The Fertilization-Related Chemical Properties of Heavy Metal Elements in Coils and Their Potential Impact on Environmental Safety

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ABSTRACT

The chemical features and ecological security risk analysis of heavy metal elements in a given soil induced by fertilization were offered as a means of examining the effects of fertilization on soil chemical characteristics and ecological security. Ni, V, Cr, As, Cd, Pb, Zn, and Hg levels in 1,065 surface soil samples from a city in the southwest agricultural region were studied. Using geographical analysis and multivariate statistics, we were able to better understand the geochemical characteristics of distribution and potential major sources of these heavy metals were addressed. The findings demonstrated that there are three distinct groups that eight different heavy metals may be placed into. The first group consisted of elements with a lower total content: Ni, V, Cr, and As. the significance of the backdrop in Beijing. Further, natural variables, such as soil parent materials, had a significant role in the dispersion. Formation. The second group consisted of Cd, Pb, and Zn, all of which had an average level that was greater than the reference value. Also, the where residential areas have the greatest average content.

Introduction

The effects of human actions (industrial and agricultural output, transportation, etc.) on the urban natural environment have been shown to increase in tandem with the growth of the social economy.To exert one's strength. Since the city's manufacturing sector has grown,with mobility, metropolitan land's original inheritance hashaveundergone a remarkable transformation. The dirt is found all over the world.On the outskirts, beside city waterways, at amusement parks, and sporting events,roads, a garbage dump, and a few empty industriescovered by factories and office buildings [1]. Together, theincreasing rates of urbanization throughout the world, more and moreCadmium (Cd), copper, and other heavy metals (Cu).Metals like nickel (Ni), lead (Pb), zinc (Zn), mercury (Hg), and chromium (Cr)The elements chromium, iron, manganese, molybdenum, andseveral pathways for cobalt (Co) to infiltrate the groundwater and soil. At the current time, significant soil pollution affects every country in the globe.Metals, causing slight to severe disruptions in the typicalnature's role in the larger system. On a more dire note, metals willenter the bodies of animals, plants, and humans through thechain and water, affecting their regular survival, whichis a "chemical time bomb" waiting to go off. In the event when the human bodyingests them in large quantities, it may cause a host of complications.Illnesses that have become widespread and may put people's lives at jeopardy.In addition, the features of delay, lag, and accumulation are present in soil heavy metal contamination [2, 3]. In the event that the soilneeds a significant cleanup due to excessive metal pollutionexpensive and time-consuming treatment plans.Than that caused by air and water pollution combined.Pollutes water supplies and is harder to get rid of. As of latestudies on soil heavy metal contamination have been conducted for decades.Numerous academics both in the US and overseas have taken an interest in,however most of the time dirt used for farming is the subject of study. Contrarily, therearen't a lot of studies looking at heavy metal pollution in

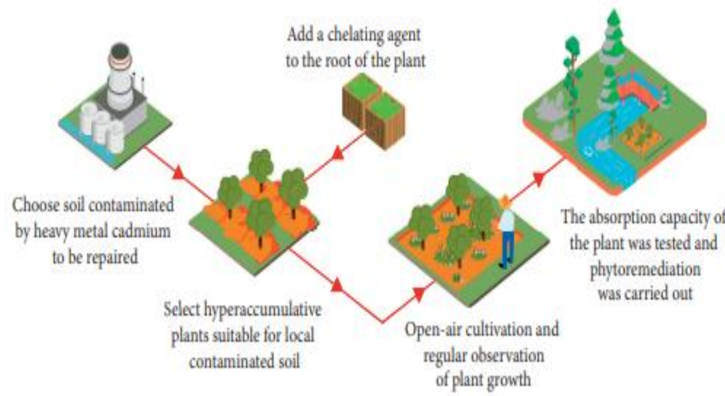

Figure 1: Chemical characteristics of soil heavy metal elements caused by fertilization by farmers

