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IMPACT OF LAND-USE TYPES ON THE DISTRIBUTION AND ACCUMULATION OF POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL FROM SAGAMU TOWN, SOUTHWESTERN NIGERIA

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ABSTRACT

Man-made activities such as urbanization and expansion of agricultural activities are increasingly changing our landscapes. An evaluation of the effects of land use on soil standards is critical for the sustainable management of human health and its surroundings. This study examines the impact of land use types on the abundance and distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in soil as affected by three different land environments; Petrol Stations (NNPC), FarmLand, and Auto–Mechanic Villages. A focus on the concentrations and spatial distribution of PAHs in soil samples collected from each land-use type in Sagamu Township and its surroundings, was subject to a generalized assessment while identifying important contaminating factors in the soil. Soil analysis confirmed that Auto-Mechanic Village constitutes the highest contributor of PAH and increased concentrations are detected from this land-use type. Significantly, the Petrol Station (NNPC) also showed a high PAH distribution but was lower than the Auto mechanic village. The levels of PAHs ($\sum$7PAHs) obtained in NNPC, Mechanic Village, and FarmLand are 0.054 mg/kg 0.073 mg/kg, and 0.0328 mg/kg respectively. The highest values of PAHs concentration were returned from Mechanic Village soil samples and the lowest value was obtained from the FarmLand samples. This trend of PAH prevalence was consistent with the number of rings inside the structure, apparent at each sampling site and across the whole study area. The Σ5-6 ring PAHs dominate at a concentration of 0.0481 mg/kg (50% of total PAHs). Σ2–3ring PAHs show 0.0257 mg/kg, percent abundance 27%. In contrast, there are scarce occurrences of Σ4 ring PAHs, of which the lowest values reach up to 0.0223 mg/kg (23%). The findings highlight the relevance of accounting for co-exposure to different land-use-type when assessing the risk of soil contamination for human health and offer useful insights to policymakers, environmental regulators, and land-use planners.

Keywords: Chromatograph, FarmLand, Polycyclic Aromatic Hydrocarbons, Toxic Equivalent Factors.

INTRODUCTION

Soil is a dynamic, complex and critical, key player in the Earth system where the interaction of multiple components forms a terrestrial medium for life including land plant and microbial life support, water filtration and carbon storage (Barry and Bruce, 2010). Soil is a natural body of air, organic minerals, water, minerals, and mostly mineral, that has the potential to support vegetation. Soil is made of four main components — Mineral Particles (Clinton *et al.,* 2023), Organic Matter (Carlos *et al*., 2021), Water (Rudiyanto *et al*., 2020), Air (Clinton *et al*., 2023). There are many factors affecting soil formation and process; Parent Material (Brady & Weil, 2008), Climate (Ronald, 2021), Biological Activity (Lal, 2004), and Time (Ronald, 2021).

In accordance with our present age, soil has a vital and significant role in a variety of ecological, agricultural and environmental processes. Soil is the basis of agriculture as the physical base for roots and as a nutrient source. Soil is directly linked to crop yields and food production (Clinton *et al.,* 2023), whilst the water filtration function of soil regulates the cleanliness of groundwater by removing impurities and pollutants as water percolates through the soil profile. Carbon storage: Its stores carbon in organic and mineral forms Biodiversity: Provides habitat to a large number of organisms — earthworms, bacteria, fungi, insects. They play a role in biodiversity and ecosystem health, Erosion Control Healthy soils with robust networks of roots help to decrease soil erosion, keeping landscapes stable and avoiding sedimentation in waterbodies Carlos *et al.*, 2021.

Land use means how mankind uses land including human activities. The definition includes splitting land for diffusion of uses, along with residential, commercial, agricultural, industrial, recreation, and conservation. Land use is essential to urban and rural planning, environmental management, and sustainable development. Land Use Impact is the utilization of land and its natural resources to fulfill the desires of human life. Depending on how it is planned between human-centric and nature-based, land use decisions can be positive sustainable development direction or a world of negative consequences like climate change, a social crisis, an economic downturn, and an environmental calamity.

The negative impacts of land use in Nigeria are attracting more concern with growing urbanization, industrialization, and agricultural expansion. Many of these sites have been studied regarding the negative effects inflicted on the environment, society, and economy. Some of them include; deforestation and habitat loss to agricultural expansion, logging, and urbanization. The loss of essential wildlife habitats and a negative impact on biodiversity (Ayanlade & Jegede, 2018), Soil degradation which encompasses land clearing, improper land management, and overgrazing, have resulted in soil erosion; nutrient deficiencies, and low agricultural productivity (Eneji *et al.,* 2016).

Land use has resulted, caused permanent negative environmental impacts (Gibson *et al.,* 2011; Rowan, 2019), social (Telford *et al.,* 2018; Cornelis *et al.,* 2024), and economic impacts (Nabighian *et al.,* 2005). Potential processes where Polycyclic Aromatic Hydrocarbons (PAHs) accumulate in mass in our environment include; PAH emissions are majorly due to industrial and land use especially those involving the production and processing of fossil fuels, chemicals, and metals (Ruqayah *et al.,* 2023; Eder *et al.,* 2022). PAHs are also released into the air from industrial processes that settle on land surfaces, soils, and water surfaces and become residual contaminants in the environment (Patil and Hement., 2004), urban and transportation land use areas that are highly trafficked and emit vehicular air pollutants contribute significantly to PAH pollution (Ruqayah *et al.,* 2023). Vehicle exhaust, tire wear particles, and road dust are the primary sources of PAHs in sediments, stormwater runoff and urban soil. This is especially noticeable in areas with high traffic volume and poor pollution control practices. Residential land use contributes to PAH contamination in many ways. One such way is the emission of PAHs into air and soil due to wood-burning stoves or fireplaces used for heating (Cai *et al.,* 2022). Besides this, cooking with coal or other solid fuels in some households leads to the indoor generation of PAHs. Some types of pesticides and fertilizers used may also be contaminated with PAHs (Lammel, 2015). Off-site aerial transport from surrounding industrial or urban localities to agricultural lands can cause crop and soil contamination. Natural landscapes and green spaces carry PAHs that come as atmospheric deposition from far-off sources (Liu and Jianwei, 2024). Pristine natural landscapes can receive long-range transport of PAHs.

