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Assessment of heavy metals and Physico-chemical parameters of sewage water and soil in the different blocks Jaipur district of Rajasthan India

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Abstract
Jaipur is the capital state of Rajasthan. During the year 2021, District Jaipur of 3 blocks (Chomu, Sanganer, and Shahpura) in 9 villages [Keshav Nagar (V_1), Morija (V_2), Nindola (V_3), Goner (V_4), Shrikishanpura (V_5), Durgapura (V_6), Shivpuri (V_7), Manoharpur (V_8), Nwalpura (V_9)] were selected for estimation of physico-chemical properties of soil and Heavy metals contamination in sewerage channels. A total of 9 samples were collected from 9 villages sewerage channels and soils. This study aimed to analyze the physico-chemical properties of agricultural soil and irrigation water in three blocks of Jaipur, Rajasthan. The findings revealed significant variations in the physico-chemical properties of the agricultural soil and water in Chomu, Sanganer, and Shahpura. Standard methods were employed to assess the physico-chemical characteristics of soil samples contaminated with sewerage effluents in these regions, which exhibited considerable diversity. The pH levels of the soil samples were predominantly slightly acidic and alkaline ranging from 6.22 to 7.31. Electrical conductivity values varied between 0.41 to 0.62 mmhos/cm. The percentages of organic matter and organic carbon in the soil samples ranged from 0.17% to 0.25% and 0.29% to 0.43%, respectively. Additionally, the analysis included heavy metals such as zinc (Zn), manganese (Mn), iron (Fe), and copper (Cu). The soil samples were found to contain elevated levels of heavy metals, surpassing the permissible limits. The discharge of sewerage effluent into the environment, primarily originating from the textile industry, house, etc. constitutes are major source of pollution that can adversely impact the local flora and fauna. Therefore, it is imperative to implement effluent treatment measures before their release into the environment.

Keywords: Jaipur district, sampling sites, physico-chemical properties, heavy metals, etc.

Introduction
Environmental deterioration is a serious ecological catastrophe that faces our world right now. The negative consequences of pollution brought on by urbanisation, rising household and vehicle fuel consumption, and industry are notably felt in South Asia's developing nations, such as Pakistan, Nepal, Bangladesh, and India (Karn and Harada, 2001) [5].

The city of Jaipur in Rajasthan, situated in the central region, has witnessed rapid urban growth and industrial development in the past two decades. Numerous industrial areas have emerged throughout Jaipur and its neighbouring regions during this period. Heavy metal pollution, which refers to the presence of hazardous metallic elements with high density and low concentration tolerance, such as copper, manganese, lead, cadmium, iron, mercury, zinc, and nickel, has become a common problem as a result of industrialisation (Raikwar *et al*., 2008) [10]. Even though heavy metals are naturally present in the Earth's crust, human activities like mining, smelting operations, and industrial processes involving metal refinement, coal burning, petroleum combustion, nuclear power generation, and manufacturing in a variety of industries like plastics, textiles, microelectronics, wood preservation, and paper processing are the main causes of environmental contamination and exposure (Yadav *et al*., 2020) [14]. Birds are particularly sensitive to environmental contaminants resulting from human activities and serve as vital indicators of ecological conditions in specific areas. Therefore, they are widely used in monitoring environmental changes (Medona *et al*., 2015) [7]. The analysis of heavy metal excretion through bird fecal matter has gained attention due to the Wildlife Protection Act of 1972, which prohibits the capturing and killing of birds in India. Consequently, researchers in this field focus on analytical studies that utilize bird tissues and organs less frequently. Moreover, limited studies on heavy metal pollution in bird feces exist within the Indian context.

