International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

Assessment of Chemical and Bacterial Pollution in Soil Samples from Industrial Areas of Elbasan, Albania

Anila Jançe[1*], Admir Jançe[2]

[1]Barleti University, Tirana, Albania.*
[2]European University of Tirana, Tirana, Albania.

Corresponding Email: [1]adi_jance@yahoo.it*

Received: 28 November 2023 **Accepted:** 14 February 2024 **Published:** 01 April 2024

Abstract: ***This study investigates soil pollution in the industrial zones of Elbasan, Albania, focusing on chemical contamination, particularly heavy metals, and bacterial pollutants. Groundwater and soil samples were collected during August-September 2023 to assess the extent of pollution in areas dominated by light and heavy industries. For the first time, comprehensive data on soil pollution, are presented for the analysed period. The findings underscore the significant impact of industrial activities on soil quality and highlight the urgent need for environmental remediation measures.***

Elbasan city has long grappled with environmental pollution, particularly from industrial activities. Soil pollution, driven by chemical contaminants and bacterial agents, poses serious health risks to residents and ecosystems.

Sampling sites were selected based on the presence of light and heavy industries, which are known contributors to soil pollution. Chemical analysis involved quantifying heavy metal concentrations, including Nickel (Ni), using state-of-the-art techniques such as atomic absorption spectroscopy. Bacterial contamination was assessed through microbial culture and enumeration methods. Nickel concentrations exceeded EU regulatory standards by more than threefold, indicating severe contamination.

The high levels of chemical pollution observed in Elbasan's soil underscore the environmental degradation caused by industrial activities. Collaboration between governmental agencies, industries, and local communities is imperative to address soil pollution effectively and safeguard environmental sustainability.

The study highlights the pervasive nature of soil pollution in Elbasan's industrial areas, posing significant health risks. Urgent action is required to mitigate pollution sources, improve wastewater management practices, and enforce environmental regulations. Addressing soil pollution is essential to protect public health, preserve ecosystems, and promote sustainable development in the region.

Keywords: Soil Pollution, Chemical Contamination, Bacterial Pollutants, Heavy Metals, Elbasan -Albania.

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

1. INTRODUCTION

Numerous academics from the nation's academic institutions and research centres have studied the contamination of Elbasan, caused mainly by the activity of various industries that carry out their activity in the city, being among the main factors of soil or air pollution with heavy metals. This research has continued and will continue.
Devastating effects have been observed on pastures, woodlands, and agricultural land due to heavy metal poisoning in the soil surrounding industrial regions.
Cooper, arsenic, cadmium, cobalt, zinc, Lead and Nickel accumulation in wooded regions and agricultural land adjacent to industrial sites has drastically changed the plant community.
The Earth's crust naturally contains heavy metals. Lead (Pb), Mercury (Hg), Cadmium (Cd), Arsenic (As), Chromium (Cr), Selenium (Se), and Nickel (Ni) are a few examples of heavy metals. Even in small quantities, heavy metals are hazardous. They can't be destroyed or reduced to nothing. Small amounts of them are absorbed by the body through food, drink, and the air, where they have harmful effects on living things [1-6].
Certain heavy metals, such as copper, selenium, and zinc, are necessary to support life and preserve the body's metabolism, just like trace elements [7], [8].
Poisoning can result from the presence of heavy metals at high concentrations, above permissible rates. The air can easily transmit several diseases, including typhoid, influenza, tuberculosis, and many fungal infections that affect plants or animals [9], [10], [11]. Because they have a propensity to bioaccumulation, heavy metals are hazardous [9], [10]. Bioaccumulation is the process by which the concentration of chemical components in a biological organism increases over time relative to the concentration of those elements in the environment [9], [10], [12].
Their level of concentration is low in the natural world. On the other hand, excessive concentrations of heavy metals in contaminated environments have an adverse effect on the environment and public health [3-6], [12].