Dabaibeh (2020) determined the soil properties and PAHs value around the Jordan Petroleum Refinery Company (JPRC). The research assessed the spatial distribution of the contaminants and analyzed the sixteen PAHs. The findings exhibited acidic pH conditions support photolytic degradation while alkaline favors microbial degradation of PAHs (Singh and Issac, 2018, Emoyan *et al.*, 2018). The first segment of higher concentration trends is indicative that JPRC is the primary source. It has been emanated from an Al-Hussein Power Plant situated in the vicinity (Tong *et al.,* 2018). The third segment has been associated with industrial boilers and steel smelting industries within the locality Liu *et al.* (2010). It can be concluded that it is in the core part of the concentrated area (Peng *et al.*, 2011).

The assessed of polycyclic aromatic hydrocarbons in soils affected by used engine oil wastes in the Abakaliki Auto-Mechanic Village was investigated by (Obini *et al.* 2013). The assessment subdivides the zone into three randomly selected workshops within each sub-area to obtain samples. Batch soil samples, totaling nine and arranged into three composite samples, were obtained from 0-15 cm depth. The analysis of the sixteen PAHs was implemented using a Gas Chromatographic System of 6890 plus and 6890 series fitted with a dual detector FID-ECD, dual column, and TriPlus AS auto-sampler that uses helium as the carrier gas along with a quadrupole Mass Spectrometer Agilent 5975 MSD, which follows USEPA method 8100 EPA. Results showed that out of PAHs compounds investigated, benzo fluoranthene and phenanthrene account for the highest percentage in the soil among sixteen.

Using gas chromatography-mass spectrometry, Antoaneta *et al.* (2012) measured the polycyclic aromatic hydrocarbons in southeastern Romanian soils. PAHs' preliminary amounts and distribution patterns in soil samples taken from different industrial and rural zones of Southeastern Romania are checked against Romanian regulations. The outcome showed that a greater concentration of total PAHs was obtained in rural areas as a result of activities such as; burning of agricultural residue, unintended inputs of fossil gasoline consisting of diesel from vehicles used for diverse farm practices, or use of generators. The polluted soils in industrial regions and agricultural farms are derived from burning and petrogenic sources.

Kadili *et al.* (2021) evaluated the risk factor and concentration of Polycyclic Aromatic Hydrocarbons in Soils in Kogi State-Nigeria using the vicinity of some selected petrol stations. The study was accomplished at three major cities in the state: Ankpa, Anyigba, and Idah located in the eastern region of Kogi State, Nigeria. Three petrol stations were picked from each town for sample collection. At each town considered in the analysis, control samples were taken from the pristine site, where petrol stations and agricultural and industrial activities were absent. The percentage of 16 USEPA priority polycyclic PAHs was estimated using Gas Chromatography-Mass Spectrometry (GC-MS) on a Hewlett Packard (HP) 6890 chromatograph geared up with dual column and injector. The results showed that the soil in the vicinity is predominantly sandy soil with low possibilities of clay and silt. The samples' pH confirmed that the soil samples were a little acidic. Finally, all the 16 USEPA priority Polycyclic Aromatic Hydrocarbon were found to be present except Chry, BbF, BkF, and InP.

This research is rooted in the urgent need to comprehensively understand and address the environmental implications of anthropogenic activities in diverse land-use settings. The presence and accumulation of Polycyclic Aromatic Hydrocarbons (PAHs) in soil, pose a significant threat to environmental and human wellness. PAHs are known to be persistent organic pollutants with potential carcinogenic and mutagenic effects, and their distribution in soils under different land-use types necessitates a detailed investigation to gauge the extent of environmental impact. Understanding the contribution of land-use types to PAH accumulation allows for targeted interventions and risk mitigation strategies, aiding environmental regulatory bodies and policymakers in directing resources where they are most needed.

This research investigated the impact of land-use types on the buildup and distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in soil within Sagamu environs. The study focuses on three distinct land-use types: Petrol station, farmLand, and Mechanic village, with a specific emphasis on evaluating the relative contributions of each land-use type to the presence and concentration of PAHs. However, the research has the following objectives; to assess and characterize the circulation of Polycyclic Aromatic Hydrocarbons (PAHs) in soil for three different land-use types and to establish correlations between specific land-use activities and the corresponding presence and concentrations of PAHs in the soil.

MATERIALS AND METHODS

Description of Study Area

Samples for this study was obtained within Sagamu town and its environs, Ogun State, Nigeria. Three different locations with different land-use were selected (Figure 1); NNPC (6°52'09"N 3°33'12"E, 298 m), Mechanic village (6°52'1.371"N 3°33'30.09"E, 200 m), and FarmLand (6°52'07"N 3°33'15"E, 256 m). The NNPC Mega Station was located at the center of Sagamu town where sample 1 was taken at the loading and discharge area. The farmLand was a plantation with a very large land mass located within Sagamu where sample 2 was taken a few meters from the NNPC Mega Station. The Auto-mechanic village offers repairs to both commercial and private vehicles within Sagamu and its environs, which also include the deposition of metallic scraps, grease, spent engine oil, paint, diesel, petrol, battery electrolyte and other heavy metals, represents the third site where sample 3 was taken.

