RESEARCH PAPER

Evaluation of microorganisms and contaminants of soil of the different industrial city of U.P

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Abstract

The geochemical visitation were carried to determine the extent of chemical pollution caused by industrial waste in the soil in the Awadh region (Jajmau, Unnao and Panki) industrial area, which are situated of U.P. One of the main hubs for the tannery and leather processing industries is the U.P industrial area, which is located on the Ganga River. The soil in U.P industrial areas, especially Awadh region, exhibits changed microbial communities and elevated levels of heavy metals pollution. Fifteen soil samples were taken from various locations in the Awadh region industrial areas. To examine the microorganisms such as bacteria and fungi as well as heavy metals such as Pb, Zn, Cu, Ni, Hg and As in the soil sample surrounding the industrial areas of Awadh region. The range of Pb (85-89), Ni (40-42), Zn (55-58), Hg (12.07-13.04), and As (3.0-3.6) in Unnao. The range of Pb (86.0-89), Ni (40-42), Cu (40-45), Zn (56-58), Hg (13.02-14.07) and As (3.8-4.5) in Jajmau. The range of Pb (87.2-89), Ni (40-41), Cu (30-39), Zn (57-59), Hg (13.01-14.04) and As (4.05-4.2). Unnao, Jajmau and Panki have higher mean concentrations of Pb (87), (87.2) and (87.88) than the other heavy metals. Range of microbial count of bacteria (3.05-3.35) and fungi (2.95-3.93) in Unnao. The range of microbial count of bacteria (3.24-4.11) and fungi (3.26-3.96) in Jajmau. The range of microbial count of bacteria (3.35-3.96) and fungi (2.79 to 3.45) in Panki. The mean concentration value of microbial count of bacteria (3.2) is lower in Unnao and fungi (3.0) is lower in Panki than the other microbial count. The environment, crop production, human health and all other living things are seriously threatened by the presence of heavy metals in soil. Microorganisms are harmed by high concentrations of heavy metals in soils, which lowers the microbial count. Microorganisms are healthier and have a higher microbial count when heavy metals are reduced in the soil.

Key Word: Geochemical, visitation, hub, community, heavy metals and microorganisms.

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Introduction

Environmental pollution is one of the world's biggest issues, and it is getting worse every day as a result of urbanization and industrialization (Tadesse and Guya, 2017). The soil pollution produces modification in the abundance and diversity of biological soil populations. This opportunity is important because of the role of soil organisms in plant survival and development. Such eradication of soil organisms creates problems for plant survival and development crops grown on contaminated soil may contain harmful levels of pollutants that can reach humans and animals eat them (Aransiola *et.al*, 2019). The tannery industry is the main environmental polluter, and the discharge of unofficial waste poses a serious risk of contaminating water and soil (Pal *et.al*, 2024). The industrial area's waste materials are dumped into the ganga. Both human life and the aquatic life in the Ganga are suffering greatly as a result of the commercial effluents from tanneries being dumped into the river (Ray *et.al*, 2008). Because of Kanpur's expanding industrial area, soil pollution has become a major issue. For both organic and inorganic pollutants discharged into the environment from industrial waste, soil is thought to be the ultimate sink (Tadesse and Guya, 2017). An industry that produces large amount of waste water contains, many non-biodegradable organic and toxic substances that can affect the enzyme activities of the soil thereby affecting soil fertility (Meena *et.al*, 2020). With 450 tanneries Kanpur, a city on the banks of the Ganges, has grown into a massive tannery complex. Because of the leather factory, the surrounding environment has deteriorated significantly. Serious issues are being caused by pollution of water and soil as a result of factory effluent discharge. Cd, Mn, Zn, As Cr, Pb and Hg are among the toxic pollutants found in the soil. The nutrient and fertility status of soil is significantly influenced by the presence of heavy metals. Numerous metals such as Zinc and Copper, are necessary for the healthy growth of plants and other living things, but their excess or deficiency in the soil can lead to a variety of problems (Agrawal and Singh, 2016). Heavy metal pollution in agricultural soils caused by the regular use of chemical fertilizers, pesticides and industrial effluent wastewater is one of Kanpur's biggest ecological problems (Rahman *et.al*, 2012). The treated effluent

still contains concentrations of heavy metals such as Pb, Zn, Hg, Mg and Hg. It is being used expensively to irrigate 2100acres of agricultural land for two decades or more (Sinha *et.al*, 2006). Due to indiscriminate dumping of hazardous waste in Jajmau, Unnao and Panki industrial areas, the local soil has become heavily polluted (Gowd *et.al*, 2010).

