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Assessment of Heavy Metal Pollution and Water Quality of the Luni River of Rajasthan, India

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Abstract: The Luni River, a crucial water body in the arid region of Rajasthan, faces mounting environmental challenges due to anthropogenic activities and natural processes. This paper presents a comprehensive assessment of heavy metal pollution and water quality in the Luni River. Field surveys were conducted, and water and soil samples were collected from multiple sites along the river. Various physicochemical parameters, including heavy metal concentrations, biochemical oxygen demand (BOD), and chemical oxygen demand (COD), were analyzed to evaluate the river's water quality.

Keywords: Metal, pollution, river.

Introduction: -

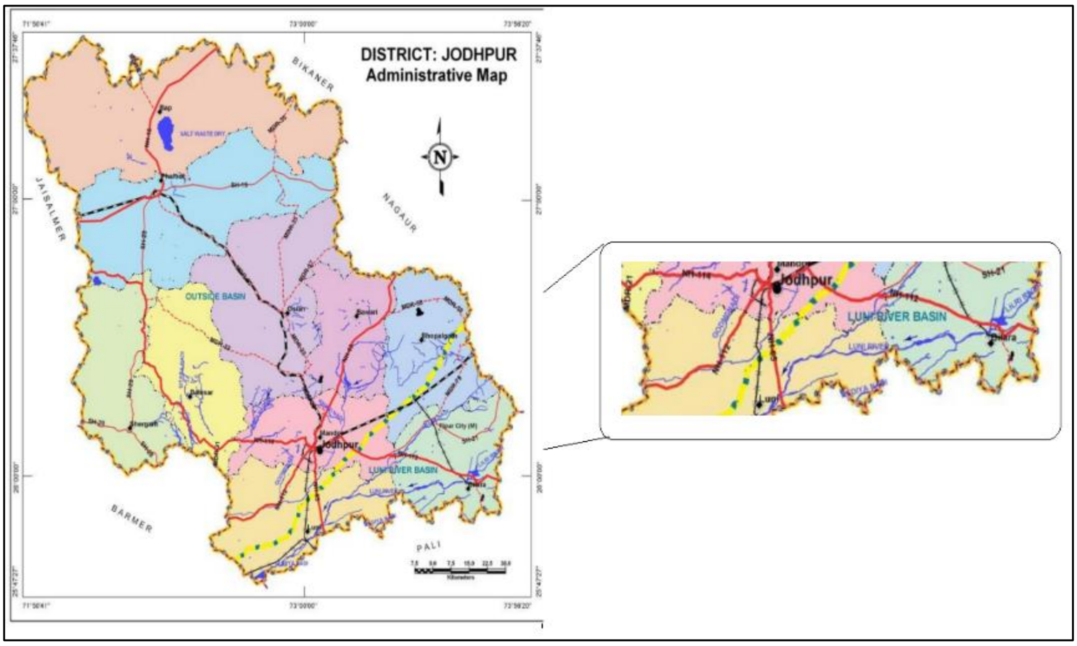
Rivers are a very valuable natural resource since water is so scarce. They are crucial to the health of the watershed ecosystem because they provide as a home for aquatic organisms, regulate biodiversity, store and purify water, and much more besides. Heavy metals in the river are caused by both natural processes like soil erosion and weathering of rocks and human activity like agricultural runoff, industrial effluent, constructional waste, etc. Such actions lead to a rise in the concentration and toxicity of contaminants and heavy metals in water systems. Rapid urbanization and industrialization contribute to the ongoing rise in the concentration of these heavy metals in the aquatic system. River water contamination has far-reaching consequences for not just aquatic life but for the ecology and human health. As heavy metals are both harmful and persistent, their accumulation disrupts the eco-natural system's cycle. Because of its widespread distribution, soil is often used as an indication of heavy metal buildup in the environment. To a large extent and over its whole length, the river serves as a dumping ground for waste that has not been treated, making it unsafe for use by humans and other animals. During the last three to four decades, scientists have been poring through river sediments to learn more about the quantity and consequences of heavy metals on people, animals, and flora. The Tano River in Ghana, the Tigris River in Turkey, the Ganga River in India, the Brisbane River in Australia, the Isiukhu River in Kenya, and the Liaohe River in China have all had their heavy metal concentrations studied.

