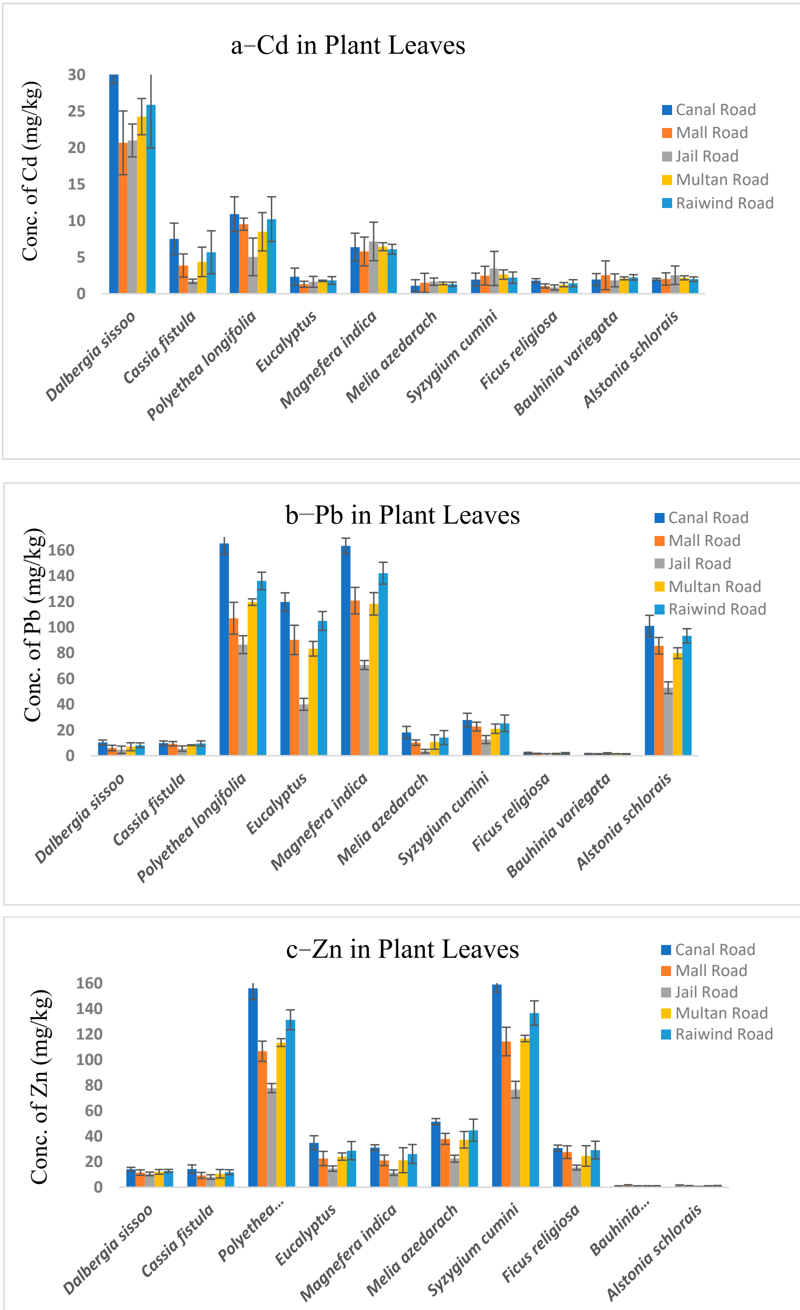

Figure 4. *Cont.*

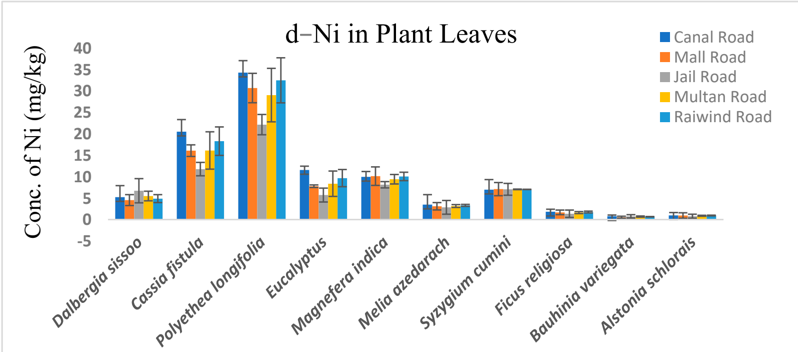

Figure 4. Heavy metals accumulation by selected tree species along each roadside. (**a**) represents the maximum accumulation of Cd by *D. sisso* followed by *P. longifolia*, (**b**) represents the maximum accumulation of Pb by *P. longifolia*, *Eucalyptus*, *M. indica* and *A. scholaris*, (**c**) represents the maximum accumulation of Zn by *P. longifolia* and *S. cumini* and (**d**) represents the maximum accumulation of Ni by *C. fistula* and *P. longifolia*, respectively.

