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A STUDY OF THE IMPACTS OF UNSUSTAINABLE HUMAN ACTIVITIES ON THE DEGRADATION OF THE KOTHARI RIVER IN BHILWARA CITY, RAJASTHAN

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ABSTRACT
The study investigates the degradation of the Kothari River in Bhilwara city, Rajasthan, caused by unsustainable human activities. Rapid industrialization and population growth have led to the continuous discharge of industrial effluents and untreated sewage, severely affecting the river's water quality. Unsustainable agricultural practices, including the overuse of chemical fertilizers and pesticides, further contribute to the pollution load and declining aquatic ecosystem health. The research utilizes both primary data as well as secondary data. Analysis of these data reveals alarming levels of contamination and declining ecological balance. The findings emphasize the urgent need for sustainable management, industrial regulation and agricultural reforms to mitigate river pollution and ensure the long-term environmental sustainability of the Kothari River in Bhilwara.
KEYWORDS: *Kothari River, Bhilwara City, Industrial Effluents, Untreated Sewage, Unsustainable Agriculture*

INTRODUCTION
Bhilwara city is situated in the central-south-eastern part of Rajasthan, at the intersection point of 25°35' North latitude and 74°64' East longitude and on the bank of Kothari River (Ground Water Department Rajasthan, 2013). Being a leading hub in textile industry Bhilwara, famously known as the 'Textile City' or the 'Manchester' of Rajasthan, exemplifies these challenges. The city's rapid industrial expansion and population growth have placed enormous stress on the Kothari River, which is Bhilwara's main source of water and also known as the 'lifeline of Bhilwara city'. However, over the past few decades, the river has experienced significant ecological degradation due to unsustainable human activities. Rapid industrialization along the riverbanks has led to the discharge of industrial effluents containing harmful chemicals and dyes, especially from textile processing units. These pollutants have altered the physicochemical properties of the river water, making it unsuitable for aquatic life and human use. Additionally, the unchecked release of untreated sewage from urban settlements further exacerbates the contamination levels, promoting the growth of pathogens and reducing dissolved oxygen content (Singh et al., 2023). Unsustainable agricultural practices, including excessive use of fertilizers and pesticides, contribute to nutrient loading and eutrophication, affecting the river's ecological balance (Onyango, 2018). Together, these activities have resulted in a declining water quality and shrinking biodiversity within the Kothari River system. The degradation of this vital water resource poses serious environmental and socio-economic challenges for Bhilwara, underscoring the urgent need for sustainable water management practices, effective wastewater treatment and stricter regulation of industrial discharge to restore the river's health and ensure its long-term sustainability.

Industrial Effluents in the Kothari River
It refers to the wastewater which is generated from industrial process houses. Unlike the domestic sewage, industrial effluent often contains a much more complex mix of contaminants such as, oil and grease, iron, manganese, sodium, calcium, magnesium, calcium carbonate, chloride, sulphate, potassium etc. The Pollutants detected in the Industrial effluent dumped into the Kothari river have been shown in the table 1.1. The table presents a comparative analysis of various pollutants present in the industrial effluent discharged into the Kothari River and the standard permissible limits for each pollutant set by the BIS; Bureau of Indian Standards. The results highlight that the quantities of some pollutants particularly oil and grease, sodium and magnesium are significantly above permissible limits, indicating severe water quality degradation.

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Oil and grease are detected at 60 mg/L (standard: 10 mg/L), pointing to significant organic and hydrocarbon contamination. Such levels can harm aquatic organisms by forming a surface film that reduces oxygen transfer and affects water usability for irrigation or drinking (Al-Fanharawi, 2023).

Magnesium also exceeds standards (61.5 mg/L vs. 50 mg/L), which, while a plant nutrient, at excess levels can lead to issues like scale formation in industrial and domestic settings (Qadir et al., 2018).

Sodium content is very high (520 mg/L vs. the 5 mg/L standard), indicating potential problems like soil sodicity and health issues upon prolonged exposure (Basavaraddi et al., 2012). Excess sodium can degrade soil structure and affect crop productivity, while in humans, it may pose cardiovascular risks.

Table: 1.1: Pollutants identified in the Industrial effluent dumped into the Kothari river

S. No.	Pollutants Detected	Actual Quantity (mg/L)	Standard Quantity (mg/L)
1.	Oil and grease	60	10
2.	Iron	0.37	03
3.	Manganese	0.07	02
4.	Sodium	520	05
5.	Calcium	62.4	75
6.	Magnesium	61.5	50
7.	Calcium carbonate	408	No universal limit
8.	Chloride	378	600
9.	Sulphate	348	1000
10.	Potassium	24	60

Source: Bhagat & Tiyasha, 2013

Other measured pollutants (iron, manganese, calcium, chloride, sulphate and potassium) mostly fall within permissible limits, but their cumulative and interactive effects, given the already exceeded parameters, contribute to overall ecological stress.

