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"IMPACT OF ANTHROPOGENIC ACTIVITIES ON WATER QUALITY AND FISH BIODIVERSITY IN KUBER TALAB, REWA WITH SPECIAL EMPHASIS ON LABEO ROHITA"

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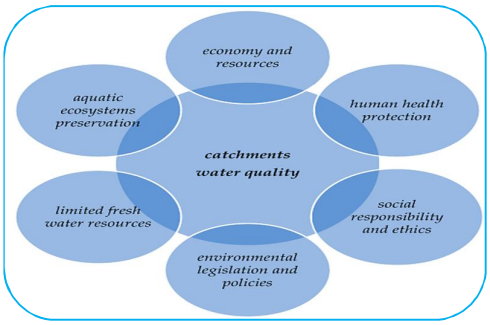
ABSTRACT:



Anthropogenic activities have significantly altered freshwater ecosystems, affecting both water quality and aquatic biodiversity. The present study evaluates the impact of human-induced disturbances on the physico-chemical parameters of water and fish diversity in Kuber Talab, Rewa (Madhya Pradesh), with special emphasis on Labeo rohita. Water samples were analyzed for key parameters such as pH, temperature, dissolved oxygen (DO), biochemical oxygen demand (BOD), and nutrient content. Fish diversity was assessed through regular sampling and identification. The results indicate deterioration in water quality due to activities such as domestic waste discharge, agricultural runoff, and urbanization. A decline in sensitive fish species and stress indicators in Labeo rohita were observed. The study highlights the urgent need for conservation and sustainable management strategies to restore ecological balance.

KEYWORDS: *Anthropogenic activities, Water quality, Fish biodiversity, Labeo rohita, Kuber Talab, Pollution and Freshwater ecosystem.*

INTRODUCTION:

Freshwater ecosystems such as ponds, lakes, and rivers play a crucial role in maintaining ecological balance, supporting biodiversity, and providing essential ecosystem services to human populations. These ecosystems act as habitats for a wide variety of flora and fauna, regulate hydrological cycles, and contribute to nutrient recycling. In addition, they serve as a primary source of water for domestic, agricultural, and industrial purposes. Despite their immense ecological and economic importance, freshwater bodies are increasingly subjected to degradation due to intensifying anthropogenic activities.

In recent decades, rapid urbanization and population growth have significantly increased pressure on natural water resources. Activities such as unplanned urban expansion, discharge of untreated sewage, agricultural runoff containing fertilizers and pesticides, and industrial effluents have led to a decline in water quality. These pollutants introduce excessive nutrients, toxic chemicals, and suspended solids into aquatic systems, resulting in eutrophication, oxygen depletion, and habitat alteration. Consequently, the health and sustainability of freshwater ecosystems are severely compromised.

One of the most critical consequences of water pollution is its impact on aquatic biodiversity, particularly fish communities. Fish are highly sensitive to changes in water quality parameters such as

temperature, pH, dissolved oxygen, turbidity, and concentrations of toxic substances. Any alteration in these parameters can disrupt physiological processes, reproduction, growth, and survival of fish species. Moreover, the accumulation of pollutants in fish tissues can lead to bioaccumulation and biomagnification, posing serious risks not only to aquatic organisms but also to human consumers.

Among freshwater fish species, Labeo rohita (commonly known as Rohu) holds significant ecological and economic importance in India. It is one of the major Indian carps widely cultivated in aquaculture due to its high nutritional value and market demand. Rohu serves as an important indicator species for assessing the health of freshwater ecosystems because of its sensitivity to environmental changes. Variations in its population structure, growth patterns, and health status can reflect the overall condition of the aquatic environment.

Anthropogenic disturbances not only alter the physicochemical characteristics of water bodies but also lead to habitat fragmentation and loss. Activities such as excessive water extraction, encroachment, dumping of solid waste, and construction near water bodies further degrade aquatic habitats. These changes reduce the availability of suitable breeding and feeding grounds for fish, leading to a decline in species diversity and abundance. In many cases, pollution-tolerant species dominate, while sensitive species gradually disappear, resulting in reduced biodiversity and ecological imbalance.

Kuber Talab, located in Rewa district of Madhya Pradesh, represents a typical freshwater body facing such anthropogenic pressures. The pond is subjected to multiple sources of pollution, including domestic sewage inflow, washing activities, agricultural runoff, and local human interference. These activities contribute to the deterioration of water quality and directly impact the aquatic life within the pond. Understanding the extent of these impacts is essential for developing effective conservation and management strategies.