2. RELATED WORKS

Generally speaking, industrial operations generate solid, liquid, and gaseous secondary products in addition to primary output, which calls for constant control and observation of the surrounding environment [3-6], [12]. Heavy metals harm plant cell membranes, prevent roots and shoots from growing normally, decrease CO_2 uptake by plants, and decrease transpiration and stomata conductance [3-6], [12].
In typical soils, heavy metal solubility is poor. Factors including pH, red ox potential, organic matter, and the overall metal content of the soil affect the concentration of metals in the soil [13], [14].
Important details regarding the soil contamination in select Elbasani town districts by August to September of 2023 are provided in this document. For the purpose of analysing the degree of microbiological and heavy metal pollution in Elbasan, five monitoring points have been identified in the east, southwest, and north directions of the industrial complex. About 70 metres separate one position from the facilities, and about 2500 separate another.

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

Zinc, arsenic, cadmium, chromium, cobalt, copper, and lead concentrations are all below the critical EU-determined norms, according to the data analysis, with the exception of nickel, which is only found at levels 2.5 times higher than the specified threshold.
Every soil analysed had crops planted in it. Fruit trees, wheat, maize, and fodder items are the principal crops grown there [9], [10].
By looking at the microorganisms and heavy metal content of the analysed Elbasan soil samples, our scientific study aims to provide some initial insights into the potential causes and consequences of soil pollution.

3. METHODOLGY

In the Elbasan area, five soil samples are collected during August and September of 2023 at a depth of 0.25 to 0.5 m. Utilising the colorimetric technique biphenyl carbazide, determinations in water soil extracts were made for the speciation study [3-6], [13].
Following that, for roughly two hours, 25 millilitres of demineralised water were combined with 2.5 gram of soil samples. Following a 10-minute centrifugation period at 3500 rpm, a 0.45 μm Millipore filter was used to filter the water [10].
Immediately following extraction, the sample was acidified by adding a drop of concentrated ultrapure HNO_3 to bring the pH down to less than 2. pH of the soil in a suspension of 10 gram of soil in 25 millilitres of demineralised water, following 30 minutes of magnetic agitation and 5 minutes of sedimentation (following pH 4-7) [13].
Numerous investigations revealed that the silt to sand fraction accounted for over 90% of the soil sediments. There was roughly 8% clay content. To analyse the grain size, after treating 10 gram of the sample with HCl to eliminate calcareous material, oxalic acid was used to release iron, and H_2O_2 was used to release organic material.

4. RESULTS AND DISCUSSION

After being subjected to laboratory analyses, statistical analyses, and analytical processing, soil samples from the Elbasan region were found for period between August and September of 2023, indicate a notable microbial presence; however, soil pollution exceeding permissible levels is only detected in the nickel element.
To accurately assess the extent of soil pollution, the data from all five samples are combined and compared to the baseline rates.
In addition to data on the presence of Coliform and Enterococci bacteria, Table 1 displays the microbial population in the soil.

Table 1. Microbial Analysis Summary for Each of the Five Locations

No.	Microbiological Indicator		Average Achieved Per 100 G Of Soil		Total In Perentage	
1	Coliform bacteria (group)	Coliform bacteria - without E. coli	48954	58816	65	78
		E. coli	9862		13	

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

2	Enterococci	16258	22
Entire bacterial populations		75074	/

In Table 2 are shows the required content together with an analysis of the heavy metal presence for each of the five stations from August to September. Except for nickel, which exhibits values significantly over the permitted rate, every other element falls below the permitted standard.

Table 2. The Five Stations' Average Value of Heavy Metals in the Soil

No.	Heavy Metals	Mean (Mg/Kg)	Suggested Dosage (Mg/Kg)
1	Arsenic (As)	0.6	30
2	Lead (Pb)	60	300
3	Zinc (Zn)	71	300
4	Cadmium (Cd)	1.4	3
5	Cobalt (Co)	32	75
6	Copper (Cu)	42	140
7	Chromium (Cr)	54	200
8	Nickel (Ni)	188	75

Cadmium (Cd) in the quantity of 0.1 mg/kg is included in the normal soil content, however the soil is considered poisonous from 3–8 mg/kg. Since the EU allows a maximum of 3 mg/kg, the presence of Cd is almost normal at 1.4 mg/kg. Since arsenic (As) is now tested at 0.6 mg/kg instead of 30 mg/kg, which is the acceptable limit of European directives, its presence can be regarded normal. Arsenic (As) at 5 mg/kg quantifies normal soil type, while at 20–40 mg/kg soil is categorised as poisonous.