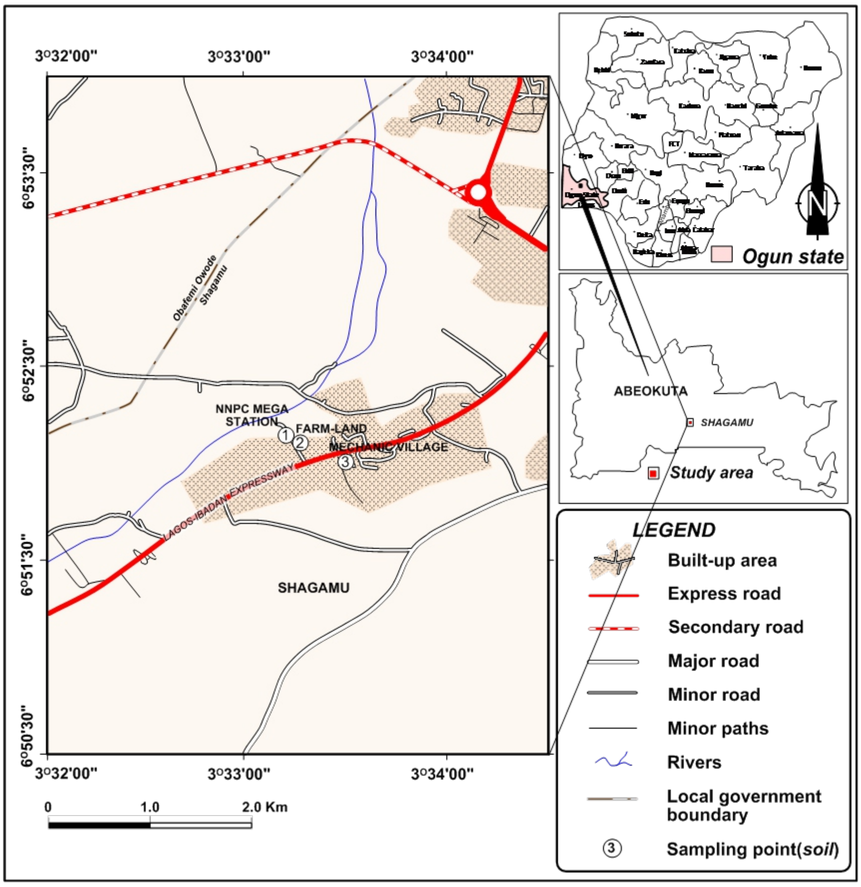

Figure 1: Location map of the study area.

Geology of Study Area

Geologically, Ogun state is predominantly composed of both sedimentary rocks and crystalline rocks from the basement complex. Approximately 40% of the total land area is underlain by basement rocks, while sedimentary rocks cover the remaining 60%. The region around Imeko, Abeokuta, Ijebu-Igbo, and Odeda features old granite formations. These older granites, dating from the late Precambrian to early Paleozoic period, are of magmatic origin, (Gerald, 2020). Sagamu is situated within the Dahomey Basin, which is defined by a thick sedimentary sequence. The basin includes various geological formations, such as the Abeokuta Group, the Ewekoro Formation, and the Akinbo Formation. These formations consist of a variety of sedimentary rocks, including sandstones, shales, and limestone. The Dahomey Basin has undergone tectonic activity throughout its geological history, leading to the development of structural features. Faults, folds, and fractures may be present in the rocks of the region, influencing the overall geological architecture. The weathering of rocks in Sagamu contributes to the formation of soils (Figure 2). The type of soil and its composition are influenced by the underlying geological formations. Erosional processes also play a role in shaping the landscape.

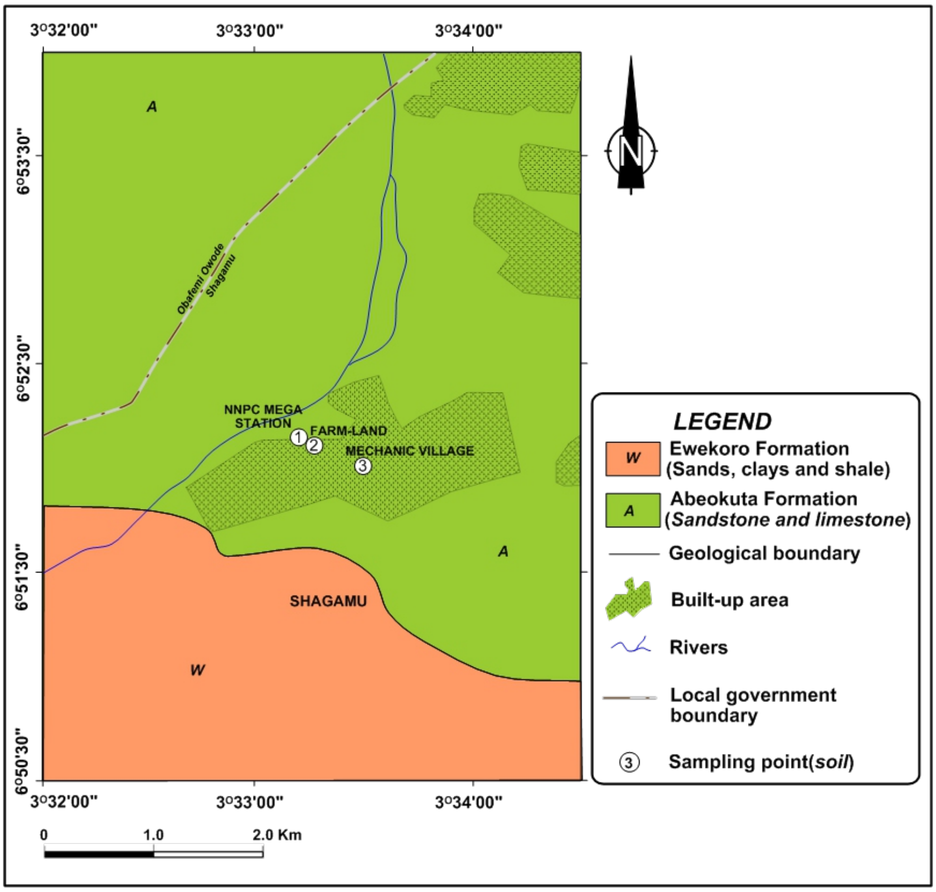

Figure 2: Geological map showing the rock types that underlie the study area.

Soil Sampling

Three amalgam samples were collected from distinct locations: NNPC Mega Station, farmLand, and an automobile workshop, each taken at a depth of 15–20 cm as detailed in Table 1. The collected samples were carefully placed in sanitized polythene bags, appropriately labelled, and then taken to the laboratory for subsequent study.

Table 1: Location of sampling points in the field.

Sample	Site	Depth	Latitude	Longitude
1	NNPC	0-20	6.8632	3.5547
2	FarmLand	0-20	6.8657	3.5558
3	Mechanic Village	0-20	6.8670	3.5583

Determination of Physico-chemical Properties of Soil Samples

Soil physicochemical parameters were implemented using standard methods. The ratio 1:1 of soil-to-water was adopted to study the pH of the samples (Carter and Gregorich, 2007). Organic Carbon was estimated using the Walkley Black acid digestion method (Emoyan *et al.,* 2015). Extraction was implemented according to the modified USEPA method 8270 (Emoyan *et al.*, 2020; Tong *et al.,* 2018). Samples were weighed (5 g) and 25 mL of acetonitrile was added, it was shaken vigorously on the shaker for 45 minutes, 1 g of anhydrous sodium sulphate was added, it was then transferred into a centrifuge tube and centrifuged for 5 minutes at 2000 rpm, the extract was filtered with Teflon filter paper for GCMS analysis. The model of GC applied for the analysis is Agilent Technologies 7890 and the mass spectrometer detector is Agilent Technologies 5795, the column used is Agilent Technologies HP5MS of length 30 m, internal diameter is 0.320 mm and the thickness is 0.20 micrometer. The PAHs in the soil samples were determined using solvent extraction and gas chromatography with mass spectrometric detection.