Water quality assessment involves the analysis of various physicochemical parameters such as temperature, pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), and nutrient levels. These parameters provide valuable insights into the condition of the aquatic environment and its suitability for sustaining aquatic organisms. Changes in these parameters are often directly linked to anthropogenic activities and can be used to evaluate the degree of pollution in a water body.

Fish biodiversity, on the other hand, serves as a reliable biological indicator of ecosystem health. A diverse and balanced fish community reflects a stable and healthy aquatic ecosystem, whereas a decline in diversity indicates environmental stress and degradation. The study of fish diversity, abundance, and distribution patterns helps in understanding the ecological status of the water body and the impact of external stressors. Special emphasis on economically important species such as Labeo rohita provides additional insights into the effects of pollution on fish health and productivity.

Previous studies have highlighted the adverse effects of anthropogenic activities on freshwater ecosystems across India. Many researchers have reported a decline in water quality and fish diversity in ponds and lakes due to increased human interference. However, localized studies are essential to understand site-specific conditions and to develop targeted management strategies. In this context, the present study focuses on assessing the impact of anthropogenic activities on water quality and fish biodiversity in Kuber Talab, Rewa.

The objectives of this study are to evaluate the physicochemical characteristics of water, analyse fish biodiversity, and assess the impact of anthropogenic activities on the aquatic ecosystem of Kuber Talab. Special emphasis is given to Labeo rohita to understand its response to environmental changes and its role as an indicator species. The findings of this study are expected to contribute to the conservation and sustainable management of freshwater resources in the region.

Freshwater ecosystems are under increasing threat due to human activities, and there is an urgent need to monitor and manage these resources effectively. Studies like the present one provide valuable baseline data and help in identifying the key factors responsible for environmental degradation. By understanding the relationship between anthropogenic activities, water quality, and fish biodiversity, appropriate measures can be taken to restore and protect aquatic ecosystems for future generations.

MATERIALS AND METHODS :

Study Area: The present investigation was carried out in Kuber Talab, located in Rewa district of Madhya Pradesh, India. Kuber Talab is a freshwater pond that serves as an important local resource for domestic use, irrigation, and fisheries. Geographically, the pond lies in a semi-urban region and is influenced by surrounding human settlements. The ताल॰ब receives water from rainfall and surface runoff, while also being subjected to anthropogenic inputs such as domestic sewage, agricultural runoff, cattle bathing, washing activities, and disposal of solid waste.

The climate of the study area is tropical, characterized by three distinct seasons: summer (March–June), monsoon (July–October), and winter (November–February). Seasonal variations significantly influence the physicochemical characteristics of water and aquatic biodiversity. Multiple sampling sites were selected within the pond based on varying degrees of anthropogenic disturbance to obtain a representative assessment of water quality and fish diversity.

Collection: Water and fish samples were collected monthly over a specified study period (e.g., one year) to account for seasonal variations.

Water Sampling: Water samples were collected from different selected sites using clean, sterilized polyethylene bottles. Sampling was carried out during morning hours to minimize diurnal variations. Parameters such as temperature and pH were recorded on-site using portable instruments, while other parameters like dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), and nutrients were analyzed in the laboratory following standard methods (APHA, 2017).

Fish Sampling: Fish specimens were collected with the help of local fishermen using nets such as cast nets, gill nets, and drag nets. The collected fishes were washed with clean water and preserved in 5–10% formalin solution for further analysis. Special attention was given to the collection of Labeo rohita specimens for detailed study of morphometric and ecological aspects.

Identification: Fish specimens were identified up to species level using standard taxonomic keys and literature such as Day (1878) and Talwar and Jhingran (1991). Morphological characteristics including body shape, fin structure, scale pattern, and coloration were used for identification. The identification of Labeo rohita was confirmed based on distinguishing features such as elongated body, slightly arched dorsal profile, terminal mouth, and characteristic fin arrangement. Scientific nomenclature and classification were verified using standard ichthyological references.

Data Analysis: The collected data were analyzed to evaluate water quality status and fish biodiversity.

Physicochemical Analysis: Mean values and seasonal variations of water quality parameters were calculated. The obtained values were compared with standard permissible limits (WHO/BIS guidelines) to assess pollution levels.