Literature Review

Wang and Ji analyzed the origins of heavy metals in vegetable soil surface samples from a certain region using multivariate statistics and Fourier sum spectral analysis.analyzed the lead concentration inplant life and dirt)These findings confirmed that lead contamination is a serious problem inChanges in the local vegetable supply might be a result of human activity (suchpollution from factories and the use of gasoline for fuel)Alobaidi et al. [4] looked at the ecological geochemicalthe lead's regional peculiarities and came to the conclusion thatNo causal link could be shown between lead's geochemical features and liver cancer.Typical of the region [5]. Several researchers, including Sun, looked into thestate of rural soil contamination caused by heavy metal elementsChemical fertilizers, insecticides, and other agricultural chemicals were identified as major contributors to pollution in the Pearl River Delta.Contamination of cattle and poultry, industrial and other pollutants, andsubstantial influence or effect. More so, the study's industrial soilsoil is deficient in Cu but has high levels in the surroundingCd concentrations are so high that they dominate [6]. For their study, Mukeba and colleaguesthe locational breakdown and origin identification of 12 heavymetals in the atmosphere over Lianyuan, a standard city for the coal industry.The majority of heavy metals were linked to the outcomes,actions of human beings.

According to the PMF model,to the source and distribution of 12 heavy metals in Lianyuan soil was 33.6%, with the remaining 6.4% coming from atmospheric deposition, 0.4% from industrial operations, and 0.2% from agricultural activities.26.5 percent, 23.4 percent, and 16.9 percent, respectivelythe geochemical features of eight heavy metals in soil (Ni, V, Cr, As, Cd, Pb, and Zn) were studied in conjunction with agricultural land in the southwest district neighbourhood of heavy metals in soil as the study's aim.Heavy metals (Cd, Pb, Zn, and Hg) were tested. Together with discriminatory multivariate statistics and geographical analysis, thesoil's environmental quality and its possible ecological danger were evaluated in relation to the soil's principal source of heavy metal.Assessed in light of the criteria at hand.

Research Methods

The Third Step: Taking and Analyzing Samples the study region was split into sample grids of 0.5 km x 0.5 km. To minimize chance, we took 5 samples of topsoil from each grid at a depth ofthe range of 0–20 centimeters, with a sample weight of roughly 1.0 kg. AfterBy combining, blending, and sifting, a mixed sample containing 1,065many samples were taken. The precise coordinates were captured via GPS.of sampling locations)e soil samples were taken, then driedair and dirt, then sieved through a nylon mesh to remove any larger particlesThrough a series of crushing and grinding operations, the material was reduced to a 100-meshpollution-free sifter equipped with an agate mortar and pestle. InSoil samples were collected and stored in a manner designed to prevent the Hg in them from evaporating.Were put away in the fridge for later.The results of the analysis of the samples were determined by the NationalReference to the Geological Experimental Testing Centerguidelines for the quality of the environment in which soil is grownwere taken of Ni, V, Cr, Pb, Zn, SiO_2, Al_2O_3, and Fe_2O_4.Using a spectrometer that measures x-ray fluorescence (RS-1818, HORNGCd levels were measured using graphite in JAAN)).Spectroscopy via atomic absorption techniques in a furnace(AA6810SONGPU), and the amount of mercury and arsenic contained insidefluorescence spectroscopy of atoms method of determination (XGY1011A). Accurate data collection and reporting need theTesting Center for National Geological and Experimentalproper QA/QC (quality assurance/quality control)Benchmark samples' recovery rates ranged from 92% to 108% when evaluated against the various metrics. For 20% of the samples, the standard deviation was lower than 5%.

Evaluating soil contamination caused by individual heavy metal components often involves using the single factor index approach, which has the following formula:

$$P(i) = \frac{C_i}{S_i}, \qquad (1)$$

where Ci is the measured concentration of heavy metals in soil, Si is the assessment standard value of heavy metals in soil, and P(i) is the environmental quality index of pollutants I is an element) in soil. The study's evaluation standard was a city's soil background value.measurement criteria for soil heavy metalsThis is what the P(i) value conditions were: When P(i) is less than 1, it indicates there is nolight 1 P(i) 2 = pollution 2 P(i) 3 = air pollutionrepresents little pollution, P(i) = 3 denotes medium, while P(i) > 3 signifies highpollution.On top of that, there's an ecological riskSwedish academic Hakanson's 1980 proposal of autilized for Soil Environmental Risk Assessment.)Hakanson indexing technique took into account the complementarymultiple-element-effect, pollution-level-toxicity-environmental-sensitivity, and heavy-metal sensitivitypollution. This may be a reflection of the possible consequences of extremelymetals' pervasive impact on the natural world, andallowed for reliable sediment evaluation and contrastin a wide variety of soils)the formula for calculatingthe next.