The consistently high levels of certain pollutants underscore the lack of effective industrial effluent treatment and regulatory enforcement. This scenario is mirrored by similar reports highlighting toxic levels of metals and salts in groundwater and surface water near Bhilwara's industrial belt, severely impacting water quality for humans, agricultureand livestock.

Untreated sewage discharged in the Kothrai River

Kothari river is consistantly struggling by the discharge of untreated sewage generated from households, businessesand industries directly into it. This sewage contains a mix of organic matter (human waste, food scraps), pathogens (bacteria, viruses, parasites), nutrients (nitrogen, phosphorus), chemicals, suspended solidsand sometimes hazardous substances. The worrying thing is that the presence of heavy metals has been detected in the sewage water discharged into the Kothari river which is displayed in the table 1.2 (Kothari, Gupta, & Shrivastava, 2024).

Table: 1.2: Heavy Metals identified in the Water samples of Kothari river

S. No.	Heavy Metals found	Actual Quantity	Standard Quantity
1.	Lead	0.15 mg/L to 0.45 mg/L	0.01 mg/L
2.	Cadmium	0.02 mg/L to 0.08 mg/L	0.003 mg/L
3.	Mercury	0.005 mg/L to 0.02 mg/L	0.001 mg/L

Source: Kothari, Gupta & Shrivastava, 2024

Lead (Pb): The concentration ranges from 0.15 to 0.45 mg/L, which is substantially higher than the standard permissible limit of 0.01 mg/L. This indicates serious lead contamination, likely resulting from textile dyeing and industrial effluents in the Bhilwara region. Prolonged exposure can cause severe health effects including neurological and renal disorders (Yadav, 2018).

Cadmium (Cd): Levels vary between 0.02 and 0.08 mg/L compared to the standard of 0.003 mg/L. This suggests moderate to high contamination, possibly due to industrial wastewater and the use of phosphate fertilizers in agricultural runoff. Cadmium toxicity may affect the liver and kidneys and disrupt aquatic life (Liu et al., 2022).

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Mercury (Hg): The detected range is 0.005 to 0.02 mg/L, exceeding the permissible limit of 0.001 mg/L. Mercury contamination may stem from chemical processing industries and can bio accumulate in aquatic organisms, posing long-term ecological and health hazards (Ibrahem et al., 2025).

Overall, the data shows that all three heavy metals surpass the standard limits set by the BIS; Bureau of Indian Standards. Such contamination poses threats to both aquatic ecosystems and human populations dependent on this water source for domestic or agricultural use.

As the wastewater has not passed through any sewage treatment system, all its contaminants remain and can significantly pollute water bodies. Untreated sewage commonly causes:

- Oxygen depletion in the water due to high organic loads, leading to the death of aquatic life.
- Spread of waterborne diseases, affecting both humans and animals.
- Eutrophication, where excess nutrients cause algal blooms and disrupt the ecosystem.
- Release of unpleasant odors and toxic gases from the decomposition of organic waste.

The discharge of untreated sewage is a major environmental and public health issue, making the treatment of sewage before disposal or reuse essential to prevent pollution and protect ecosystems and communities.

Unsustainable Agricultural Practices

Agricultural activities within the Kothari River basin have become a major factor contributing to the worsening condition of the river ecosystem. The widespread dependence on chemical fertilizers, pesticides and other agrochemicals used to boost crop productivity has resulted in significant runoff of these pollutants into the river system. During rainfall or irrigation events, these chemicals are washed off from farmlands into nearby streams and eventually enter the Kothari River, leading to the accumulation of harmful residues that pollute the water. Such contamination affects not only aquatic biodiversity but also the communities relying on the river for domestic and agricultural purposes.

The table 1.3 “Nutrient standards for soils in India” provides both reference nutrient levels and actual concentrations measured in the Kothari River basin on 25 July 2025. The data reveals several important insights, threats and actionable recommendations for sustainable soil and river management.

From the table, it can be observed that, Organic Carbon (0.63%) falls in the medium range, reflecting moderate soil health. However, consistent chemical fertilizer use and limited organic amendments could restrict carbon buildup, eventually leading to reduced soil fertility and poor structure, both of which heighten vulnerability to erosion and runoff issues.

