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Underground Distribution of Heavy Metals in Central Albania.

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Abstract **–** The scientific study provides information on the heavy metal concentrations found in the Middle Albanian city of Elbasan's subterranean levels. We can draw a significant conclusion from the data if heavy metal concentrations are high enough to be regarded as contributing contributors to soil contamination. This work's main goal was to demonstrate any potential links between chemical soil contamination and pollution, which has a negative influence on public health.

Five soil samples that were obtained in March 2024, down to a depth of 0.5 m, were served to achieve this target. We draw attention to the fact that Elbasan City has been implicated in serious soil, water, and air chemical pollution throughout the years.

We were able to collect findings from the statistical analysis of the data that provide information on chemical components that may be implicated in soil contamination.

In conclusion, we find a chemical pollution of the soil from the element nickel, which is present in an amount approximately 2.5 times more than the standards defined by the EU Regulatory Acts. This is based on a qualitative analysis of the results compared to the permitted pollution rates from the EU.

According to our assessment, the identified contamination of the Elbasani soil is primarily caused by agricultural farmers' improper use of chemical and organic fertilizers, and primarily abusive behavior by light and heavy industries operating in the city.

Keywords – Heavy Metal, Soil Contamination, Nickel, Industries, Elbasan City.

I. INTRODUCTION

The heavy metal pollution of Elbasan's industrial facilities, mines, and enrichment plants has been extensively researched by a multitude of scholars from the country's academic institutions and research centers. This study hasn't stopped and won't stop.

Heavy metal contamination in the soil near industrial areas has had devastating impacts on pastures, woods, and arable land. Cu, Ni, Zn, Pb, Co, Cd, and arsenic accumulation on agricultural land and forest ecosystems near industrial sites has drastically changed the plant community.

Heavy metals are naturally present in the crust of the Earth. Heavy metals include lead (Pb), mercury (Hg), cadmium (Cd), arsenic (As), chromium (Cr), nickel (Ni), and selenium (Se).

Along with trace elements, several heavy metals are essential for maintaining life and the body's metabolism, including copper, zinc, and selenium [1-2].

Heavy metals are dangerous even in small doses. They cannot be eliminated or made into nothing. They have detrimental impacts on living organisms when ingested in small amounts through food, drink, and the air [3,4,5,6,7, 8,9].

When heavy metal concentrations are higher than allowable limits, poisoning may ensue.

Heavy metals are dangerous because of their tendency to bioaccumulate [7].

Other diseases, such as typhoid, influenza, tuberculosis, and other fungal infections that impact plants or animals, can be easily spread through the air [10, 11, 12].

Bioaccumulation is the process by which chemical components become concentrated over time in a biological organism as opposed to their concentration in the environment [10,11, 13].

In the natural world, they are not as focused. Conversely, high quantities of heavy metals have detrimental impacts on human health and the ecosystem in contaminated regions [5-9, 13].

Plants that are exposed to heavy metals have damage to their cell membranes, abnormal growth of roots and shoots, reduced CO_2 absorption, reduced transpiration, and reduced stomatal conductance [5-9, 12-13].

In addition to the primary output, industrial processes produce solid, liquid, and gaseous secondary products, which need continuous management and environmental monitoring [5-9, 13].

pH, redox potential, organic matter, and total metal content are a few examples of the factors that influence the concentration of metals in soil [14, 15].

The soil pollution that was present in a few Elbasan areas in March 2024 is extensively discussed in this article. Five monitoring sites have been selected to investigate Elbasan's microbiological and heavy metal pollution levels. These stations are in the industrial complex's north, east, and southwest directions.

The two locations are around 80 and 2100 meters away from the facility, respectively.

The data analysis showed that the concentrations of zinc, arsenic, cadmium, chromium, cobalt, copper, and lead are within the threshold limits specified by the EU, except for nickel, which is present at levels 2.5 times higher than the stipulated criteria.

Crops were grown in every soil that was examined. The main crops planted there are fruit trees, wheat, maize, and fodder items [10, 11].

Investigating the underground distribution of heavy metals in Central Albania is crucial for understanding the environmental impacts of mining activities, industrial pollution, and other anthropogenic factors in the region. Our scientific study seeks to provide early insights into the possible causes and contributing factors of soil pollution. We studied soil samples from Elbasan city and evaluated the presence of heavy metals and microorganisms.

II. MATERIALS AND METHOD

Five soil samples are taken in March 2024 at a depth of 0.25 to 0.5 meters in the Elbasan area.

The speciation analysis in water soil extracts was determined using the colorimetric approach diphenyl carbazide [5-9, 16].

After that, 2.5 g of soil samples were combined with 25 ml of demineralized water and left for around two hours. The water was filtered using a 0.45 μm Millipore filter after a 10-minute centrifugation at 3500 rpm [14]. After extraction, the sample was acidified right away to bring the pH down to less than 2 with a drop of concentrated ultrapure HNO_3.

After 30 minutes of magnetic stirring, the sample was suspended in 25 ml of demineralized water containing 10 g of soil, and the pH of the soil was evaluated using standard calibration at pH 4–7 [16].

Over 90% of the soil sediments were found to be in the silt to sand fraction, according to many examinations. The percentage of clay was about 9%.

Ten grammes of the sample were treated with HCl to eliminate calcareous material, oxalic acid to release iron, and H_2O_2 to release organic material to determine the grain size.