The effects of heavy metals are supposed to be due to the rise in the number of vehicles in Lahore after 2000, which in turn increased traffic activity and environmental pollution [55,56]. The World Health Organization reports that, due to lead poisoning, 15–18 million children in developed countries suffer from irreversible brain damage. Lead has been used in gasoline for many years until now, and lead has a long half-life, so lead concentrations are expected to be high, which can cause environmental pollution [57,58]. In view of its toxic nature for creatures and individuals, cadmium may be a serious metal that is harmful to the environment. Cadmium comes into the environment via mechanical waste types, such as electroplating, plastic delivery, mining, paint shades, composite planning, metal-containing batteries, and anthropogenic pathways. Its high quality, and thus, low concentration indicate the extreme effects on plants. It is found that HMs (Cd, Pb, Zn, and Ni) are richly present in the soil along each of the roads caused by vehicular movement as per the permissible limit of WHO standards. These toxic HMs, especially Cd, have varied impacts on human health. Furthermore, it has also been categorized as carcinogenic for human beings [59–61]. HMs emissions from vehicles are mainly caused by the large utilization during the mechanized-working processes that release after ignition. Concentrations of HMs may also be present in the biotic (organisms) and abiotic (water and sediment) components of aquatic habitats [62]. HMs may be an insignificant component that adversely affects the development and progress of plants. In their ability to absorb substantial metals, plant species differ. The high accumulation of important metals and also the metal magnitude relationship depend on the morph-physiological characteristics of the plant. The concentration of heavy metals from previous research has been shown to decrease in both soil and plant leaves as the distance from the road increases. This has shown that these pollutants are caused by road-traffic emissions.

3.3. Correlation of APTI and Heavy Metals Uptake by Plants

Figure 5 depicts the relationship between HMs (Cd, Pb, Zn and Ni), and the APTI. The higher the APTI score, the more tolerant the plants are to air pollution. The APTI of tree species is influenced by biological variables (Ascorbic acid, total chlorophyll, pH and the relative water contents). The values of these factors have an impact on the APTI of all tree species. Similarly, the degree of HMs uptake by plants is related to these biochemical characteristics based on the APTI values of the tree species. Figure 5 shows that when the APTI values increase, so does the degree of Cd uptake. The R^2 value indicates the favorable correlation between APTI and Cd uptake by tree species. Similarly, Pb and Ni have a favorable relationship between APTI and HMs uptake by trees. However, the association between Zn and APTI was found to be slightly poor, with an R^2 value of 0.26. This demonstrates that APTI and Zn have very little connection. From the correlation results, it is concluded that in both cases, seven out of ten species were estimated to be good outcomes. These are also foreign species, but owing to poor implementation planning and an intense research inclusion method across the study region, the population density (Figure 6) of these important species is not in a good percentage, as detailed below.