Biodiversity Analysis: Fish diversity was assessed using standard ecological indices such as:

- Shannon-Wiener Diversity Index (H')
- Simpson's Diversity Index (D)
- Species richness and evenness

Statistical Analysis: Correlation analysis was performed to determine the relationship between physicochemical parameters and fish diversity. The impact of anthropogenic activities on water quality and fish population, particularly Labeo rohita, was interpreted using comparative and graphical methods.

RESULTS:

The results of the present study revealed significant variations in the physicochemical parameters of water and fish biodiversity in Kuber Talab, Rewa. These variations were largely influenced by seasonal changes and anthropogenic activities such as sewage discharge, agricultural runoff, and domestic usage.

Water quality analysis indicated that several parameters deviated from standard permissible limits, particularly during the summer season when water volume decreased and pollutant concentration increased. Similarly, fish biodiversity showed fluctuations, with a dominance of pollution-

tolerant species and a relative decline in sensitive species. The population and health status of Labeo rohita were also affected by changing environmental conditions.

Table 1: Seasonal Variation in Physicochemical Parameters of Water in Kuber Talab

S. No.	Parameters	Summer	Monsoon	Winter	Permissible Limits (WHO/BIS)
1	Temperature (°C)	30.5 ± 1.2	27.8 ± 1.0	22.4 ± 0.8	-
2	Ph	8.2 ± 0.3	7.5 ± 0.2	7.2 ± 0.2	6.5 – 8.5
3	Dissolved Oxygen (mg/L)	4.2 ± 0.5	5.8 ± 0.6	6.5 ± 0.4	≥ 5
4	Biochemical Oxygen Demand	6.8 ± 0.7	4.5 ± 0.5	3.2 ± 0.3	≤ 3
5	Chemical Oxygen Demand	18.5 ± 1.5	14.2 ± 1.2	10.8 ± 1.0	≤ 10
6	Total Dissolved Solids (mg/L)	520 ± 30	410 ± 25	350 ± 20	≤ 500
7	Nitrates (mg/L)	2.8 ± 0.4	2.1 ± 0.3	1.5 ± 0.2	≤ 1
8	Phosphates (mg/L)	1.9 ± 0.3	1.4 ± 0.2	1.0 ± 0.2	≤ 0.1

Table 1 presents the seasonal fluctuations in key physicochemical parameters of water in Kuber Talab, highlighting the influence of environmental conditions and anthropogenic activities on water quality.

The temperature of water showed a clear seasonal trend, with the highest value recorded during summer (30.5 ± 1.2°C), followed by monsoon (27.8 ± 1.0°C) and the lowest in winter (22.4 ± 0.8°C). This variation is attributed to climatic conditions and solar radiation intensity. Higher temperatures in summer can accelerate biological and chemical processes, thereby influencing other water quality parameters.

The pH of water remained within the permissible limits (6.5–8.5) across all seasons, indicating slightly alkaline conditions. The highest pH was observed in summer (8.2 ± 0.3), possibly due to increased photosynthetic activity and reduced water volume, while lower values in monsoon (7.5 ± 0.2) and winter (7.2 ± 0.2) may be due to dilution effects and reduced biological activity.

Dissolved Oxygen (DO) levels were lowest in summer (4.2 ± 0.5 mg/L), which is below the permissible limit (≥5 mg/L), indicating stressed conditions for aquatic organisms. In contrast, DO levels improved during monsoon (5.8 ± 0.6 mg/L) and winter (6.5 ± 0.4 mg/L) due to lower temperatures and increased aeration. The depletion of DO in summer suggests high organic load and increased microbial activity.

The Biochemical Oxygen Demand (BOD) values were found to be highest in summer (6.8 ± 0.7 mg/L), exceeding the permissible limit (≤3 mg/L), indicating significant organic pollution. BOD decreased in monsoon (4.5 ± 0.5 mg/L) and further in winter (3.2 ± 0.3 mg/L), reflecting reduced decomposition activity and dilution of pollutants during rainfall.

Similarly, Chemical Oxygen Demand (COD) values were elevated in all seasons, with the highest in summer (18.5 ± 1.5 mg/L), followed by monsoon (14.2 ± 1.2 mg/L) and winter (10.8 ± 1.0 mg/L). All values exceeded the permissible limit (≤10 mg/L), indicating the presence of both biodegradable and non-biodegradable pollutants in the water.

