International Journal of Advanced Research in Engineering Technology & Science
ISSN: 2349-2819
Email: editor@ijarets.org Volume-10 Issue-10 October-2023 www.ijarets.org

Assessing Heavy Metal Pollution in the Borunda Region of Jodhpur District: An Investigation into Industrial Contamination

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Abstract: This research paper investigates the extent of heavy metal pollution resulting from industrial activities in the Borunda region of Bilada Tahsil, located in the Jodhpur district of Rajasthan, India. The study employs a practical approach that combines field surveys and laboratory analysisto assess the extent of industrial pollution in the study area.

Keywords:*Pollution, industrial, metal.*

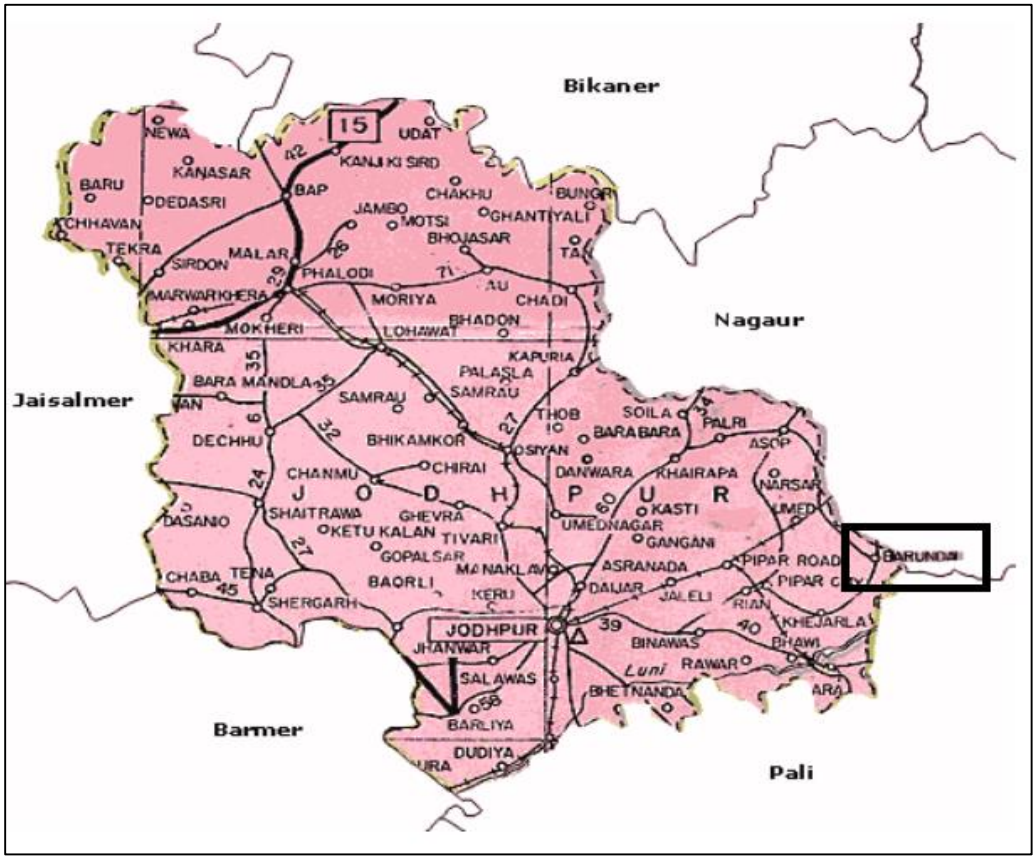
Introduction: -

Effluents from a wide variety of factories and industrial areas contribute significantly to the degradation of our natural habitat. Several individuals seem to be afflicted with lung-related illnesses. According to the CPCB (Central Pollution Control Board), industrialized regions tend to have more severe pollution problems. Soil quality is severely affected by the dumping of harmful heavy metals directly into the soil without proper treatment and the resulting health effects are known. The concentration of these toxic metals increases in the soil thus affecting soil fertility which further affects agricultural yield. The levels of toxic metals including Cadmium, copper, iron, arsenic, lead, nickel and manganese must be assessed in order to limit further rise in their concentration. In this study, soil samples of Borunda region is studied for its elemental composition in order to better understand the relation between soil quality and human health. The selected region for this study i.e., Borunda is a part of Jodhpur district, which has alarmingly high levels of pollution and the heavy concentration of crop-damaging toxic metals. Since the industrial revolution began in the region, pollution levels have steadily increased, resulting in much worse air quality. The industrial region of Borunda has gained notoriety as one of the most polluted places in the western Rajasthan. Due to the high concentration of industry in and around Jodhpur, this research analyses the concentration of numerous pollutants (toxic metals) in soil of the region surrounding this city.