Additionally, heavy metals possess the ability to bioaccumulate and bio magnify within food chains (Zhuang *et al.*, 2009) [16]. As a result, fecal matter serves as a valuable indicator of metal contamination, effectively reflecting the level of metal pollution in the environment. In order to estimate the negative effects of trace metals on these species and their surroundings, bird faeces are examined. In this study, the content of heavy metals in bird faeces in industrial settings will be evaluated, and it will also be investigated if using faeces as a non-invasive way to measure metal concentrations in the environment would be feasible. Metals are naturally occurring substances in our surroundings, particularly in the crusts of the Earth, where they help maintain the planet's equilibrium. However, human activities have caused them to be concentrated, dispersed, and chemically altered, which might enhance their toxicity (Mihaly *et al*., 2005) [8].

Materials and Methods

Jaipur, the capital city and the largest city in the state of Rajasthan, is located at a geographical position of approximately 26.9124° N latitude and 75.7873° E longitude. The district of Jaipur covers a total geographical area of 11,06,148 hectares or 11,061.48 square kilometres. In terms of agricultural land use, the Gross Cropped Area in Jaipur district is estimated to be around 8,48,313 hectares. Out of this, the Net Sown Area is approximately 6,63,167 hectares. However, it's important to note that only 3,02,428 hectares of the Net Sown Area are under irrigation. These figures provide an overview of the agricultural landscape in Jaipur district, highlighting the extent of cultivated land and the proportion that benefits from irrigation. These statistics are essential for understanding the agricultural potential and the distribution of agricultural activities in the region. (District Fact Book, 2019) [3].

Nine samples were obtained from three different blocks in the Jaipur district prior to the monsoon season. These samples included soil and sewage water effluent. The purpose was to assess the physico-chemical characteristics and Heavy Metals of the collected samples. The collection took place in the morning of June 2021, with temperature and pH measurements recorded in the field. To maintain sample integrity, acid-washed plastic bottles and sterilized plastic bags were used for collection, and the samples were stored at 4 °C. The soil samples underwent analysis to determine various parameters such as pH, electrical conductivity (EC), percentage of organic carbon (OC), percentage organic matter (OM), and Heavy metals zinc (Zn), iron (Fe), copper (Cu), manganese (Mn). On the other hand, the effluent samples were analyzed for pH, electrical conductivity (EC), as well as cations and anions present. In summary, a total of nine samples consisting of soil and sewage water effluent were collected from different blocks in Jaipur district before the onset of the monsoon season. These samples were analyzed to assess their physico-chemical properties. The collection process involved maintaining cleanliness and sample preservation, and subsequent laboratory analysis focused on various parameters specific to each sample types. The quality of the soil and ground water in the area is impacted by these heavy metals and organic compounds (Bhattacharjee *et al*., 2003). Different mechanisms allow heavy metals to enter the human body, where they have detrimental consequences (Gitimoni *et al*., 2009) [4]. Environmental pollution and ongoing human exposure to harmful heavy metals like Hg, Cd, and Pb are important problems that are getting worse all over the world (Yusuf and Sonibare 2004) [15]. In agriculture, the characteristics of dry soil as well as its kind are very important (Ahire *et al*., 2013) [1]. Soil is essential for agriculture and is advantageous to all living things (Yadav *et al*., 2023) [13]. The changes in runoff, erosion, and deposition processes that impact soil genesis are typically blamed for the variations in soil properties related to landscape location (Dengz, 2010) [2].

Sample collection areas

Table 1: Shows, were took on different locations sewerage channel water and soil samples

S. No.	Blocks	Villages	Latitude (^{0}N)	Longitude (^{0}E)
1.	Chomu (B_1)	Keshav Nagar (V_1)	26.9039^0	75.7844^0
		Morija (V_2)	27.2068^0	75.7582^0
		Nindola (V_3)	27.3185^0	75.7081^0
2.	Sanganer (B_2)	Goner (V_4)	26.8865^0	75.8341^0
		Shrikishanpura (V_5)	26.7998^0	75.8582^0
		Durgapura (V_6)	26.8518^0	75.7862^0
3.	Shahpura (B_3)	Shivpuri (V_7)	26.9426^0	75.7526^0
		Manoharpur (V_8)	26.2994^0	75.9571^0
		Nwalpura (V_9)	26.8103^0	75.8365^0