RESULTS AND DISCUSSION

Soil pH

Soil pH is a crucial indicator influencing diverse physicochemical processes, with significant repercussions on the degradation of PAHs The pH of the samples arranges between 7.32 and 7.38 (Figure 3). Sample 1 demonstrates a slightly alkaline pH of 7.38, positioning it within the spectrum of neutral to slightly alkaline soil conditions (Reynolds *et al.,* 2002). This pH level implies that the soil is generally well-suited for diverse crops and plant varieties (Brady & Weil, 2019). With a pH of 7.38, the soil is expected to offer favourable nutrient availability and microbial activity, thereby supporting robust plant growth (Brady & Weil, 2019). Sample 3 exhibits a pH of 7.36 which confirms the soil's suitability for most agricultural purposes (Brady & Weil, 2019). It is noteworthy that the minor pH variation between Sample 3 and Sample 1 may have subtle impacts on plant preferences and nutrient availability (Brady & Weil, 2019). It is also crucial to recognize that slight pH variations among soil samples can influence specific crop choices and nutrient interactions (Brady & Weil, 2019). Sample 2 presents a pH value of 7.32, slightly lower than Sample 1 but still within the neutral to slightly alkaline pH range (Reynolds *et al.*, 2002). This pH level is suitable for an expansive range of crops and agricultural practices (Brady & Weil, 2019). In summary, the soil pH analysis of Samples 1, 2, and 3 indicate that all three samples fall within the range of neutral to slightly alkaline pH values (Figure 3).

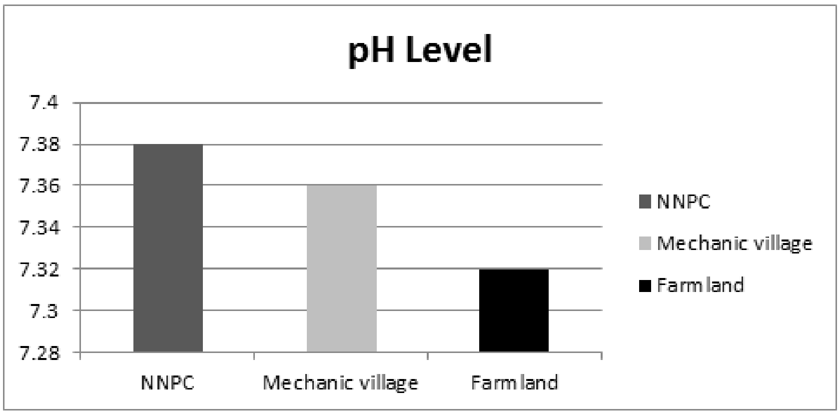

Figure 3: Level of pH concentration.

Total Organic Carbon (TOC)

TOC is a critical parameter in assessing soil health, organic matter content, and its impact on various soil properties and functions (Brocca *et al.*, 2017). TOC determines the fate of PAHs in soil. The TOC values obtained for the soils are presented in Figure 4. Sample 1 exhibits a TOC value of 0.563 mg/LC, indicating relatively lower organic carbon content. Lower TOC values may suggest reduced organic matter content in the soil, which can affect soil fertility and microbial activity (Brady & Weil, 2019). Sample 3 displays a notably higher TOC value of 1.038 mg/LC, representing an intermediate level of organic carbon content. Soils with moderate TOC values may provide a balance between fertility and organic matter content, which can support a range of land uses (Brady & Weil, 2019). Sample 2 possesses a TOC value of 1.619 mg/LC, suggesting a richer organic carbon content. Higher TOC levels can enhance soil fertility, and water-holding capacity, and support a more active soil microbial community (Lal, 2004). Such soils are however often beneficial for agriculture and can contribute to sustainable land management practices. In summary, the analysis of TOC values in Samples 1, 2, and 3 highlights variations in organic carbon content within these soils. These differences can have significant implications for soil health, fertility, and suitability for various land management practices. Proper management and amendment strategies should be considered based on the specific TOC levels to optimize soil productivity and sustainability.

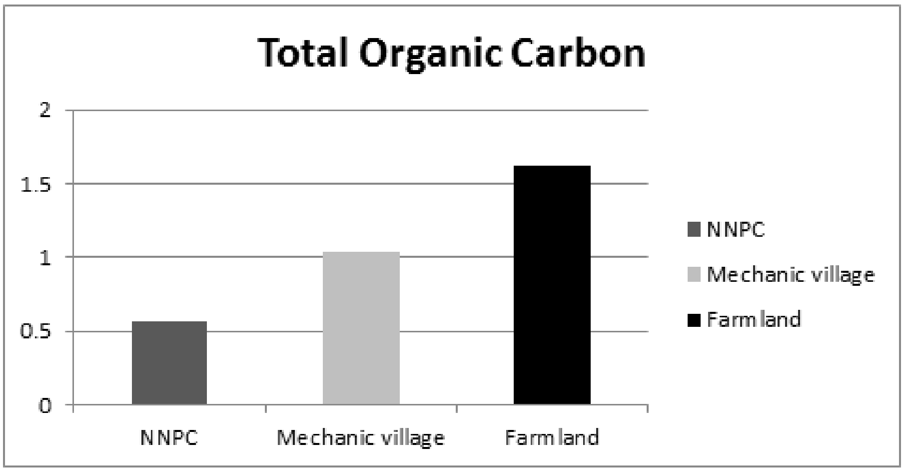

Figure 4: Level of Total Organic Carbon.

GC-MS Characterization of Polycyclic Aromatic Hydrocarbons

The concentrations results of individual PAHs from Quantitative data for different land use are revealed in Figures 5 to 7.