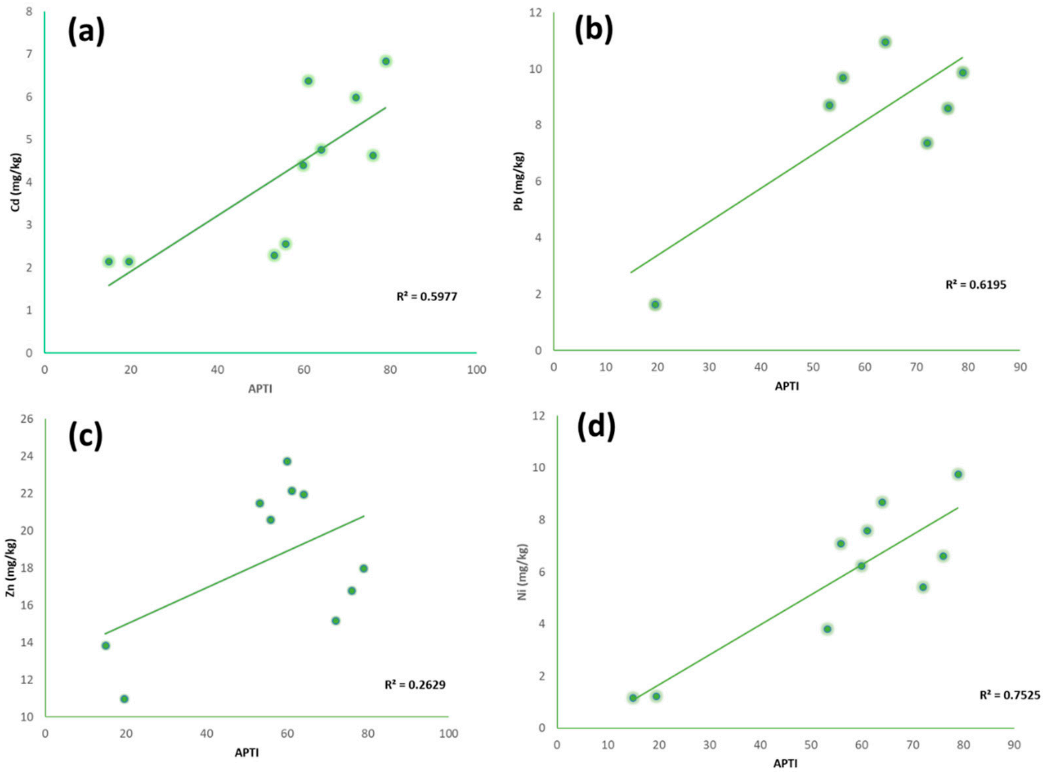

Figure 5. Correlation between HMs uptake and tree species APTI. (**a**) Cd and APTI (**b**) Pb and APTI (**c**) Zn and APTI, and (**d**) Ni and APTI correlation, respectively.

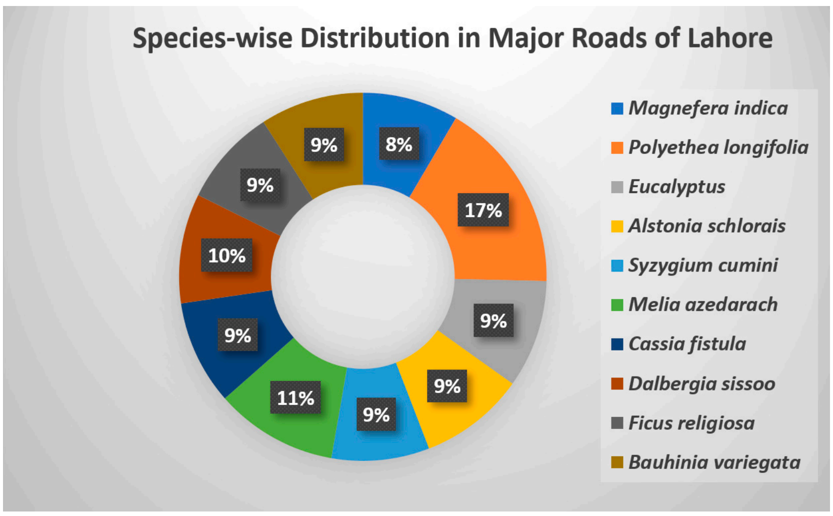

Figure 6. Percent distribution of all the tree species throughout the study area (selected roads).

3.4. Species Distribution of Trees along the Selected Roads

The population density (%) of all the identified tree species along each road was calculated to estimate the diversity of selected species, as indicated by Figure 6. The highest-density population (%) and lowest-density population (%) were of *P. longifolia* (17%) and *Bauhinia variegate* (7%), respectively. Further *C. fistula* and *M. azedarach* scored 12% and 11%, respectively, and are the second and third in the most abundant species along the roadside throughout the urban area of Lahore. Fortunately, *P. longifolia* has the highest abundance across all roads. Moreover, it is among the top three best species. *S. cumini* and *M. indica* abundance is nearly 10% along the roadside which is not a positive sign for the environmental quality of the urban area.

The air pollution tolerance index (APTI) of plant species was evaluated with the help of analysis of some biochemical parameters, and used to measure the heavy-metals accumulation capacity in their leaves and their levels of tolerance in a polluted environment. Plant leaves are utilized as a bioindicator for seasonal air pollution. To identify species that are tolerant of varying pollution loads and polluted sites, leaves are mostly used as bioindicators of traffic pollution. It will be advised to adopt plants in shelterbelt development and a man-made afforestation program to reduce air pollution based on the APTI and average HMs concentration value [18,63–65].

Results show the maximum percentage is *P. longifolia* (17%), followed by *M. azedarach* (11%). It should be the main challenge for the administrative authorities to enhance the diversity of such kind of best species regarding pollution mitigation and making the green economy for the area. By building community parks and gardens, the PHA and Government must support urban forestation. It is necessary to increase the vegetation proportion and green belts in urban areas for mitigation of air pollution.

4. Conclusions

APTI and HMs accumulation potential of the tree species depends on the socioeconomic factors as well as the overall appearance of the tree species. Based on these factors, tree species are regarded as useful tools for developing green belts in and around metropolitan areas. Trees that are useful for pollution control are less along the roadside, reflecting improper urban environmental management. *P. longifolia* and *M. indica* species absorbed heavy metal lead. Heavy metal Zn was absorbed by the two plant species: *P. longifolia* and *S. cumini*. It is recommended that these plant species or the combination of these species could be an effective tool to mitigate environmental pollution. This will be helpful not only in the absorption of pollutants but also in the increase in resilience against increasing temperatures and changing climate in urban areas. It is important to perform research on the ability of various plant species to absorb heavy metals in Lahore.

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