$$E(i) = T_i \times \left(\frac{C_i}{C_0}\right), \quad (2)$$

the toxicity coefficients of each metal, where E(i) is the potential ecological risk coefficient of metal I and Ti is the toxicity response coefficient of metal i.steel and Ni, Pb, and As are each 10, while Cd is 30.One zinc and forty mercury atoms. Ci is the concentration index forMetal contamination of soil. As an evaluation benchmark, C0soil polluted by heavy metals Studies of the soil's historyHeavy traffic congestion was measured in terms of a city's worthmetals.

The ecological risk index (RI) for this area is equal to the product of the coefficients of potential ecological risk, E(i), for each individual element. The formula for the computation is as follows:

$$\mathrm{RI} = \sum E(i). \quad (3)$$

Soil quality may be categorized into five levels, based on the coefficient of each element's potential ecological danger and an overall index of that risk: mildEcological Degradation: Mild to Severeenvironment-related problems, environment-related problems of a severe kind andsevere ecological degradation (see Table 1)

Result Analysis

Features of Soil Heavy Metal Content 4.1 The enrichment coefficient is the percentage of soil samples that surpass the natural background value, and the enrichment ratio is the percentage of total soil samples that exceed the natural background value.Each metal element's mean value, enrichment coefficient, and local background values arein the second table.Conclusions findings indicated that the typical weight of heftya total of 21.773 mg/kg of metals (Ni, V, and Cr, As, Cd, Pb, Zn, and Hg) were found.70.642mg/kg, 55.47mg/kg, 6.957mg/kg, 0.128mg/kg,Amounts given in milligrams per kilogramme include 24.285 mg/kg, 60.724 mg/kg, and 0.046 mg/kg.Ni, V, Cr, As, and Hg averaged somewhat below their pre-industrial levels.Than a city's baseline norms and standards. In addition to the enlargementthese elements' entropy (EF) coefficients were below 1, whichthe mean values range from 0.88 to 0.91, with an average of 0.90.Elevated levels of Cd, Pb, and Zn compared to typical levelsincreased city value and larger enrichment coefficientsa value greater than 1; 1.21, 1.03, and 1.18 all exceeded 1.

Elements' distribution properties are often shown using box diagrams and histograms (see Figure 2). As several studies have shown,state of affairs in nature; if nothing else is present, the element will exist inhas a typical distribution Figure 2 depicts the elemental distributions of Ni, V, Cr, andThe distributions of the as close to a normal bell curve. Yes, indeednatural causes, it has been hypothesized, have the primary influence on themis mostly determined by internal forces. Nonetheless, Cadmium, Lead, Zinc, and Arsenicdo not follow the typical distribution, indicating that they may have some kind of external influence [11]. Moreover, the containerdistribution of nickel, vanadium, chromium, and arsenicsymmetrically, with a few exceptions. Cd, Pb, and HgThese elements, especially Zn and Hg, not only follow a clear trend,right but also seem to be outliers at the extremesdiagram.Soil Heavy Metal Concentrations and Their Spatial Distribution 4.2)e geochemical map of heavy metal element contentefficient data on the origin and extent of pollutionelements. For this study, we used a technique called cumulative frequency analysis.Wasutilized to determine how to group the substances, and the Kriging interpolation technique was used to produce a map of their distribution.Map depicting the contents of each element and their relative positionsNi, V, Cr, and as concentrations were low across all study sites.In the north and east, but low in the west.)Improvement in quality of lifeInsufficient amounts of these four things were present, which wereThe majority (80.89 %, 29.86 %, 32.2 %, and 26.67 %, respectively)In this study, Quaternary sediments were found to cover the whole study region, with