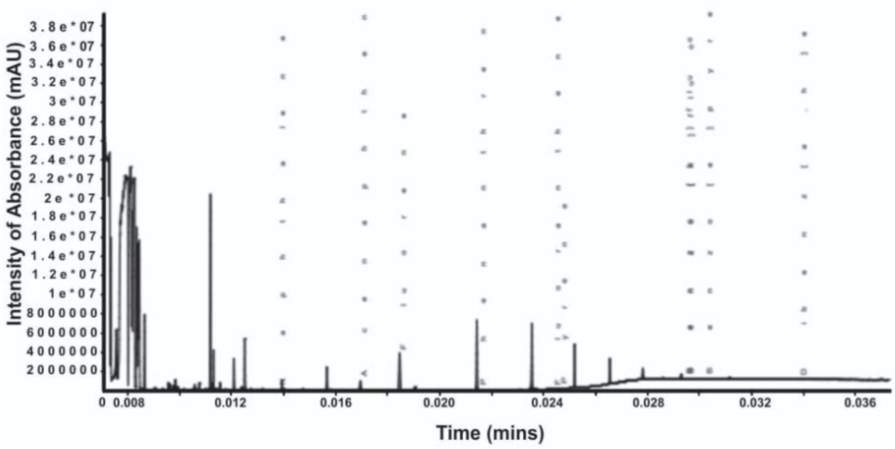

Figure 5: NNPC sample chromatogram.

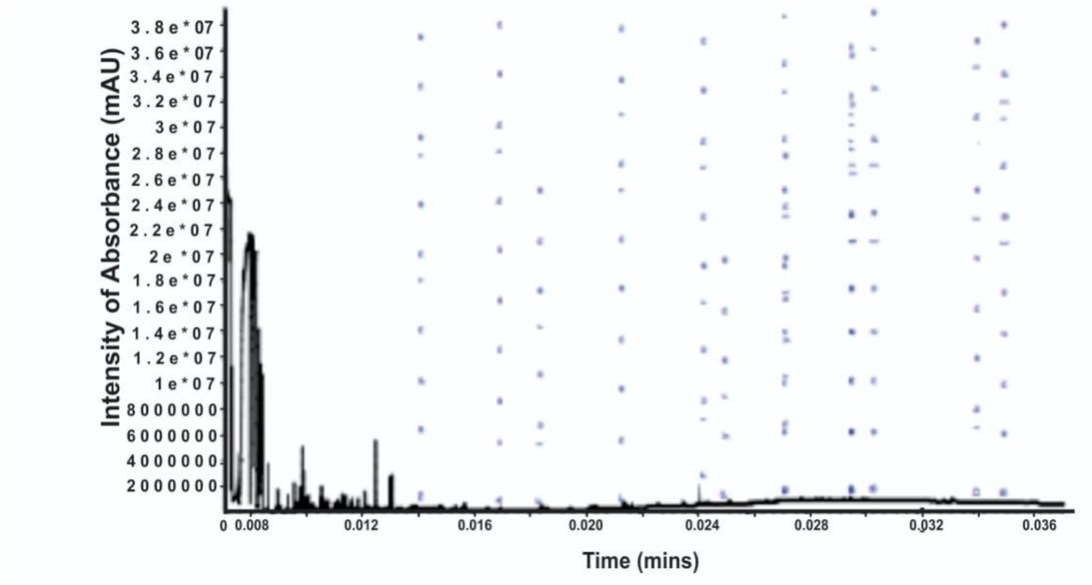

Figure 6: Mechanic village sample chromatogram.

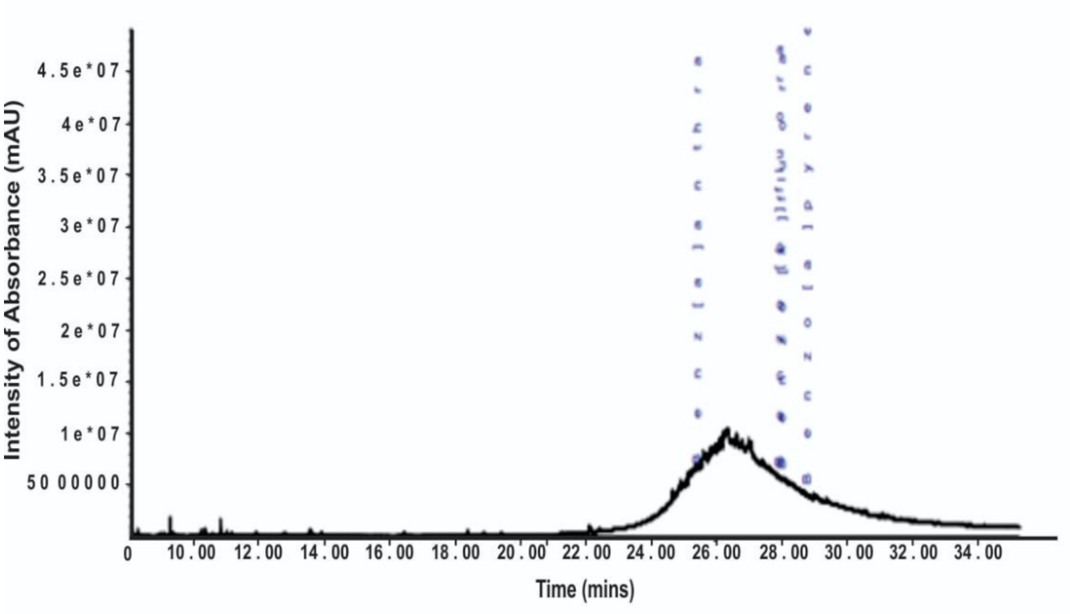

Figure 7: FarmLand sample chromatogram.

Table 2 presents Toxic Equivalent Quantities (TEQ), which depict the magnitude of human health and ecological risks within the region. To evaluate the health impacts of various pollutants, the Toxicity Equivalency Factor (TEF) method was adapted for polycyclic aromatic hydrocarbon (PAH) compounds as suggested by Nisbet and LaGoy (1992). The toxic equivalent factor (TEF) values recommended by Nisbet and LaGoy (1922) were employed to gauge the carcinogenic potential of estimated PAHs.

The United States Environmental Protection Agency (USEPA) and the International Agency for Research on Cancer (IARC) have identified seven pyrogenic PAHs (polycyclic aromatic hydrocarbons) that pose a high risk to human health. These PAHs are utilized as indicators to assess environmental pollution levels. The seven high-risk PAHs include chrysene, dibenzo[a,h]anthracene, benzo[a]pyrene, indeno[1,2,3-cd]pyrene, benzo[k]fluoranthene, benz[a]anthracene, and benzo[b]fluoranthene (Dahle *et al.,* 2006; Hussein *et al.,* 2016; UNEP 2002; IARC, 2010).