Results and Discussion

The soil samples adjoining the sewage water effluent, agriculture land regions of Jaipur. They also show different variation in the physico-chemical properties. The soil samples were analyzed for pH, Electrical Conductivity (E.C.), % organic carbon, % organic matter. The colour of soil samples were brown and dark gray. The pH of soil samples were ranged 6.22 to 7.31 slightly acidic to alkaline nature. High pH can be causes acidic soils. Similar results have been also reported by Kumar *et al.*, 2014 [6]. The electrical conductivity (E.C.) value from 0.41 to 0.62 mmhos/cm. In the variations of electrical conductivity due to present of high concentration of ions. Same type results were reported by Rahi *et al.*, 2018. The percentages of organic matter and organic carbon in the soil samples were ranged from 0.17% to 0.25% and 0.29% to 0.43%. Due to high organic waste discharged with sewage water so organic carbon and organic matter % contents increases. Similar results reported by Singh *et al*., 2010 [11]. The amount of heavy metals zinc, iron, copper and manganese ranges were reported 1.10 to 1.81 ppm, 3.10 to 4.71 ppm, 0.25 to 0.55 ppm and 2.90 to 4.70 ppm. The amount of heavy metals in sewage water crossed their standard limit. Toxicity symptoms are reported in the sewage water. Similar results have been also reported Singh *et al.*, 2006 [12].

Table 2: Standard critical limits of different parameters

Parameters	Critical limit
pH	7-8.5
Electrical Conductivity (mmhos/cm)	0-1.5
Organic Carbon %	0.5-0.75
Organic Matter %	0.8-1.29
Zinc (ppm)	0.6
Iron (ppm)	4.5
Copper (ppm)	0.2
Manganese (ppm)	2.0

Table 3: Different villages of sewage water and soil results

Sites	pH	E.C. (MMHOS/cm)	O.C.%	O.M.%	Zn (ppm)	Fe (ppm)	Cu (ppm)	Mn (ppm)
V_1	7.17	0.51	0.20	0.34	1.15	4.35	0.30	3.10
V_2	7.24	0.60	0.18	0.31	1.10	3.65	0.31	3.50
V_3	7.10	0.53	0.17	0.29	1.45	3.10	0.52	2.90
V_4	6.76	0.41	0.19	0.32	1.57	4.28	0.46	3.78
V_5	6.35	0.57	0.24	0.41	1.42	3.50	0.44	4.55
V_6	7.31	0.61	0.18	0.31	1.68	4.69	0.37	2.92
V_7	6.37	0.53	0.21	0.36	1.32	4.71	0.55	4.10
V_8	7.25	0.62	0.19	0.32	1.81	4.00	0.38	4.70
V_9	6.22	0.51	0.25	0.43	1.62	3.85	0.40	2.98

