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# Soil Pollution Caused By Heavy Metals Presence, In Elbasani Town, Middle Albania*

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***Abstract*— In this undertaken study we have tried to provide a clear framework for the distribution of heavy metals for Elbasani town. The analyzed samples were taken on the outskirts of Elbasan city which corresponds as a geographical location to the industrial area of the city. We emphasize that we are talking about soil pollution in cases when the presence of heavy metals is above the allowable norm.**

**This paper was carried out with the primary purpose of providing the link that may exist between chemical soil pollution, caused by the production activity of heavy industries that leads to the presence of heavy metals above the allowed norm and their impact on agricultural crops grown in the surrounding area. In view of this goal, we have received soil samples, during a two-month period of this year, specifically August-September.**

**We mention the fact of selecting Elbasani town as an object of study, being in these last decades the epicentre of the most polluted cities in Albania, a feature that is dedicated to the productive activity of heavy industries that carry out their activity in this city.**

**Based on the analysis of the obtained results, we conclude at an acceptable level of chemical pollution of the soil, with the exception of Nickel (Ni) which is encountered above the standard values set out in the Regulation of the Albanian State but also of the EU.**

***Keywords*— Soil pollution, Heavy metals, Nickel, Agricultural crops, Elbasani town**

## I. INTRODUCTION

Heavy metals have consistently been essential for the Earth's crust. Among the heavy metals we notice Lead (Pb), Mercury (Hg), Cadmium (Cd), Arsenic (Si), Chromium (Cr), Selenium (Se), and so on heavy metals have a harmful impact in the event that they are available in the soil over the permissible concentrations. For this situation they lead to reduction and unavoidably genuine outcomes in the horticultural yields developed on that land. Like minor components, weighty metals are of an essential character to keep up the human body's chemistry, so the human body works appropriately. Presence above the permitted norms of heavy metals causes serious damage to the surroundings and even more so to human health [1, 2]. It should be noticed that in little amounts they pass to human body, basically acquired through food, drinking water and air [3, 4].

On account of focuses over the set standards, the presence of heavy metals in the ground can prompt to serious consequences up to poisoning for the human, caused by heavy metals precisely because of their bio-accumulating ability. Bioaccumulation is the increase that the presence of chemical elements in a human organism undergoes over time, comparing this phenomenon with the concentration of these elements in the atmosphere [5, 6].

The presence above the permissible norm of heavy metals that leads to soil contamination has had a devastating effect not only on agricultural land but also livestock pastures and forest areas. Accumulations and depositions of the heavy metals in agricultural lands, pastures and forests near industrial areas, have led to a radical change of plant associations. Soil moisture is responsible for soil redox potential and biological activity, thus having a substantial impact on the chemical transformation of heavy metals present in the soil and determining their validity for plants [7, 8].

The purpose of this study was to provide data on soil pollution for Elbasani town, during the August - September 2020 period. To achieve a valid analysis of the pollution level caused by the heavy metals presence we have determined 15 monitoring points in the direction of north, east and southwest of the study area, where as the starting point of monitoring is defined the area positioned at a distance of 100 m from the study base area and as the farthest station we have determined the area located at a distance of 2.5 km.

Based on the results obtained, we conclude that: all heavy metals are present below the recommended critical values, with the exception of only nickel, which is present at levels significantly higher than border criteria.

Nickel (Ni) is a very important nutrient for plants [9] but present in high levels and above the allowed norm has potentially dangerous effects on humans [10].

We also mention that the lands where soil samples were taken are cultivated with cereals, fodder, and fruit trees [6].

By studying the presence and current amount of heavy metals in the analyzed samples we provide initial information on the impacts and possible factors that may have brought in soil pollution of Elbasani town.

## II. Materials and Methods

All the samples were processed by the method given by Page [11]. The present amount of metals in the soil samples taken was determined in the solution made from the HF - $HClO_4$ mixture based on atomic absorption spectrophotometers. Initially soil samples were treated with the 4-acid method, based on the digestion of 0.1 g of soil sample with 2.5 ml $HNO_3$.

The soil samples with the weight varied from 20 g to 200 g were dried at 40°C, separated in a porcelain mortar, homogenized and sieved. More than 95% of the soil sample are <2 mm fraction. After dividing into four parts, one part was crushed to fine powder for total analysis, while the rest of the sample was stored in plastic bags and set aside for additional analysis.