Table 2: Toxicity Equivalent Factor (TEF), and Toxicity Equivalent Concentration (TEC) Benzo[a]pyrene (BaP) Concentration in mg/kg

PAH	ABBR	TEF	MEAN(mg/kg)	TEC BaPeq (mg/kg)
Naphthalene	Nap	0.001	0.007	0.000007
Acenaphthylene	Acy	0.001	Below Cal	ND
Acenaphthene	Ace	0.001	0.0019	0.0000019
Fluorene	Flu	0.001	0.0015	0.0000015
Anthracene	Ant	0.001	0	ND
Phenanthrene	Phe	0.01	0.0153	0.000153
Fluoranthene	-	0.001	0.0063	0.0000063
Pyrene	Flt	0.001	0.007	0.000007
Benz[a]anthracene	Pyr	0.1	0.0052	0.00052
Chrysene	BaA	0.001	0.0038	0.0000038
Benzo[b]fluoranthene	Chr	0.1	0.0088	0.0000088
Benzo[k]fluoranthene	-	0.1	0.0118	0.00118
Benzo[a]pyrene	BbF	1	0.0126	0.0126
Dibenzo[a,h]anthracene	BkF	1	0.0109	0.0109
Indenol[1,2,3-cd]pyrene	BaP	0.01	ND	ND
Benzo[g,h,i]perylen	DBA	0.001	0.004	0.000004

The USEPA established toxicity equivalency factors (TEFs) in assessing the toxicity of PAHs. Benzo[a]pyrene and Dibenzo[a,h]anthracene were designated the highest TEF value of 1, while the other PAHs were assigned lower TEF values, as outlined in Table 2. The toxicity equivalent concentration (TEC) for an individual PAH is computed by multiplying the PAH concentration by its respective TEF, as represented in Eq. (1). The total toxicity equivalent concentration (TTEC) within the chemical mixture or the analyzed sample is then determined by summing the TECs of the seven carcinogenic PAHs (cPAHs).

$$\textbf{Total BaPeq} = \sum_{i=1}^{n} Ci * TEFi \quad (1)$$

Where Ci and TEFi represent the individual PAH concentration and respective toxic equivalency factors respectively.

The concentrations of individual PAHs from Quantitative data for different land uses are revealed in Table 3 and Figures 7 to 9. The results for the concentrations of PAHs ($\sum$7PAHs) in soil samples taken from NNPC, Mechanic Village, and FarmLand are respectively 0.054 mg/kg, 0.073 mg/kg, and 0.0328 mg/kg. The mechanic village had the highest PAHs concentration while the lowest PAHs concentration was at the FarmLand at 0.0328 mg/kg.

Table 3: ∑16PAHs, ∑7PAHs concentration (mg/kg)

PAH	NNPC (mg/kg)	MECHANIC VILLAGE (mg/kg)	FARMLAND (mg/kg)
Naphthalene	0.0089	0.0123	0
Acenaphthylene	0	0	0
Acenaphthene	0.0029	0.0028	0
Fluorene	0.0025	0.0021	0
Anthracene	0	0	0
Phenanthrene	0.0227	0.0223	0
Fluoranthene	0.0095	0.0096	0
Pyrene	0.0101	0.0111	0
Benz[a]anthracene3	0	0.0073	0.0083
Chrysene7	0	0.0114	0
Benzo[b]fluoranthene 4	0.0111	0.0111	0.0042
Benzo[k]fluoranthene 5	0.0159	0.0159	0.0038
Benzo[a]pyren 2	0.0107	0.0107	0.0165
Dibenzo[a,h]anthracene 1	0.0163	0.0164	0
Indenol[1,2,3-cd]pyrene 6	0	0	0
Benzo[g,h,i]perylen	0	0.0122	0
∑16PAH	0.1106	0.1452	0.0328
∑7PAH	0.054	0.073	0.0328

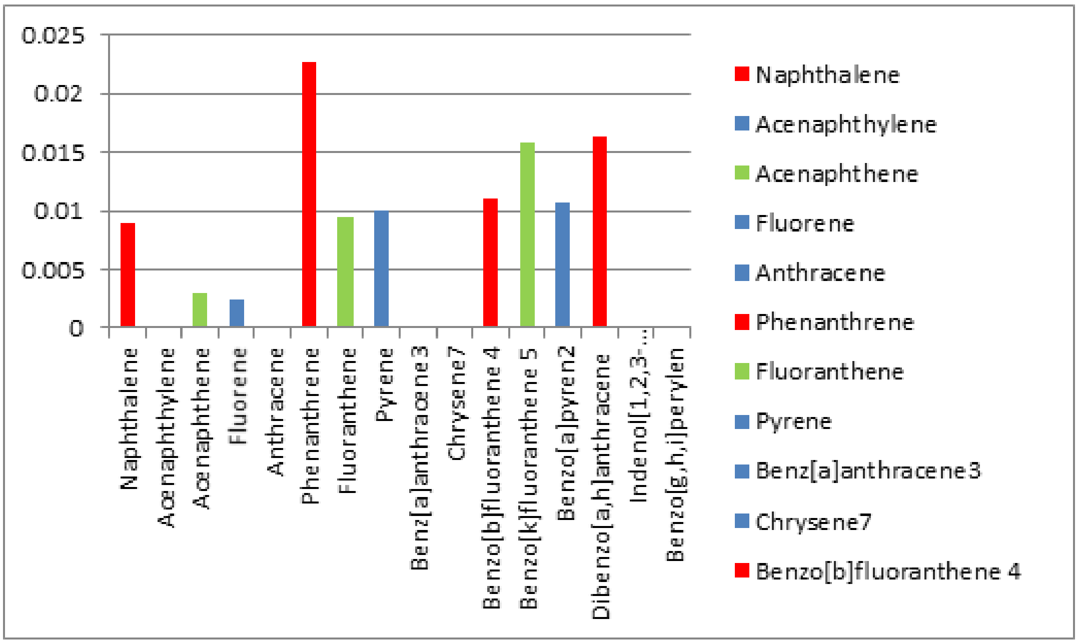

Figure 8: NNPC ∑16PAH level concentration (mg/kg).