The Total Dissolved Solids (TDS) concentration was highest in summer (520 ± 30 mg/L), slightly exceeding the permissible limit (≤500 mg/L), suggesting accumulation of dissolved salts due to evaporation and anthropogenic inputs. TDS levels decreased during monsoon (410 ± 25 mg/L) and winter (350 ± 20 mg/L) due to dilution.

Nitrate levels were considerably higher than the permissible limit (≤1 mg/L) in all seasons, with maximum concentration in summer (2.8 ± 0.4 mg/L). This indicates contamination from agricultural runoff, sewage discharge, and organic waste. Elevated nitrate levels can lead to eutrophication and excessive algal growth.

Phosphate concentrations were also significantly above the permissible limit (≤0.1 mg/L) throughout the study period, with the highest value in summer (1.9 ± 0.3 mg/L). High phosphate levels are mainly due to detergents, domestic sewage, and fertilizer runoff, contributing to nutrient enrichment and eutrophic conditions.

The results clearly indicate that water quality in Kuber Talab is moderately to heavily polluted, particularly during the summer season. Elevated levels of BOD, COD, nitrates, and phosphates, along with reduced DO, reflect the strong impact of anthropogenic activities such as sewage inflow, agricultural runoff, and domestic usage. Seasonal variation plays a significant role, with monsoon showing some improvement due to dilution, while summer conditions exacerbate pollution levels.

Table 2: Fish Biodiversity Recorded in Kuber Talab

S. No.	Fish Species	Common Name	Status	Abundance (%)
1	*Labeo rohita*	Rohu	Dominant	35%
2	*Catla catla*	Catla	Common	28%
3	*Cirrhinus mrigala*	Mrigal	Common	15%
4	*Clarias batrachus*	Magur	Tolerant species	22%

Table 2 presents the composition and relative abundance of major fish species recorded in Kuber Talab during the study period. The data indicate the dominance of Indian major carps along with the presence of a pollution-tolerant species, reflecting the ecological condition of the pond.

Among the recorded species, *Labeo rohita* (Rohu) was found to be the most dominant species, contributing the highest abundance (35%). Its dominance suggests that the pond environment is still favorable for carp species and may also reflect stocking practices and its high economic importance.

Catla catla (Catla) was the second most abundant species, contributing 28%, and is categorized as a common species. Along with *Cirrhinus mrigala* (Mrigal), which accounted for 15% of the total fish population, these species form the group of Indian major carps. Their presence indicates that the pond supports commercially important fish and maintains some level of ecological productivity.

However, the relatively high abundance of *Clarias batrachus* (Magur), accounting for 22%, is ecologically significant. This species is classified as a tolerant species due to its ability to survive in low dissolved oxygen conditions and polluted environments. Its considerable presence suggests that the water body is experiencing environmental stress and organic pollution. The fish biodiversity pattern indicates a moderate ecological imbalance in Kuber Talab. While the dominance of carp species reflects some degree of ecological stability and fishery potential, the substantial proportion of a pollution-tolerant species like *Clarias batrachus* points toward deteriorating water quality due to anthropogenic activities. This shift in species composition highlights the impact of environmental degradation on aquatic biodiversity.

Table 3: Diversity Indices of Fish Community

Index Type	Value
Shannon-Wiener Index (H')	1.33
Simpson's Index (D)	0.68
Species Richness	4
Evenness	0.79

Table 3 presents the diversity indices of the fish community in Kuber Talab, calculated based on the four recorded species (*Labeo rohita*, *Catla catla*, *Cirrhinus mrigala*, and *Clarias batrachus*). These indices provide insight into species diversity, distribution, and ecological stability of the pond ecosystem. The Shannon-Wiener Index (H') value of 1.33 indicates moderate species diversity. This suggests that although multiple species are present, the community is somewhat dominated by a few species, particularly *Labeo rohita* and *Catla catla*.

The Simpson's Index (D) value of 0.68 reflects a moderate level of dominance and diversity within the fish community. A value closer to 1 indicates higher diversity; however, the obtained value suggests that dominance by certain species reduces overall diversity.

The species richness value of 4 simply represents the total number of fish species recorded in the study. This relatively low richness indicates limited biodiversity, which may be due to environmental stress and anthropogenic disturbances. The evenness value of 0.79 indicates a fairly uniform distribution of individuals among the species, although slight dominance by *Labeo rohita* and *Catla catla* is evident. This suggests that while no species is extremely rare, the community structure is not perfectly balanced. The diversity indices suggest that Kuber Talab has moderate fish diversity with signs of ecological stress. The dominance of a few species and the presence of a pollution-tolerant species like *Clarias batrachus* indicate that anthropogenic activities are influencing the fish community structure and reducing biodiversity.