Research methodology: -

1. **Research Objectives:**The primary objective of this study is to assess the heavy metal pollution in the soil samples from the industrial area in Borunda region in Bilada tahsil of Jodhpur district in Rajasthan.
2. **Study area:**It has been hypothesized that soil samples from the industrial area in Borunda region in Bilada tahsil of Jodhpur district in Rajasthan, contain a high active concentration of heavy metals. The concentration of these elements in the soil undermines the agricultural yield and health of nearby living population. Therefore, it is important to determine the concentration of heavy metals in soil from the Borunda region of Jodhpur.

Fig 1: Study area of Borunda, Jodhpur



3. **Sample Collection:** 20 samples of soil were taken at random to determine the levels of heavy metals in the selected region.
4. **Heavy metal Analysis:**Heavy metal concentrations in soil samples were determined using an atomic absorption spectrophotometer and ICP-MS. This method utilizes inductively coupled plasma for ion production and mass spectroscopy for ion separation and detection in order to conduct chemical analysis of sample materials. Heavy metals were evaluated by ICP-MS, with NIST 1640a serving as a calibration standard and NIST 1643e as a reference material. 103Rh was employed as an internal reference material for precise measurement of heavy metals in soil samples.The metals being analysed must be in a soluble state.

Acid digestion procedures were used to remove metals from soil samples.

Digestion methods for soil samples using mixture of acids ($HF+HClO_4+HNO_3$)

Step 1: Take 0.5g of soil sample.

Step 2: Add 10ml Conc.HF, 5ml Conc HNO_3 and 1-2ml $HClO_4$ in a covered Teflon crucible with capacity of 60ml. Heat the solution at 80-90^o Celsius on hot plate.

Step 3: After 4hrs, remove the lid and further heat the solution up to complete dryness.

Step 4: Add 5ml Conc. HF, 10ml HNO_3 and 1-2ml $HClO_4$. Heat the solution up to dryness.

Step 5: Add 5ml Conc. HNO_3. Heat the solution up to dryness.

Step 6: Add 20ml of 1N HCl and heat the digested sample to make it solution at 100^o Celsius.

Step 7: Rinse the crucible with 1N HCl and DDW and filter the solution and make the final volume to 100ml using DDW.