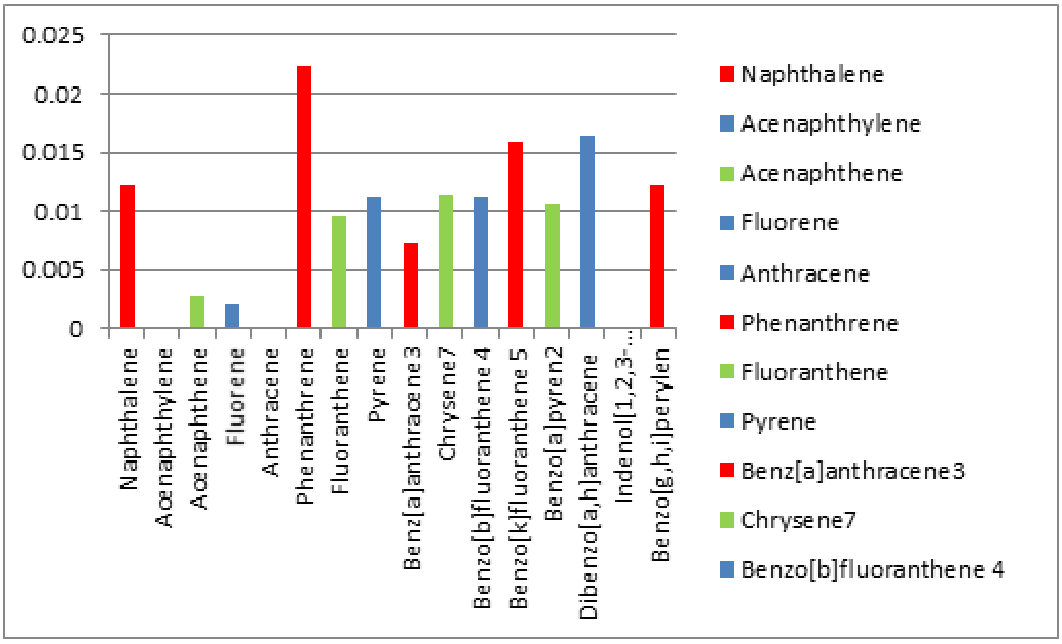

Figure 9: Mechanic Village ∑16PAH Level concentration (mg/kg).

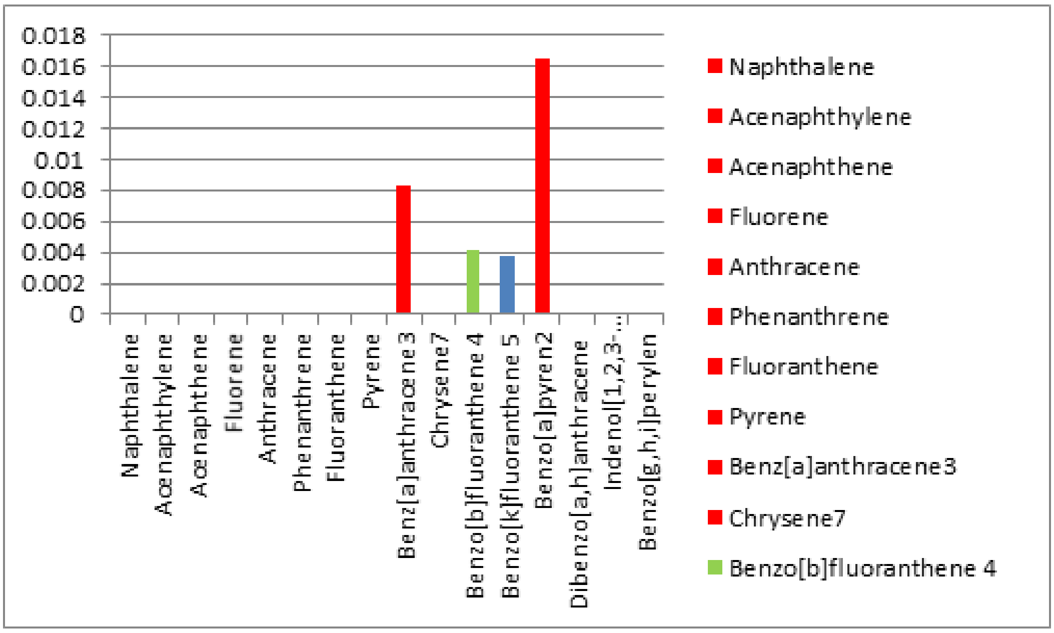

Figure 10: FarmLand ∑16PAH Level concentration (mg/kg).

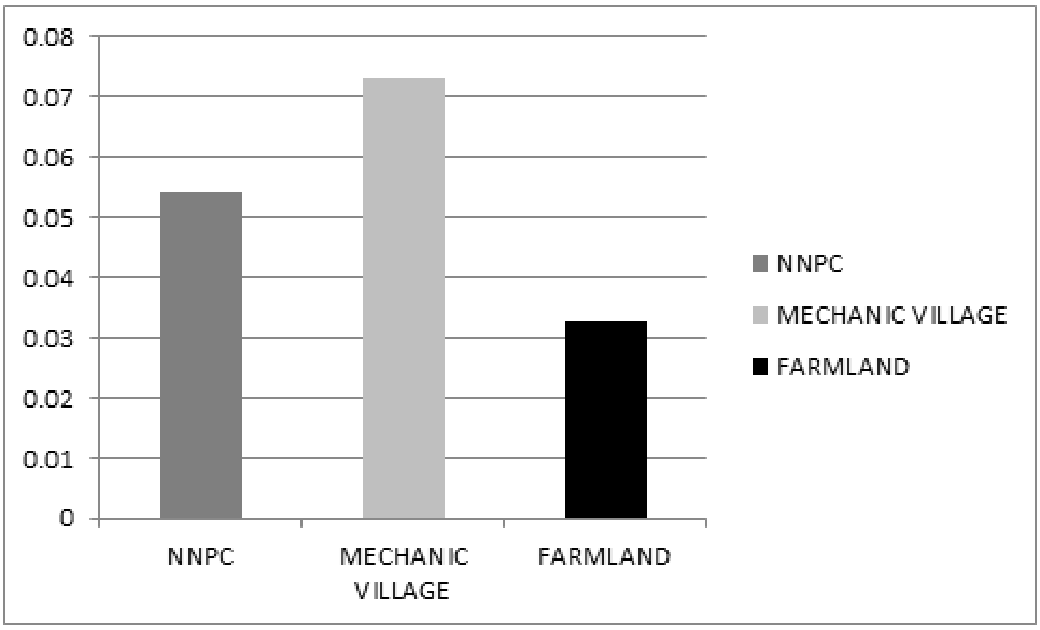

Figure 11: ∑7PAH concentration in the sample (mg/kg).