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Beneficial microorganisms help in the toxic substances, decomposition of organic residues and other pollutants and increase the fertility of the soil (Afzal *et.al*, 2014). Soil microorganisms are agents of soil organic matter, nutrients and most major soil processes (Singh *et.al*,2023). Soil microorganisms are present in high numbers and have a wide range of metabolic activities that play an important role in the cycling of nutrients in the soil and are required for the removal of pollutants from soil. Such microorganisms are found not only in surface soil but also in subsurface soil at depths from 100 to 2000 meters below the ground (Sapkota, 2023).

Material and Methods

Study area – Uttar Pradesh has both an agricultural and industrial sector. The experiment sampling study area are Awadh region (Jajmau, Unnao and Panki). The ganga river runs alongside Eastern. It is believed to be the oldest inhabited site in the region. The main sector is the leather tanneries in Northern India. Jajmau is home to most of India's produce 15000crore in revenue a year and account for 30% of the nation's exports (Tripuntold). The most famous aspects of the region are the Panki III temple and the Panki Thermal Power Station, one of the few thermal energy facilities in Northern India. It is well known for being the logistics hub for the Kanpur area. The primary exportable goods are leather and leather products, automobile parts and machinery parts (Industry Experts, 2025). The Unnao district contains the Unnao industrial area. The total area is 16.06 hectares. The Unnao district's primary industries are the leather, handloom, textile and educational sectors. The region is well-known for its chemical, leather, mosquito net and Zardori industries (Industry Experts, 2025). Carefully gathering soil samples allowed for the evaluation of various soil samples.

Sampling site – Samples were taken from U.P industrial area in Awadh region (Jajmau, Unnao and Panki). The industrial area of Jajmau, Panki and Unnao, sample sites were selected. Gathered fifteen soil sample from three locations in U.P. In this study, we use a variety of detection techniques, such as atomic absorption spectrometer and Micro-biometer, to identify the presence of heavy metals like Pb, Cu, Ni, Zn, Hg and As, as well as microbial counts like bacteria and fungi. A sharp trowel and spade were used to gather samples. The study's finding are shown in Table – 1 (a, b, c) below. A significant concentration of heavy metals in mg/kg was discovered. The quantity of bacteria and fungi has also declined in soil contamination with heavy metals because a higher concentration of heavy metals lowers their population. These kinds of study result are listed in table -2 (a, b, c).

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Table -1. Heavy metal concentration in collected soil sample – Unnao, Jajmau and Panki

(a) Mean concentration of heavy metal in mg/kg industrial area of Unnao soil sample

Heavy metals	Place I	II	III	Mean
	IV	V		
Pb	89	88	87	87
	85	86		
Ni	40	42	41	41.2
	41	42		
	40	40	38	39.2
Cu	39	39		
Zn	57	57	58	56.6
	56	55		
	13.12	13.04	12.07	
Hg	14.06	14.05		13.268
As	3.6	3.6	3.0	3.4
	3.5	3.3		

Source: Regional soil testing laboratory, Kanpur

(b) Mean concentration of heavy metal in mg/kg industrial area of Jajmau soil sample

Heavy metals	Place I	II	III	Mean
	IV	V		
Pb	89	88.0	86.0	87.2
	86.0	87.0		
Ni	41	40	42	41
	41	41		
Cu	41	40	41	42
	43	45		
Zn	58	57	56	57.4
	58	58		
Hg	13.08	14.04	14.07	
	14.05	13.02		13.652
As	4.5	3.8	4.5	4.3
	4.3	4.4		