In order to irrigate their crops, farmers are using the contaminated water. Producing food in this way poses risks to human health since people eat the fruits and vegetables that are grown. The ground water is being harmed by the very alkaline and saline water. Industries need access to enormous quantities of water for processes like textile dyeing, and farmers often provide this through wells they've dug. The already poor water quality has been further degraded by the rapid pace of water removal. As current CETPs (Common effluent treatment plant) cannot handle acidic effluents, small drains are excavated and the water is released straight into the Luni river. Unfortunately, the situation is exacerbated by the number of illegal industries operating in the area. Wastewater poisoning affects around 500,000 households. Jowar, wheat, vegetables, and fodder—all of which used to flourish before the water became contaminated—have all perished. A number of studies have shown that the soil around the Luni River has an abnormally high percentage of heavy metals. Nevertheless, the results of the investigations, which covered the length of the river, have not been published as of yet. Therefore, this study will aid in determining how much human exposure to effluents and wastewater really occurs.

Materials and Methods: -

1. **Research Objectives:** The primary objective of the study is to evaluate the pollution in Luni River of Rajasthan due to presence of heavy metals.
2. **Study area:**Water shortage is a common problem in the region around Luni River due to its location in Rajasthan. There are several manufacturing facilities functional in the areas surrounding Luni River. The concentration of various heavy metals in the wastes that many of these firms release as effluent without treatment is highly problematic. There is a risk that these metals will seep down to the ground water and pollute it. This necessitates an investigation. Therefore, soil samples from Luni River are analyzed for heavy metal pollution.A total of 20 sampling sites were selected. Soil samples 1-20a were selected for heavy metal analysis whereas water samples 1-20b were collected for BOD/COD analysis.A map of the study area of Luni River of Rajasthan is given in the figure below:

Fig 1: Study area of Luni River



3. **Heavy metal Analysis:**A soil sample's metal content was determined with the use of an ICP-OES. A distinct technique was used to digest the soil samples using nitric acid and the appropriate technique described by APHA (2012). Digestion methods for soil samples using acid mixture (HNO_3+ H_2SO_4):

   Step 1: Take 5g of soil sample in 250g beaker

   Step 2: Add 1ml Conc.H_2SO_4, 0.5 ml Conc. HNO_3 and 100ml of DDW. Heat the solution at 80-90^o Celsius. Evaporate the solution without boiling until solution remains 10-20ml. Repeat the step three times.

   Step 3: Rinse the beaker with DDW, filter the solution and make the final volume 100ml.

4. **Sampling for BOD/COD:**Water **s**amples were collected in glass containers wherever possible. Any samples with suspended particles were thoroughly mixed (homogenized) before examination. Quantitative estimates of chemical oxygen demand and biological oxygen demand were chosen and calculated according to APHA standards of practice (1985).

Results and Discussions: -

The average concentration of Cu is found to be 129.3. The sample 1a has the minimum value for Cu concentration i.e., 112 ug/g whereas sample 17a has the maximum value i.e., 155 ug/g.The average concentration of Pb is found to be 140.7. The sample 2a has the minimum value for Pb concentration i.e., 112 ug/g whereas sample 10a has the maximum value i.e., 178 ug/g.The average concentration of Co is found to be 38.7. The sample 15a has the minimum value for Co concentration i.e., 21 ug/g whereas sample 8a has the maximum value i.e., 55 ug/g.The average concentration of Cd is found to be 3.5715. The sample 2a has the minimum value for Cd concentration i.e., 1.53 ug/g whereas sample 6a has the maximum value i.e., 6.45

ug/g.The average concentration of Zn is found to be 244.05. The sample 4a has the minimum value for Zn concentration i.e., 212 ug/g whereas sample 1a has the maximum value i.e., 283 ug/g.The average concentration of Mn is found to be 1390.4. The sample 2a has the minimum value for Mn concentration i.e., 1122 ug/g whereas sample 7a has the maximum value i.e., 1653 ug/g.The average concentration of As is found to be 4.13455. The sample 5a has the minimum value for As concentration i.e., 1.122 ug/g whereas sample 9a has the maximum value i.e., 6.552 ug/g.