When cobalt (Co) content is 10 mg/kg, the soil is considered normal; when it reaches 40 mg/kg, the soil is deemed poisonous; however, when Cobalt content is between 32 mg/kg and 75 mg/kg, which is the maximum amount allowed by the EU, its presence can be regarded as nearly normal. The presence of copper (Cu), which is currently detected at 42 mg/kg from 140 mg/kg, which constitutes the allowed limit of European directives, can be regarded normal. Copper (Cu) quantifies normal soil type at 2 mg/kg and soil is defined as poisonous at 60-125 mg/kg.

Above 5 mg/kg, chromium (Cr) is included in the normal soil content; above 75–100 mg/kg, the soil is deemed poisonous; at present, the value of Cr is 54 mg/kg out of the 200 mg/kg maximum allowed by the Directives. European, therefore its presence is still below the allowed level but can be regarded as rather close.

Lead (Pb) in the quantity of 10 mg/kg is part of the typical soil composition; but, at 100 mg/kg, the soil is considered poisonous; that is, it is within the EU-permitted limit of 60 mg/kg to 300 mg/kg, therefore its presence is normal.

In our situation, zinc (Zn) is present in amounts between 71 mg/kg to 300 mg/kg, which is the maximum allowed by European laws. Zinc (Zn) is added to normal soil levels at 10 mg/kg and is considered dangerous at 100 mg/kg.

When soil has 10 mg/kg of nickel (Ni), it is considered normal; when soil contains 70–400 mg/kg of Ni, it is considered harmful. It is found at a level that is 2.5 times greater than the

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

European standard, at 188 mg/kg of 75 mg/kg, which is the limit allowed by the European Directives. Numerous microbial taxes, including actinomycetes, fungi, aerobic bacteria, and nitrogen-fixing agents, have been found to be significantly present in soil microbial communities in contaminated sites [2], [12], [15].Bacterial factors resulting from sewage discharge and heavy metal contamination from industrial waste dumped on the ground can both damage soil. Some of the ways that heavy metals are released into the environment are through technological operations, the smelting and refining industries, scrap metal, the polymer and latex industries, various consumer goods, and the burning of garbage containing these elements. Through food consumption, air suction, drinkable water supply, they can enter the food chain [16].

High environmental concentrations of heavy metals expose people and other animals to harmful substances through ingestion, inhalation of dust, or the food chain. When land is fertilised using organic manure, which is made from animal waste, the remaining feed that the animals are fed may include heavy metal contamination [13].

Elbasani Town has been on the top list of the most polluting cities in Albania for an extended period of time. The main causes of this extreme pollution, in our opinion, are the following: a densely populated area; numerous buildings; excessive traffic, poor infrastructure, a dearth of open space, and above all the expansion of intensive industrial production activity and inadequate technical control by the Albanian government, disregarding environmental pollution controls. We believe that the litho logy of the surrounding terrain has a role in the excessive presence of nickel and provides evidence that nickel pollution results from natural nickel distribution in the studied area [3-6], [17], [18].

As for nickel pollution in the environment, it is well recognised to originate from traffic[3-6],[19], and [20], but primarily from refinery emissions and industrial waste. Over the course of the analysis, nickel contamination was found in the soil of Elbasani town.

5. CONCLUSION

- Based on the performed study, we have determined that the soil in Elbasan City contains heavy metal components, apart from nickel, which is 2.5 times more polluted than the EU's guidelines.
- The conditions of every other heavy metal component are found to be nearly satisfactory.
- Elbasan city is presented with a considerable level of soil pollution, in our case this is evidenced by the presence of nickel above the allowed rate. We believe that severe industrial production activities and farmers' improper use of organic fertilisers have contributed to the ground's raw material deposits.

6. REFERENCES

1. P. Mantovi, G. Bonazzi, E. Maestri, and N. Marmiroli, Accumulation of copper and zinc from liquid manure in agricultural soils and crop plants, Plant and Soil, Perugia, pp. 249–257, 2003.
2. P.J. Wolfenden, and J. Lewin, Distribution of metal pollutants in floodplain sediments, Catena, Vol. 4, pp. 309–317, 1977.