Source: Regional soil testing laboratory, Kanpur

(b) Mean concentration of heavy metal in mg/kg industrial area of Panki soil sample

Heavy metals	Place I	II	III	Mean
	IV	V		
Pb	88	87.5	89	
	87.2	87.7		87.88
Ni	41	40	40	41
	41			40.6
Cu	39	38	39	
	38	30		36.8
Zn	58	58	59	57
	57			57.8

Hg	13.01	13.05	13.02	
	14.04	14.01		13.426
As	4.05	4.08	4.1	
	4.06	4.2		4.098

Source: Regional soil testing laboratory, Kanpur 4

Table – 2. Total microbial count of collected soil samples – Unnao, Jajmau and Panki

(a) Mean of total microbial count of collected from Unnao soil sample (cfu/g^{-1})

Microbes	Place			Mean
	I	II	III	
	IV	V		
	3.35	3.28	3.50	
Bacteria	3.05	3.08		3.252
Fungi	3.60	3.93	3.90	3.5
	2.95	3.12		

Source: Regional soil testing laboratory, Kanpur

(b) Mean of total microbial count of collected from Jajmau soil sample (cfu/g^{-1})

Microbes	Place			Mean
	I	II	III	
	IV	V		
	4.11	4.00	4.05	
Bacteria	3.24	3.54		3.788
Fungi	3.96	3.92	3.92	
	3.54	3.26		3.72

Source: Regional soil testing laboratory, Kanpur

(c) Mean of total microbial count of collected from Panki soil sample (cfu/g^{-1})

Microbes	Place			Mean
	I	II	III	
	IV	V		
Bacteria	3.40	3.35	3.96	
	3.75	3.54		3.5
Fungi	2.92	2.89	2.79	
	3.43	3.45		3.096

Source: Regional soil testing laboratory, Kanpur

Result and Discussion

In the present study, we analyzed the heavy metals and total microbial count present in the industrial soil of Awadh region (Jajmau, Panki and Unnao) U.P from different places. Laboratory report show the amounts of heavy metals and microbial count for various parameters in contaminated soil. The result of this study are shown in table 1 (a, b, c) and Table 2 (a, b, c). The mean concentration of Pb (87) is high in Unnao, the mean concentration of Pb (87.2) is high in Jajmau and the mean concentration of Pb (87.88) is high in Panki comparison to other heavy metals. It was discovered that the total number of bacteria and fungi in the fertile soil sample was significantly greater than the total number of bacteria in the metal-contaminated soil sample (Mhatre *et.al,* 2022). The presence and activity of soil microorganisms are strongly impacted by the concentration of heavy metals. A group of microorganisms may be poisoned by low concentrations of heavy metals, which could have an impact on their diversity and abundance.

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Industrial activity may result from high soil concentrations of heavy metals (Lenart and Wolny-Koladka, 2013). The diversity, population and activity of microorganisms are negatively impacted when heavy metals such as copper, zinc, and lead are present in excess in the soil. Mocro-organisms may become less diverse and biodiverse as a result of disruptions to cellular processes, metabolic pathways and cooper and zinc enzyme activity. Micro-organisms may be poisoned by high concentrations of heavy metals (Lugauskas *et. al,* 2005*).* The total microbial count of three places of Awadh region (Jajmau, Panki and Unnao) are bacteria and fungi is high in Jajmau in comparison to other microbial count is low.

Conclusion

According to the study 's findings, soil from various Uttar Pradesh industrial cities has different concentrations of pollutants, such as heavy metals and other industrial pollutants. The population and diversity of soil microorganisms are greatly impacted by these pollutants. Higher pollution levels typically result in lower soil fertility and beneficial microbial communities. Nonetheless, certain microorganisms exhibit adaptability and resistance to contaminated environments, suggesting their possible application in bioremediation. To preserve soil health and ecological balance, regular soil quality maintenance, appropriate industrial waste management, and pollution control measures are crucial. The role of resistant microorganisms in cleaning up contaminated soils should be investigated further.

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