III. RESULTS

Soil samples taken in the Elbasan area in March 2024 are found to have a substantial microbial presence after laboratory exams, statistical analysis, and analytical processing. However, nickel is the only element when soil contamination is above allowed limits.

The data from each of the five samples is pooled and compared to the baseline rates to precisely determine the level of soil contamination.

Table 1 presents the mandatory information along with a heavy metal presence analysis for each of the five locations in March.

Table 1. The average amount of heavy metals found in the five study sites' soil.

No.	**Heavy Metals**	**Recommended content *(mg/kg)***	**Average *(mg/kg)***
1	Cadmium (Cd)	3	1.08
2	Arsenic (As)	30	0.69
3	Cobalt (Co)	75	31
4	Nickel (Ni)	75	**178**
5	Copper (Cu)	140	38
6	Chromium (Cr)	200	45
7	Lead (Pb)	300	52
8	Zinc (Zn)	300	66

All elements except nickel, which show values much above the allowed rate, are within the allowed range.

Since the amount of *Zinc (Zn)* in our soil (66 mg/kg) is less than the 300 mg/kg legal limit established by European regulations, it may be regarded normal. However, 10 mg/kg of zinc introduces it into the normal soil contents, and 100 mg/kg of zinc is called deadly soil.

Lead (Pb) is a typical component of soil at a level of 10 mg/kg, but above 100 mg/kg, the soil is deemed toxic; in other words, it is present in normal amounts at 52 mg/kg of the maximum 300 mg/kg permitted by the EU.

Beyond 5 mg/kg of *Chromium (Cr)* is considered part of the normal soil composition; beyond 75–100 mg/kg, the soil is considered dangerous; now, the value of Cr is 45 mg/kg, which is less than the 200 mg/kg maximum permitted by the Directives. Because it is European, its presence is nevertheless considered to be rather near but still below the permitted limit.

The presence of *Copper (Cu)* can be regarded as normal as it is now evaluated at 38 mg/kg rather than the 140 mg/kg permitted limit by European rules. Normal soil type is quantified by copper (Cu) at 2 mg/kg, whereas dangerous soil is classified at 60-125 mg/kg.

Soil with 10 mg/kg of *Cobalt (Co)* is considered normal; 40 mg/kg of Co is considered dangerous; nevertheless, Co concentration between 31 mg/kg and 75 mg/kg, the maximum quantity permitted by the EU, can be considered almost normal.

Since the permitted limit set by European guidelines is 30 mg/kg, *Arsenic (As)* is evaluated at 0.69 mg/kg, suggesting that its presence may be normal. Normal soil type is measured at 5 mg/kg, while dangerous soil is defined as 20–40 mg/kg.

Cadmium (Cd) concentration is classified as normal when it is less than 0.1 mg/kg; toxic when it exceeds the EU's upper limit of 3–8 mg/kg; and almost normal when it is less than 1.08 mg/kg.

- 10 mg/kg of *Nickel (Ni)* in soil is regarded as normal; 70–400 mg/kg of Ni in soil is regarded as dangerous. It is discovered to be 2.5 times higher than the European Union standard and the maximum permitted by European Directives, with a value of 178 mg/kg of 75 mg/kg.

IV. DISCUSSION

Soil degradation can result from both industrial waste pollution and heavy metal contamination. It has been demonstrated that soil microbial communities in contaminated areas contain a considerable number of microbial taxa, such as actinomycetes, fungi, aerobic bacteria, and nitrogen-fixing agents [2,4, 15].

Heavy metals are discharged into the environment through a variety of technological processes, the smelting and refining industries, metal scrap, the plastics and rubber industries, various consumer goods, and the burning of waste containing these elements. They can get into the food chain by ingestion of food, air suction, and a source of potable water [17].

When heavy metal concentrations in the environment are high, people and other animals are exposed to toxic compounds through ingestion, dust inhalation, or the food chain.

The residual feed that animals are fed may include heavy metal pollution when land is fertilised using organic manure, which is derived from animal waste [14].

Elbasan City ranks among the most polluted cities in Albania. We believe that the following factors are the main causes of this pollution: a densely populated area, lots of buildings, traffic, infrastructure, a dearth of green spaces, and, most importantly, the expansion of heavy industrial production activity and the Albanian government's insufficient technical control, which ignores environmental pollution measures.

We think that this high concentration of nickel is caused in part by the lithology of the surrounding terrain, which also shows that nickel pollution in the examined area is a natural outcome of nickel dispersion [5-7, 18-19]. Environmental contamination with nickel, transportation is known to be the source [5-7, 20-22], although refinery emissions and industrial waste account for most of the pollution.

To address soil contamination with nickel, remediation strategies may include soil removal and replacement, soil amendments (e.g., lime, organic matter), phytoremediation (using plants to extract or immobilize contaminants), and containment measures (e.g., capping). Monitoring and regulatory measures are also important for managing and preventing nickel contamination in soil [5-9, 22].

When the Elbasan region's soil was being analysed, nickel pollution was discovered there.

V. CONCLUSION

- All the heavy metal components have almost ideal conditions found for them.
- The Elbasan region's soil is contaminated with heavy metals, with nickel being the only element to show pollution at above 2.5 times the EU's recommended values.
- We believe that Elbasan's raw material deposit from the city's heavy and light industries is the main reason for the high concentration of nickel in the soil, which makes the city known for having polluted soil.

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