DISCUSSION:

The present study reveals that anthropogenic activities have significantly influenced the water quality and fish biodiversity of Kuber Talab, Rewa. The observed seasonal variations in physicochemical parameters clearly indicate that summer season experiences maximum environmental stress, which is mainly due to reduced water volume, increased temperature, and higher concentration of pollutants. Similar seasonal trends have been reported by APHA (2017), emphasizing that temperature and organic load play a crucial role in determining water quality.

The decline in dissolved oxygen (DO) levels during summer and its improvement during winter and monsoon is consistent with findings of Wetzel (2001), who reported that higher temperatures reduce oxygen solubility while increasing microbial respiration. Low DO levels observed in the present study indicate stress conditions for aquatic organisms and may lead to fish mortality in extreme cases.

The elevated values of biochemical oxygen demand (BOD) and chemical oxygen demand (COD) suggest the presence of high organic pollution in the pond. These findings are in agreement with the work of Trivedy and Goel (1986), who reported that increased BOD and COD values are direct indicators of organic waste contamination from domestic sewage and agricultural runoff. The continuous inflow of such pollutants in Kuber Talab has contributed to the deterioration of water quality.

High concentrations of nitrates and phosphates recorded in this study indicate nutrient enrichment and eutrophic conditions. According to Vollenweider (1968), excessive nutrients accelerate algal growth, leading to eutrophication and subsequent oxygen depletion. The present findings support this observation, as increased nutrient levels are associated with reduced DO and increased BOD.

The fish biodiversity pattern observed in Kuber Talab reflects the impact of these physicochemical changes. The dominance of *Labeo rohita* and *Catla catla* indicates that the pond still supports economically important species. However, the significant presence of *Clarias batrachus*, a pollution-tolerant species, suggests environmental degradation. Similar shifts in fish community structure under polluted conditions have been reported by Karr (1981), who emphasized that tolerant species dominate in disturbed aquatic ecosystems.

The moderate value of diversity indices (Shannon-Wiener and Simpson's index) indicates reduced species diversity and ecological imbalance. According to Shannon and Simpson, diversity indices are effective tools for assessing ecosystem health, where lower values indicate environmental stress and dominance of a few species.

Furthermore, the presence of pollution-tolerant fish species and the decline in sensitive species are in line with the findings of Odum (1971), who stated that disturbed ecosystems tend to lose biodiversity and become dominated by opportunistic species. This ecological shift is evident in Kuber Talab due to continuous anthropogenic pressure. The study establishes a clear relationship between anthropogenic activities, water quality degradation, and alteration in fish biodiversity. The findings are consistent with earlier studies conducted on freshwater bodies in India, which report that untreated sewage, agricultural runoff, and human interference significantly affect aquatic ecosystems. The degradation of water quality and changes in fish community structure in Kuber Talab highlight the

urgent need for conservation and management strategies. Effective control of pollution sources, regular monitoring, and sustainable utilization of resources are essential to restore and maintain the ecological balance of the pond.

CONCLUSION:

The present study on Kuber Talab, Rewa, clearly demonstrates that anthropogenic activities have a profound impact on water quality and fish biodiversity. The analysis of physicochemical parameters revealed significant seasonal variations, with the summer season showing the highest level of pollution. Elevated values of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), nitrates, and phosphates, along with reduced dissolved oxygen (DO), indicate the presence of organic pollution and nutrient enrichment in the pond. The deterioration of water quality is mainly attributed to human activities such as discharge of domestic sewage, agricultural runoff, washing, bathing, and solid waste disposal. These factors have contributed to eutrophication and degradation of the aquatic environment. The study of fish biodiversity showed that *Labeo rohita* is the dominant species, followed by *Catla catla* and *Cirrhinus mrigala*, indicating the presence of economically important fish species in the pond. However, the considerable abundance of *Clarias batrachus*, a pollution-tolerant species, reflects environmental stress and declining water quality. The diversity indices further confirm moderate biodiversity with signs of ecological imbalance. Therefore, it is essential to implement effective management strategies such as controlling sewage discharge, reducing agricultural runoff, preventing solid waste dumping, and promoting public awareness. Regular monitoring of water quality and biodiversity should also be carried out to ensure the conservation and sustainable utilization of Kuber Talab.

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