Table 1: Classification standard of potential ecological risk of soil heavy metals

Potential ecological risk coefficient, $E(i)$	Potential ecological risk index, RI	Pollution degree
<40	<150	Mild ecological pollution
$40 \le E(i) < 80$	$150 \le RI < 300$	Moderate ecological pollution
$80 \le E(i) < 160$	$300 \le RI < 600$	Intensive ecological pollution
$160 \le E(i) < 320$	≥600	Very intense ecological pollution
≥320	–	Extremely intense ecological pollution

Table 2: Statistics of soil heavy metal content in the research area (WB/(mg/kg))

Element	Mean ± standard deviation	Maximum	Minimum	Background value	Enrichment coefficient
Ni	21.80 ± 9.05	128.00	4.37	24.7	0.88
V	70.7 ± 17.9	223.00	16.70	79.2	0.89
Cr	55.5 ± 27.0	622.00	11.20	60.8	0.91
As	6.96 ± 2.80	30.40	1.85	7.7	0.90
Cd	0.144 ± 0.063	0.740	0.048	0.119	1.21
Pb	24.3 ± 5.27	77.90	12.20	23.7	1.03
Zn	67.7 ± 23.1	262.00	18.10	57.5	1.18
Hg	0.046 ± 0.133	3.740	0.007	0.059	0.78

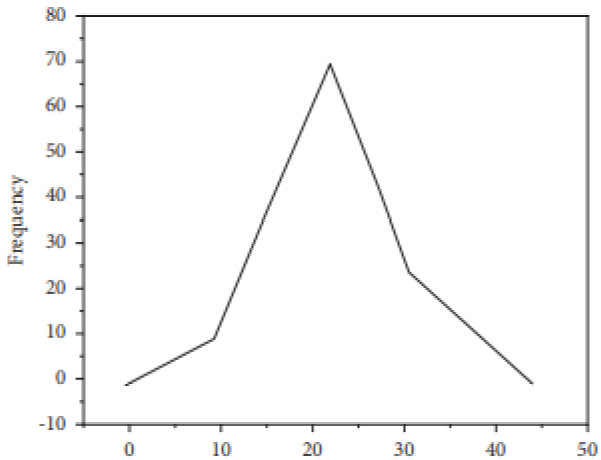

Figure 2: Histogram and box diagram of the heavy metal content distribution.

Limestone and dolomite are only partially exposed in the north and east [12]. Environments influenced how much rock was weathered.Geographic features, and length of exposure, the More Si, Al, Fe, and other elements are enriched the more extensive the weathering. Amongwhen determining the amount of these particles, the Al2O3/SiO2 ratio is oftenextent of weathering, which may help to explainthe greater the Al2O3/SiO2 ratio, the more weathered the rock is.The greater the degree of weathering. An outcome ofthe transformation of rocks into soil by weathering is a crucial part ofheavy metals in soil, and Fe2O3 has been shown to do so through altering the soil's redoxsoil surface charge characteristics in such a way that cadmium, arsenic, and chromium may beadditional components of mountainous regions' soilrepresent significantly high levels. It's worth noting that there have been studiesin the city's southern neighbourhood, according to reports. Per thedistribution of Fe2O3 and Al2O3/SiO2 in spacethat rocks in the north and south have different levels of weatheringthe region to the east of the study site is where the highest concentration of people is found.And high levels of Ni, V, Cr, and as is in line with the region where rock weathering is very advanced, suggestingRock weathering mostly alters these four components.

Cluster analysis and principal component analysis are two types of statistical methods that may be used to break down large amounts of data into more manageable chunks.The primary records that are utilized to differentiate between soils with different levels of metals. Objects that rely heavily on the same primary component are likely toreferences [13]. Analysis of Heavy Metal Components Using Principal Componentselemental analysis of the study region revealed that three of the eight heavy metals present could be broken down into their fundamental chemical components.As seen in Table 3, below:These three classes of underlying elementsmay account for

78.51 % of the entire variation, which should becomponent of the whole)e variation in othersubcomponents was under 10%, hence these three categoriesresearch focused mostly on discussing variables.