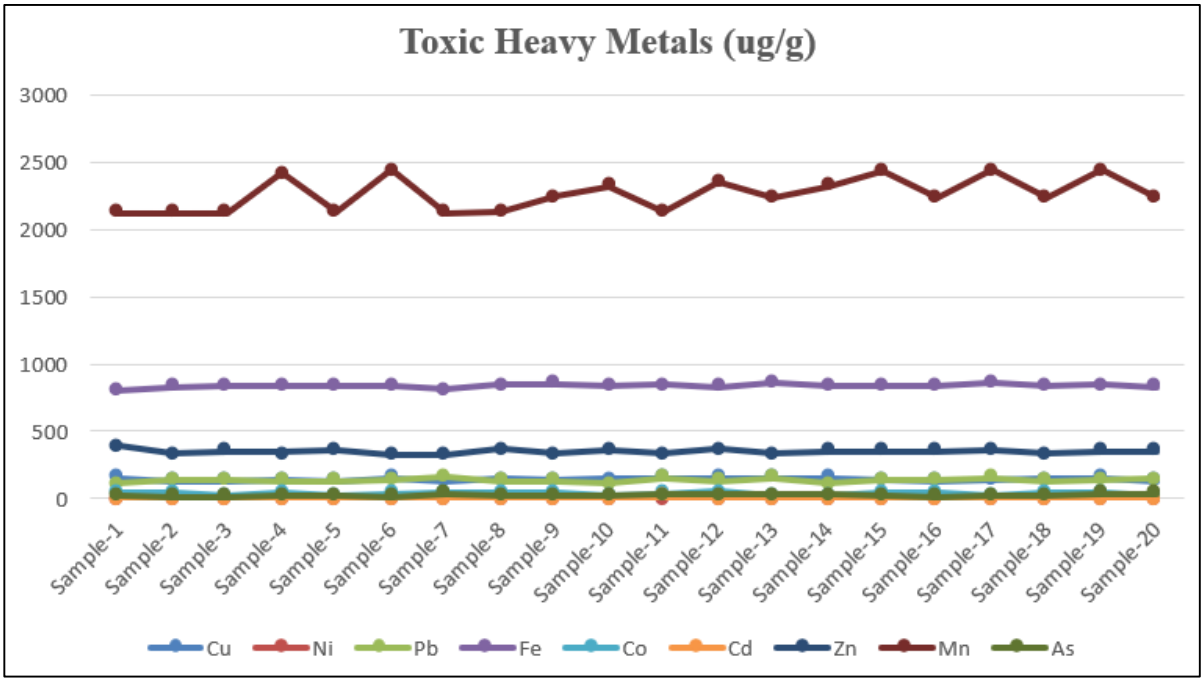
Research Findings: -

The value for concentration of Cu is concentrated around 139.3 which is mean value. The sample 2 has the minimum value for Cu concentration i.e., 121 ug/g whereas sample 11 has the maximum value i.e., 155 ug/g.The value for concentration of Ni is concentrated around 3.262 which is mean value. The sample 4 has the minimum value for Ni concentration i.e., 2.24 ug/g whereas sample 18 has the maximum value i.e., 4.42 ug/g.The value for concentration of Pb is concentrated around 133.8 which is mean value. The sample 10 has the minimum value for Pb concentration i.e., 112 ug/g whereas sample 7 has the maximum value i.e., 163 ug/g.The value for concentration of Fe is concentrated around 836.22 which is mean value. The sample 1 has the minimum value for Fe concentration i.e., 806.6 ug/g whereas sample 13 has the maximum value i.e., 856.8 ug/g.The value for concentration of Co is concentrated around 36.168 which is mean value. The sample 10 has the minimum value for Co concentration i.e., 21.75 ug/g whereas sample 12 has the maximum value i.e., 54.75 ug/g.The value for concentration of Cd is concentrated around 3.776 which is mean value. The sample 5 has the minimum value for Cd concentration i.e., 2.23 ug/g whereas sample 11 has the maximum value i.e., 5.54 ug/g.The value for concentration of Zn is concentrated around 347.15 which is mean value. The sample 6 has the minimum value for Zn concentration i.e., 323.8 ug/g whereas sample 1 has the maximum value i.e., 389.2 ug/g.The value for concentration of Mn is concentrated around 2264.9 which is mean value. The sample 2 has the minimum value for Mn concentration i.e., 2122 ug/g whereas sample 17 has the maximum value i.e., 2453 ug/g.The value for concentration of As is concentrated around 24.091 which is mean value. The sample 3has the minimum value for As concentration i.e., 12.24 ug/g whereas sample 7 has the maximum value i.e., 36.64 ug/g.

Table 1:HeavyMetalContentinsoilsamples

Location	Toxic Heavy Metals (ug/g)								
	Cu	Ni	Pb	Fe	Co	Cd	Zn	Mn	As
Sample-1	151	3.53	113	806.6	41.45	2.92	389.2	2125	16.53
Sample-2	121	2.34	143	823.3	42.45	2.43	332.3	2122	13.23
Sample-3	132	3.43	142	842.6	23.03	3.53	349.6	2123	12.24
Sample-4	134	2.24	124	834.3	45.22	3.34	342.3	2423	23.55
Sample-5	123	4.24	123	835.3	24.03	2.23	354.7	2134	23.53
Sample-6	153	3.53	143	832.4	33.45	4.54	323.8	2452	13.33
Sample-7	123	2.24	163	813.6	42.56	5.23	324.3	2124	36.64
Sample-8	145	2.53	122	845.2	41.32	2.42	365.6	2134	26.32
Sample-9	134	4.23	124	853.7	43.64	3.56	335.3	2252	23.46
Sample-10	145	4.23	112	832.7	21.75	4.25	363.5	2315	21.35
Sample-11	155	4.23	153	845.3	34.54	5.54	335.3	2134	32.63
Sample-12	146	2.52	123	823.5	54.75	5.23	365.7	2352	28.34
Sample-13	154	2.45	154	856.8	23.43	2.67	334.3	2242	28.57
Sample-14	152	4.22	112	843.2	24.34	4.34	343.6	2324	31.78
Sample-15	137	2.43	143	834.9	47.64	4.75	344.2	2433	19.33
Sample-16	123	2.32	134	843.6	43.32	3.54	343.1	2234	13.45
Sample-17	134	3.23	146	856.2	24.54	4.45	356.4	2453	23.34
Sample-18	145	4.42	123	832.4	43.24	3.56	333.6	2235	24.32
Sample-19	153	3.34	134	845.2	45.53	3.42	352.3	2452	35.54
Sample-20	126	3.54	145	823.6	23.12	3.57	353.8	2235	34.34
Average	139.3	3.262	133.8	836.22	36.1675	3.776	347.145	2264.9	24.091
Min	121	2.24	112	806.6	21.75	2.23	323.8	2122	12.24
Max	155	4.42	163	856.8	54.75	5.54	389.2	2453	36.64

Fig 2:HeavyMetalContentinsoilsamples



Conclusion: This study focused on assessing heavy metal pollution in the Borunda region of Bilada Tahsil, situated in the Jodhpur district of Rajasthan, India. Through extensive field surveys and laboratory analyses, valuable data and sampleswere gathered regarding the concentration of various heavy metals, including Cu, Ni, Pb, Fe, Co, Cd, Zn, Mn, and As, within the study area. Sample-to-sample variations revealed that the sources of heavy metal pollution in the region are not uniform, suggesting the influence of diverse factors, including proximity to industrial sites, agricultural practices, and natural geological conditions. In light of these results, it is evident that industrial activities have played a significant role in contributing to heavy metal pollution in the Borunda region. This underscores the importance of implementing stringent regulatory measures to control industrial emissions and waste disposal practices in the area. Furthermore, this study highlights the need for increased awareness among local communities about the potential health risks associated with heavy metal contamination.

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