Table 1.3: Nutrient standards for soils in India

S. No.	Nutrient	Low	Medium	High	Actual Concentration (Through sample testing done at 25 July 2025)
1	Organic Carbon	< 0.50 %	0.50 % to 0.75 %	> 0.75 %	0.63 %
2	Potash	< 120 kg/ha.	120 to 280 kg/ha.	> 280 kg/ha.	195 kg/ha.
3	Phosphate	< 10 kg/ha.	10 to 25 kg/ha.	> 25 kg/ha.	67.5 kg/ha.
4	Zinc	< 0.6 ppm	-	> 0.6 ppm	1.29 ppm
5	Iron	< 4.5 ppm	-	> 4.5 ppm	6.42 ppm
6	Copper	< 0.2 ppm	-	> 0.2 ppm	0.54 ppm
7	Manganese	< 2.0 ppm	-	> 2.0 ppm	4.21 ppm

Source: Soil Health Card Scheme and field survey

Potash (195 kg/ha) is also in the medium range, sufficient for crops but at risk of depletion if intensive farming continues without balanced replenishment.

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Phosphate (67.5 kg/ha) is well above the high threshold, signaling excessive phosphorus accumulation. This raises particular concern for runoff-led eutrophication, threatening water quality and aquatic life in the Kothari River. Excess phosphorus is also known to disrupt soil nutrient ratios and encourage unwanted weed growth (Khalili & Moridi, 2025).

Zinc (1.29 ppm), Iron (6.42 ppm), Copper (0.54 ppm) and Manganese (4.21 ppm) are at or above adequate levels, but such micronutrient buildup can eventually result in toxicity, compromised crop health and further downstream contamination, especially during periods of heavy rainfall and runoff.

The overall nutrient profile suggests intensive fertilizer use, with risks of leaching, river contamination, nutrient imbalance for crops and long-term soil degradation.

Suggestions for Sustainable Management

1. Continuous monitoring of polluted water discharged from industrial units can be done by local authorities. Strict action can be taken against the culprits for following the implemented policies and laws. Apart from this, environmental audits of industries and impose strict penalties or shutdowns for non-compliance to deter illegal dumping can be done at regular basis.
2. Local authorities and the government can motivate the owners of industrial units to set up Effluent Treatment Plants (ETPs). Apart from this, they can be made aware about the subsidy provided by the government for setting up such plants.
3. Encourage and facilitate industries to transition toward environmentally sustainable technologies and production processes that prioritize resource efficiency, energy conservation and pollution control. Such approaches should aim to minimize the generation of industrial waste and prevent the discharge of toxic effluents into natural water bodies, thereby promoting long-term environmental protection and sustainable industrial development.
4. Implement regular river restoration programs focused on systematic cleaning, removal of solid waste and treatment of polluted water to improve water quality and revive aquatic ecosystems. These initiatives should also include ecological remediation measures such as bio-rehabilitation, afforestation along riverbanks and community participation to ensure the long-term restoration of the river's ecological balance and environmental health.
5. Promote collaborative partnerships among government agencies, industrial sectors and environmental organizations to design and implement integrated sustainable water management strategies. Such partnerships should focus on efficient resource utilization, pollution control, wastewater recycling and the adoption of eco-friendly technologies. Joint initiatives can help align policy frameworks, strengthen regulatory mechanisms and ensure collective responsibility for preserving water quality and maintaining the ecological integrity of river systems.
6. A municipal Sewage Treatment Plant (STP) with adequate capacity (such as the proposed 15 MLD plant in Bhilwara) should be constructed and operated efficiently to treat sewage before releasing it into the river. This will significantly reduce organic and microbial pollutants in the water.
7. Mobilizing funds through government schemes, industrial association involvement and possibly public-private partnerships can ensure proper implementation and maintenance of sewage infrastructure.
8. Organize comprehensive awareness campaigns to educate local communities about the harmful impacts of sewage pollution on river ecosystems, public health and livelihoods. These initiatives should promote active citizen participation in river conservation through community clean-up drives, responsible waste disposal practices and advocacy for sustainable sanitation systems. Encouraging local involvement will strengthen environmental stewardship and foster a collective commitment to protecting and restoring river health.
9. Treated sewage water can be reused for irrigation and industrial processes, reducing freshwater demand and promoting sustainable water resource management.
10. Promote soil testing via 'Soil Health Card Scheme' before fertilizer application, ensuring site-specific and need-based nutrient management to avoid over-enrichment. This prevents wasteful spending and unnecessary chemical discharge.
11. Combine organic and inorganic sources applying micronutrients only when required and correcting deficiencies carefully.
12. Avoid excessive irrigation and runoff-prone practices. Employ drip or sprinkler irrigation to minimize erosion and nutrient loss.

CONCLUSION

Rapid industrial growth, unchecked urbanization, poor waste management and weak governance have severely polluted and diminished the Kothari River in Bhilwara, mainly due to untreated textile effluents. This environmental crisis threatens ecosystems and public health. Sustainable development requires enforcing strict pollution controls, upgrading waste treatment, promoting eco-friendly agricultural practices and ensuring community involvement in water governance. Restoring the river is crucial for Bhilwara's long-term prosperity. The evidence highlights the urgent need for effective pollution control, compliance with environmental standards and investment in wastewater treatment to revive the river and protect public welfare.

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