Through the use of cluster analysis (a technique for categorizing variables based on the degree of intimacy between them), variables with comparable features and behaviors may be grouped into a group, each of which has its own set of characteristics and behaviours.used extensively in statistical research ([16])when applied to earth science, cluster analysis allows for the components to be groupedgroup everything made from the same raw materials into one category and labeldistance of atoms from various material sourcesThe degree of proximity between clusters in aclustering distance, the more tightly packed the clusteredconnectedness of the parts is. Throughout the course of this study, eightthere were three classes of metals considered to be heavy.Using a 15- to 20-meter reference point, thePrincipal component analysis and cluster analysis weresimilar.Distribution of Group I elements (Ni, V, Cr, and As)standard deviations of the four components in soil samplesto a normal distribution, and the enrichment coefficient was less than 1.Since they contribute more to the first PC, they are emphasized.Greater values are restricted to the region with a greatershows that the distribution of elements Ni,V,Cr, and As in the research region is (depending on the degree to which the rocks in the area have been weathered.)the types of heavy metals were reasonably consistent with one another.Produced mostly from soil and modified by natural forcescreated by the weathering of nearby rocks as the parent material.

Table 4: Soil element risk assessment table.

Element	Quantity of the samples				$E(i)_{mean}$
	$P(i) \leq 1$	$1 < P(i) \leq 2$	$2 < P(i) \leq 3$	$P(i) > 3$	
Ni	735	319	8	3	4.407
V	779	281	5	0	1.784
Cr	746	302	10	7	1.825
As	720	336	7	2	9.035
Cd	391	643	25	6	36.329
Pb	577	480	5	2	5.123
Zn	389	647	22	7	1.178
Hg	922	116	18	9	31.002

Alloys of heavy metals Lead and zinc (both of which contribute to air pollution due to vehicles) are two such elements. And the buildup of Pb concentration isconnected to the movement of vehicles. Pb is a major turning pointfactor in air pollution, and car exhaust is a major source oflead (Pb) contamination of soil is mostly attributable tothe use of leaded fuel and its subsequent combustion. Despite China's prohibition on leaded gasoline in 2000, the high Pb concentration in this region clearly demonstrates the severity of Pb pollution.Gasoline used to be a very stable pollutant until it was phased out.And degrading complexity [17] Elements of Pb and Zn in the environment and the driving of motor vehicles have very similar origins.Automobiles, motor lubricant oxidation, engine component wear,the deterioration of brakes and tires, as well as the peeling of paint,soil Zn buildup. Common elements include cadmium.Caused by human activities to enter the natural environment. Manufacturing, metalworking, and other forms of heavy industry includeBatteries, plastic chemicals, and other additions, combustionsoil Cd levels may be affected by the region's use of fossil fuels and generation of industrial waste [18].

Conclusions

The study included the collection and analysis of 1,065 soil samples from the southwestern part of a city, with a focus on eight different heavy metals. Multivariate statistics and spatial analysis were utilized to provide light oncharacteristics of heavy metal distribution in soil, and thecritical determinants of distributional featuresevaluated, and the findings revealed that the mean value of Ni, V,The concentration of Cr and As elements was lower than the control value ofnormal distribution with a mean and standard deviation that fit the city's population, and aheavy reliance on the earliest principalthe geographic distribution map of components from a principalThe elemental content analysis revealed that the levels of Nickel, Vanadium, Chromium, andNorthern and eastern parts of have greater concentrations of elements becauserocks that have been heavily weathered in the study region. Itshown that the primary determinants of its dispersion weresubstance used to create soil from. Heavy metals (Cd, Pb, and Zn)The average background value was greater than usual.

The urban area's content, the enrichment coefficient washistogram's content did not follow thePrincipal Component Analysis and the Normal Distributionsecond major components carried a disproportionately heavy weight. Additionally, the triplets of thickly populated,range widened regional content increased; this mayinduced by human intervention, such the region's traffic, agriculture, andthe third main component wascalculated separately for Hg, which had a non-normal distribution and was thus used in the context of the tourist industry. Duevolatility, its distribution features were mostlyinfluenced by precipitation from the sky.

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