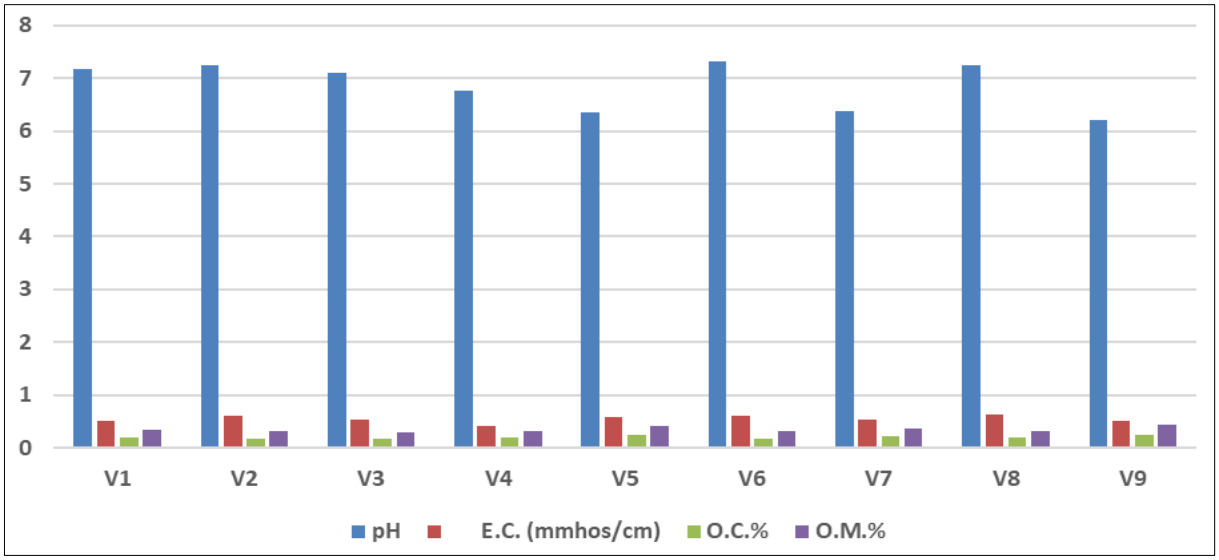

Fig 1: Status of physico-chemical properties

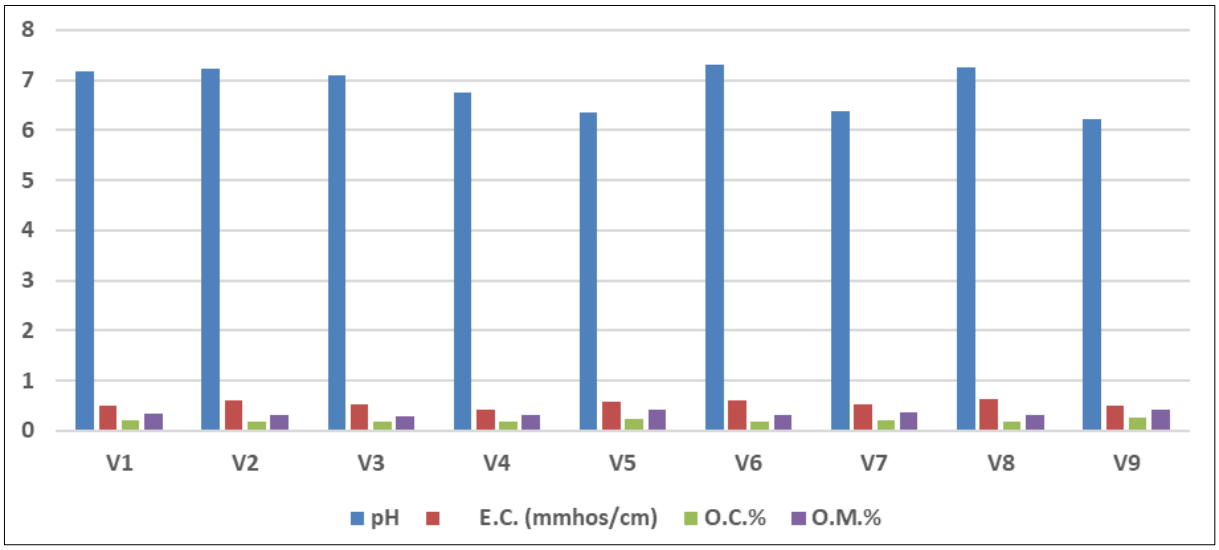

Fig 2: Status of heavy metals

Conclusion

This research has demonstrated that soil samples in Chomu, Sanganer, and Shahpura blocks have been affected by sewage water effluent, resulting in a noticeable increase in coloration, unpleasant odor, and a slightly acidic to alkaline pH. Furthermore, these soil samples contain trace amounts of metal ions at concentrations that do not meet the required standards. The study has also revealed that the effluent released from the sewage channel is significantly polluted. It is crucial to promptly implement appropriate methods for treating the effluent before it is discharged into surface water sources in order to mitigate the potential environmental risks it poses.

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