Figure 12 and Table 4 illustrate the prevalence of PAHs as a percentage of abundance at each sampling location. The data reveals that the higher percentage values are primarily associated with Low Molecular Weight (LMW) PAHs, which typically consist of 5 to 6 rings. This trend of PAH prevalence based on the number of rings in the structure is evident at each sampling location and throughout the study area.

Table 4: (Below Calc = 0).

PAHs	ABBR	NUMBER OF RINGS	MEAN (mg/kg)
Naphthalene	Nap	2	0.007
Acenaphthylene	Acy	3	Below Cal
Acenaphthene	Ace	3	0.0019
Fluorene	Flu	3	0.0015
Anthracene	Ant	3	0
Phenanthrene	Phe	3	0.0153
∑ 23 Ring PAHs	-	-	0.0257
Fluoranthene	Flt	4	0.0063
Pyrene	Pyr	4	0.007
Benz[a]anthracene	BaA	4	0.0052
Chrysene	Chr	4	0.0038
∑ 4 Ring PAHs	-	-	0.0223
Benzo[b]fluoranthene	BbF	5	0.0088
Benzo[k]fluoranthene	BkF	5	0.0118
Benzo[a]pyren	BaP	5	0.0126
Dibenzo[a,h]anthracene	DBA	6	0.0109
Indenol[1,2,3-cd]pyrene	InP	6	Below Cal
Benzo[g,h,i]perylen	BP	6	0.004
∑ 56 Ring PAHs	-	-	0.0481
∑16 PAHs	-	-	0.00961

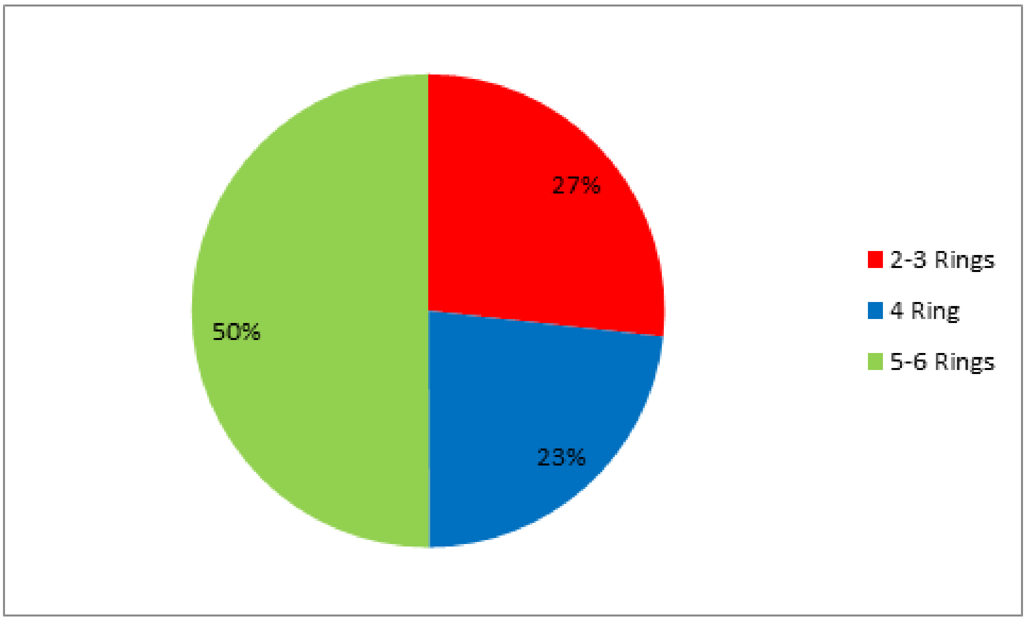

Figure 12: Percent abundance of total PAH concentration in the study area.

The Σ5-6 rings amounted to a concentration of 0.0481 mg/kg, accounting for 50% of the total. Following this, PAHs Σ2-3 ring PAHs exhibit a concentration of 0.0257mg/kg and a percent abundance of 27%. In contrast, the four-membered ring represented as Σ4 PAHs, is less prevalent, with values as low as 0.0223 mg/kg (23%).

As a result of the abundance of Σ5-6 rings of Polycyclic Aromatic Hydrocarbons (PAHs) in the soil, it can have adverse effects on soil. These effects include carcinogenicity, mutagenicity (i.e the ability to induce mutations and genetic damage that can lead to a range of health issues, including birth defects and genetic disorders), genotoxicity (i.e PAHs can accumulate in the tissues of plants and animals that come into contact with contaminated soil), soil and water contamination (i.e When it rains, these compounds can also leach into groundwater or surface water, affecting water quality and aquatic ecosystems), environmental persistence (i.e HMW PAHs tend to be highly persistent in soil due to their complex chemical structures, their longevity in the environment can lead to long-term contamination and ecological risks), and harm to both human health and wildlife (ATSDR, 1995).

CONCLUSION

In the pursuit of understanding the impact of land use types on the accumulation and distribution of Polycyclic Aromatic Hydrocarbons (PAHs) in soil, our investigation focused on three distinct land-use categories: Petrol station (NNPC), farmLand, and Mechanic village. Through a meticulous analysis of the data obtained, it is evident that these diverse land-use types exert varying degrees of influence on the availability and concentrations of PAHs in the soil. Notably, this study reveals that the Mechanic village emerges as the most significant contributor to PAH accumulation (0.073 mg/kg), followed closely by the Petrol station (0.054 mg/kg), with farmLand exhibiting comparatively lower levels of PAH contamination (0.0328 mg/kg).

In conclusion, the accumulation and distribution of PAHs in soil are intricately linked to the nature of land-use activities. The Mechanic village stands out as the most critical contributor, urging immediate attention and intervention to mitigate environmental and health risks. The petrol station (NNPC) also warrants focused management strategies to curtail the further spread of PAHs. Recognizing the significance of land-use types in influencing PAH distribution is a crucial step toward developing targeted remediation and preventive measures for sustainable environmental management.

Moving forward, a multidisciplinary approach that involves collaboration between policymakers, environmental scientists, local communities and urban planners is essential. By implementing effective strategies to reduce PAH emissions, enforce proper waste disposal practices, and promote sustainable land-use planning, we can strive towards creating healthier environments that balance human activities with the preservation of soil quality and environmental integrity.

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