Table 1: Concentration of heavy metals found in soil sample

Location	Heavy Metals (ug/g)						
	Cu	Pb	Co	Cd	Zn	Mn	As
Sample 1a	112	132	34	2.67	283	1345	4.131
Sample 2a	115	112	32	1.53	232	1122	2.454
Sample 3a	132	152	31	3.23	245	1323	3.234
Sample 4a	142	162	34	2.34	212	1434	5.535
Sample 5a	122	137	36	4.12	245	1565	1.122
Sample 6a	142	143	45	6.45	256	1343	4.543
Sample 7a	115	134	23	2.45	223	1653	2.543
Sample 8a	114	156	55	4.67	256	1235	5.234
Sample 9a	118	123	44	4.66	276	1653	6.552
Sample 10a	132	178	52	4.23	254	1366	6.234
Sample 11a	121	143	43	2.24	234	1345	4.345
Sample 12a	123	153	32	3.43	231	1356	5.343
Sample 13a	124	123	32	2.56	253	1314	3.546
Sample 14a	143	143	34	4.25	254	1343	4.346
Sample 15a	134	143	21	2.64	233	1536	4.425
Sample 16a	123	134	43	4.46	243	1264	3.464
Sample 17a	155	145	44	3.45	246	1425	5.254
Sample 18a	132	125	35	3.26	239	1535	5.245
Sample 19a	144	123	53	5.56	228	1265	2.566
Sample 20a	143	153	51	3.23	238	1386	2.575
Average	129.3	140.7	38.7	3.5715	244.05	1390.4	4.13455
Min	112	112	21	1.53	212	1122	1.122
Max	155	178	55	6.45	283	1653	6.552

An increased BOD suggests that some organic waste has made its way into the water supply. It's a warning sign that things aren't as they should be, thus water treatment is required before it can be used for anything. Water samples show significant levels of pollution from industrial waste, with CODs ranging from 7.2 to 36.6 mg/l. These high numbers suggested that the water used for human consumption was high in oxidizable inorganic chemicals or dissolved organic components.

Table 2: BOD/COD of Collected Water Samples

Location	BOD (mg/L)	COD (mg/L)
Sample 1b	1.1	7.2
Sample 2b	2.2	23.1
Sample 3b	4.4	36.5
Sample 4b	5.5	12.7
Sample 5b	3.3	36.3
Sample 6b	5.1	36.6
Sample 7b	12.5	28.8
Sample 8b	2.7	36.2
Sample 9b	12.2	12.4
Sample 10b	13.4	28.5
Sample 11b	12.4	24.3
Sample 12b	13.4	33.4
Sample 13b	12.4	32.7
Sample 14b	2.4	33.6
Sample 15b	5.4	21.4
Sample 16b	6.4	22.7
Sample 17b	5.4	12.2
Sample 18b	6.4	23.7
Sample 19b	8.4	32.4
Sample 20b	4.4	14.7
Average	6.97	25.47
Min	1.1	7.2
Max	13.4	36.6

Conclusion: The assessment of heavy metal pollution and water quality in the Luni River of Rajasthan, India, reveals alarming levels of contamination, posing significant environmental and public health concerns. Heavy metals, including lead (Pb), cadmium (Cd)and arsenic (As), were found to exceed permissible limits, indicative of the river's deteriorating water quality. Additionally, elevated levels of BOD and COD indicated organic pollution, primarily originating from untreated industrial and domestic discharges.To mitigate heavy metal pollution and enhance water quality, a multi-pronged approach is necessary. This includes enforcing stricter regulations on industrial effluents, promoting wastewater treatment and recycling, and raising awareness among local communities about the consequences of pollution. Collaborative efforts at the regional and national levels are essential to address these pressing environmental challenges effectively.

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