Twice jointly 5 ml HF and 1.5 ml $HClO_4$ were added and as the last process was added, after partial evaporation 2.5 ml HCl. The total concentrations of Cr, Ni, Zn, Cu, Cd, Co, As and Pb were defined by Flame Atomic Absorption Spectrometry *(FAAS, types Varian AA6 and Varian AA-1475).* The insoluble residue from the 4-acid digestion varied between 1-3% of the initial sample weight. The detection limit for most of the trace elements varied around 0.1 and 1 mg/kg. Determination in dry soil/sediments was made in laboratory conditions based on the Munsell [12].

Soil-pH was measured in a suspension solution of 10 g of sediment (<2 mm) in 25 ml demineralised water after magnetic stirring for 30 min and 5 minutes sediment settling. Grain size analyses [13] were carried out on composite samples, and were determined by laser diffraction.

## III. Results and Discussion

Based on the results obtained for soil samples analyzed during the August - September 2020 period in Elbasani town, it is seen that the nickel element is present above the allowed norms, thus leading to soil contamination.

The results of both months are grouped in order to present as concisely as possible the performance of soil pollution.

Table 1 shows the presence of chemical elements for both months analyzed, also gives the recommended content. With the exception of nickel, all other elements are present in the soil below the permitted norm.

Figure 1 is constructed from the data of Table 1.

This figure gives the level of presence of heavy metals in the ground compared to the recommended content.

Cadmium (Cd) in the quantity of 0.1 mg/kg is involved in the normal soil content while for 3-8 mg/kg the soil is considered toxic; in particular it is in the value of 1.1 mg/kg of 3 mg/kg constituting the limit permitted by the EU, so its presence can be considered almost normal.

Arsenic (As) for the quantity of 1 mg/kg is introduced into the normal soil content while for the amount of 20-50 mg/kg the soil is called toxic. It is present at a value of 2 mg/kg of 30 mg/kg; so its presence can be considered almost normal.

TABLE I. Presence of heavy metals in soil samples

| No. | **Heavy Metals** | **Recommended content** ***(mg / kg)*** | **Content found** ***(mg / kg)*** |
|---|---|---|---|
| 1 | Cadmium (Cd) | 3 | 1.1 |
| 2 | Arsenic (As) | 30 | 2 |
| 3 | Copper (Cu) | 140 | 23 |
| 4 | Lead (Pb) | 300 | 24.2 |
| 5 | Cobalt (Co) | 75 | 24.4 |
| 6 | Zinc (Zn) | 300 | 84.3 |
| 7 | Manganese (Mn) | 300 | 103.9 |
| 8 | Nickel (Ni) | 75 | **154.5** |
| 9 | Chromium (Cr) | 200 | 166 |
| 10 | Iron (Fe) | 5000 | 1358.8 |

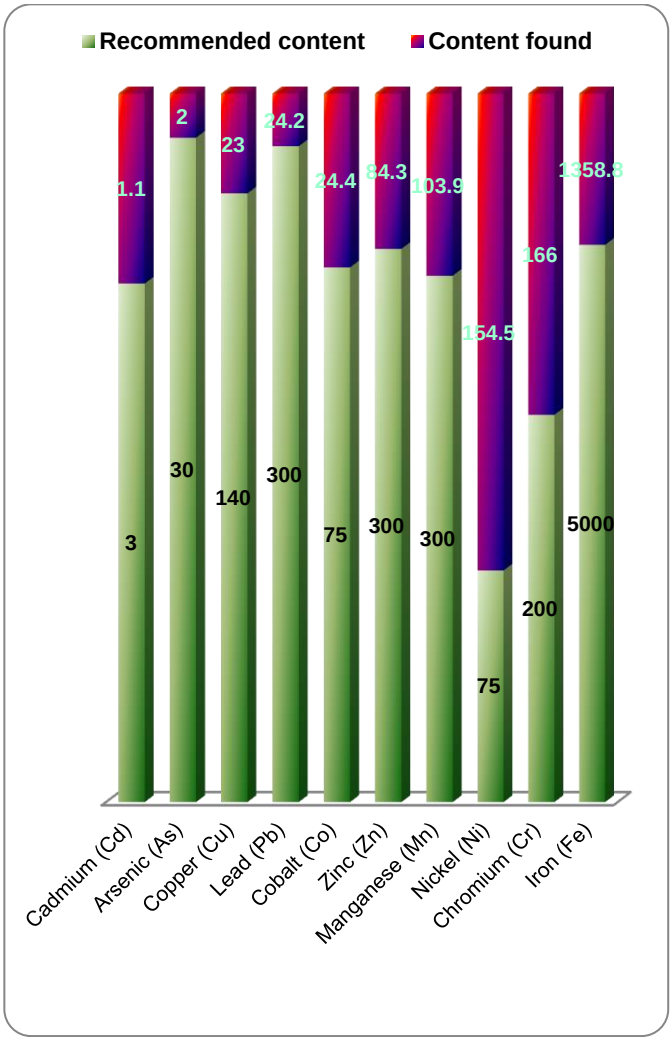


Fig. 1. *Soil pollution level by chemical elements in relation to the recommended amount*

Copper (Cu) for 2mg/kg quantifies normal soil type and for 60-125 mg/kg soil is classified as toxic, currently it is measured at 23 mg/kg from 140 mg/kg constituting the permissible limit of European directives, so its presence can be considered normal.