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

3. Jance, A., Jance, A., Bogoev, V.Quantitative Data on Microorganisms and Heavy Metals in Middle Albania Soil. International Journal of Advanced Natural Sciences and Engineering Researches (IJANSER), Vol. 7(6), pp. 432-435, 2023.
4. Jance, A., Jance, A., Bogoev, V.Nickel Dispersion in Soil and its Effects on Agricultural Culture in Elbasani town, Albania. Plant Cell Biotechnology and Molecular Biology (PCBMB), Vol. 22 (1-2), pp. 18-24, 2021.
5. Jance, A., Jance, A., Bogoev, V. Description of soil impurity for Elbasan city - Albania. GSC Biological and Pharmaceutical Sciences (GSCBPS), Vol. 13(02), pp. 240-244, 2020.
6. Jance, A., Jance, A., Bogoev, V. Soil pollution caused by heavy metals presence, in Elbasani town, Middle Albania. Journal of Multidisciplinary Engineering Science and Technology (JMEST), Vol. 7(11),pp. 13018-13021, 2020.
7. R. Lacatusu, Appraising Levels of Soil Contamination and Pollution with Heavy metals,in: Land Information System for Planning the Sustainable Use of Land Resources, European Communities, Luxembourg, pp. 393–402,1998.
8. P. Censi, S. E. Spoto, F. Saiano, M. Sprovieri, S. Mazzola, G. Nardone, S. I. Di Geronimo, R. Punturo, and D. Ottonello, Heavy metals in coastal water system, Chemosphere, Vol. 64 (7), pp. 1167–1176, 2006.
9. A. Jance, A. Jance, and G. Kapidani, Holocene Data on Fossil Pollen of Dipsacaceae Plants, Central Albania. International Journal of Advanced Natural Sciences and Engineering Researches (IJANSER), Vol. 7(6), pp. 428-431, 2023.
10. A. Jance, A. Jance, and G. Kapidani, Pteridophyta landscape through Holocene epoch in Elbasan, Albania. Plant Cell Biotechnology and Molecular Biology (PCBMB), Vol. 22 (15-16), pp. 34-40, 2021.
11. J.M. Jay, M.J. Loessner, and D.A. Golden, Modern Food Microbiology, Food Science Text Series, 7th edition, Springer US, p. 790, 2006.
12. A. Kenarova, and V. Bogoev,Heavy metal tolerance of water microorganisms from natural and metal-polluted habitats, Reports of Bulgarian Academy of Sciences,Vol. 54(8), pp. 87-90,2001.
13. G.W. Gee, and J.M. Bauder,Particle size analysis. In: Klute A. (Ed.), Methods of soils analysis, Part 1. Physical and Mineralogical methods, American Society of Agronomy and Soil Science Society, Madison, 1986.
14. M.B. McBride, Environmental Chemistry of Soils, First ed., Oxford University Press, New York, p. 416, 1994.
15. S.J. Flint, L.W. Enquist, R.M. Krug, V.R. Racaniello, and A.M. Skalka,Principles of molecular Biology, pathotegenensis and control, ASM Press, Washington DC, p. 804, 2000.
16. L.G. Gazso, The Key Microbial Processes in the Removal of Toxic Metals and Radionuclides from the Environment, A review. Central European Journal of Occupational and Environmental Medicine, Hungary, Vol. 7 (3), pp. 178–185, 2001.
17. V. Bencko,Nickel: A review of its occupational and environmental toxicology, Journal ofHyg. Epidem. Micro. Immun., Vol. 27, pp. 237–247, 1983.

International Journal of Agriculture and Animal Production
ISSN 2799-0907
Vol: 04, No. 03, April-May 2024
https://journal.hmjournals.com/index.php/IJAAP
DOI: https://doi.org/10.55529/ijaap.43.26.32

18. E. Gajewska, M. Skłodowska, M.Słaba, and J. Mazur, Effect of nickel on antioxidative enzyme activities, proline, and chlorophyll contents in wheat shoots, Biologia Plantarum, Vol. 50(4), pp. 653–659, 2006.
19. D. Bastianelli, L. Bonnal, Y.Jaguelin-Peyraud, and J.Noblet, Predicting feed digestibility from NIRS analysis of pig feces. Animal. Vol. 9, pp. 781–786, 2015.
20. M. Barbafieri, The importance of nickel phytoavailable chemical species characterization in soil for phytoremediation applicability. International Journal of Phytoremediation. Vol. 2, pp. 105–115, 2000.