Lead (Pb) it is in the value of 24.2 mg/kg of 300 mg/kg which constitutes the limit permitted by the European Directives, so its presence can be considered almost normal.

Cobalt (Co) for the quantity of 10 mg/kg is introduced into the normal soil content while for the amount of 60-200 mg/kg the soil is called toxic. It is present at a value of 24.4 mg/kg of 75 mg/kg; so its presence can be considered normal.

Zinc (Zn), for the quantity of 10 mg/kg is the normal soil contents and for the amount of 100 mg / kg the soil is called toxic, in our case it is in the value of 84.3 mg/kg of 300 mg/kg constituting the limit permitted by European directives, so its presence can be considered normal.

Manganese (Mn) it is measured at 103.9 mg/kg from 140 mg/kg constituting the permissible limit of European directives, so its presence can be considered normal.

Chromium (Cr) for the quantity of 5 mg/kg is included in normal soil content and for the presence of 75-100 mg/kg the soil is considered toxic, currently it is present in the value of 166 mg/kg out of 200 mg/kg, so its presence can be considered below than the allowed parameters.

Iron (Fe) in our case it is in the value of 10358.8 mg/kg of 5000 mg/kg constituting the limit permitted by European directives, so its presence can be considered normal.

Nickel (Ni) for the quantity of 10 mg/kg is introduced into the normal soil content while for the quantity of 70-400 mg/kg the soil is considered toxic. It is present at a value of 154.5 mg/kg of 75 mg/kg which constitutes the limit permitted by the European Directives; this means that it is at a higher level than the European standard.

Due to the fact that nickel is one of the key nutrients for normal plant growth and development, as well as being essential for the activation of enzymes such as urease and glycoxalase-I, makes nickel an important element with an essential role in various physiological processes, where we mention seed germination, vegetative growth, photosynthesis and nitrogen metabolism.

In this way, the plants are conditioned and cannot carry out their biological cycle without supply at the proper rate of Ni [14].

The source and high presence of Ni in the soil comes mainly from the land filling of wastewater and industrial waste [15].

Nickel is one of the heavy metals that with its presence above the allowed norms in the soil, causes environmental damage not only in urban cities, but wherever there is a decrease in soil pH values, improper use of soil lime on agricultural lands and excessive deposition resulting from acid rain in industrialized areas [16, 17].

The highest presence of Ni is found in acidic soils, followed by neutral soils and the lowest presence is found in alkaline soils. This phenomenon is due to the essential effect of equilibrium pH on the concentration of this element. Reddy et al. [18] in studies conducted has suggested that with decreasing soil pH, the availability of metal ions in the soil increases. Lowering the soil pH leads to increased solubility and mobility of nickel, thus being the soil pH the main factor that controls the solubility, mobility and absorption of nickel in the soil, while the composition of clay, iron-manganese minerals and soil organic matter have a secondary role [19, 20].

We emphasize that heavy metals are present in the environment mainly from technological processes, the activity of smelting and refining industries, scrap, plastics and rubber and waste incineration. The path that heavy metals follow for us in the food chain is through the supply of drinking water, air and the consumption of plant-based foods [9, 21].

Elbasani town has always been one of the most polluted cities in Albania.

This alarming pollution is mainly due to: urban traffic, infrastructure, and lack of green areas, high population density and above all the development of heavy industry activity in Elbasan followed by improper management regarding technical control carried out by the relevant state instances.

In conclusion, we can say that Elbasan city soil, results to be polluted by Nickel.

## IV. Conclusion

1. Elbasani town soil is rich in heavy metals, which all except Nickel do not present a level of pollution and are within the allowed parameters.

2. Nickel is present in soils with values significantly higher than the standards set by EU regulation and the Norms set by the Albanian state.

3. Elbasan city has real soil pollution; a phenomenon that we think is dedicated to the storage of raw materials on the ground from the production activities of heavy industries that carry out their activity in Elbasan area.

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