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"ASSESSMENT OF FRESHWATER ECOSYSTEM HEALTH AND ITS IMPACT ON INDIGENOUS FISH DIVERSITY IN KUBER TALAB, ANANTPUR REWA WITH SPECIAL REFERENCE TO CATLA CATLA"

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ABSTRACT:

Freshwater ecosystems are highly sensitive to environmental changes and anthropogenic disturbances. The present study was conducted to assess the ecological health of Kuber Talab, Anantpur (Rewa) and its impact on indigenous fish diversity, with special reference to Catla catla. Physicochemical parameters of water and fish diversity were analysed to evaluate ecosystem status. The results indicated seasonal fluctuations in water quality, with elevated levels of BOD, COD, nutrients, and reduced dissolved oxygen, particularly during summer. Fish diversity analysis revealed the dominance of carp species, while the presence of pollution-tolerant species indicated ecological stress. The study highlights a strong relationship between water quality deterioration and changes in fish community structure. The findings emphasize the need for sustainable management practices to conserve freshwater biodiversity and maintain ecological balance.

KEYWORDS: *Freshwater ecosystem, Water quality, Fish biodiversity, Anthropogenic activities, Catla catla, Kuber Talab.*

INTRODUCTION:

Freshwater ecosystems such as ponds, lakes, and rivers are essential components of the natural environment, supporting diverse biological communities and providing ecosystem services such as water supply, nutrient cycling, and fisheries. These ecosystems are highly dynamic and sensitive to environmental changes, particularly those caused by human activities.

In recent years, rapid urbanization, agricultural expansion, and population growth have intensified anthropogenic pressures on freshwater bodies. The discharge of untreated sewage, agricultural runoff containing fertilizers and pesticides, and other human activities have resulted in the degradation of water quality. These disturbances lead to eutrophication, oxygen depletion, and habitat destruction, which adversely affect aquatic organisms.

Fish are important indicators of aquatic ecosystem health due to their sensitivity to environmental changes. Variations in water quality parameters such as temperature, pH, dissolved oxygen, and nutrient levels directly influence fish diversity, distribution, and abundance. Indigenous fish species are particularly vulnerable to environmental stress and serve as reliable indicators of ecosystem disturbance.

Among freshwater fishes, *Catla catla* is one of the major Indian carps and plays a vital role in aquaculture and natural fisheries. It is highly valued for its rapid growth and economic importance. However, its survival and productivity depend largely on water quality and environmental conditions. Kuber Talab in Anantpur, Rewa, is an important freshwater body subjected to increasing anthropogenic pressure. Activities such as domestic waste disposal, agricultural runoff, and human interference have led to the deterioration of its ecological health. Therefore, assessing the ecosystem condition and its impact on fish diversity is essential for conservation and management.

MATERIAL AND METHODS:

Study Area: The present study was conducted at Kuber Talab located in Anantpur, Rewa district (Madhya Pradesh, India). The pond is a freshwater ecosystem influenced by nearby human settlements and is subjected to various anthropogenic activities such as domestic sewage discharge, agricultural runoff, washing, and cattle bathing. The region experiences a tropical climate with three distinct seasons summer, monsoon, and winter which significantly influence water quality and aquatic biodiversity. Multiple sampling sites were selected within the pond to represent different levels of disturbance.

Collection: Water and fish samples were collected regularly on a monthly basis over a period of one year to capture seasonal variations. Sampling was conducted in the morning hours to minimize diurnal fluctuations. Standard protocols were followed to ensure consistency and reliability in sample collection.

Water Sampling: Water samples were collected from different locations of the pond using clean and sterilized polyethylene bottles. On-site measurements of temperature and pH were taken using portable instruments, while parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), nitrates, and phosphates were analyzed in the laboratory following standard methods (APHA, 2017).

Fish Sampling: Fish specimens were collected with the assistance of local fishermen using different types of nets such as cast nets, gill nets, and drag nets. The collected specimens were washed with clean water and preserved in 5–10% formalin solution for further identification and analysis. Special emphasis was given to *Catla catla* for ecological assessment.

Identification: The collected fish specimens were identified up to species level using standard taxonomic keys and reference literature such as Day (1878) and Talwar and Jhingran (1991). Identification was based on morphological characteristics including body shape, fin structure, scales, and coloration patterns. Scientific names were verified using standard ichthyological references.

Data Analysis: The collected data were systematically analyzed to assess water quality and fish biodiversity. Seasonal mean values of physicochemical parameters were calculated and compared. The data were organized in tabular and graphical forms for better interpretation of results.

Physicochemical Analysis: The physicochemical parameters of water including temperature, pH, DO, BOD, COD, TDS, nitrates, and phosphates were analyzed and compared with standard permissible limits (WHO/BIS guidelines). These parameters were used to assess the pollution status and ecological condition of the pond.

Biodiversity Analysis: Fish biodiversity was evaluated using ecological indices such as Shannon-Wiener Diversity Index (H'), Simpson's Diversity Index (D), species richness, and evenness. These indices helped in understanding the diversity, distribution, and dominance patterns of fish species in the study area.

Statistical Analysis: Statistical analysis was carried out to determine the relationship between physicochemical parameters and fish diversity. Correlation analysis was used to assess the impact of water quality on fish population, particularly *Catla catla*. The results were interpreted using comparative and descriptive statistical methods.

RESULTS:

The results of the present study indicate significant seasonal variations in physicochemical parameters of water and their influence on fish biodiversity in Kuber Talab, Anantpur (Rewa). Anthropogenic activities such as sewage discharge, agricultural runoff, and domestic usage have contributed to the deterioration of water quality, especially during the summer season. Fish diversity analysis revealed moderate diversity with dominance of major carp species, particularly *Catla catla*.

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)	31.2 ± 1.1	28.0 ± 1.0	23.1 ± 0.9	-
2	pH	8.3 ± 0.2	7.6 ± 0.3	7.3 ± 0.2	6.5 – 8.5
3	Dissolved Oxygen (mg/L)	4.0 ± 0.4	5.6 ± 0.5	6.3 ± 0.3	≥ 5
4	Biochemical Oxygen Demand	7.2 ± 0.6	4.8 ± 0.4	3.5 ± 0.3	≤ 3
5	Chemical Oxygen Demand	19.0 ± 1.4	14.5 ± 1.1	11.2 ± 0.9	≤ 10
6	Total Dissolved Solids (mg/L)	540 ± 25	420 ± 20	360 ± 18	≤ 500
7	Nitrates (mg/L)	3.0 ± 0.3	2.2 ± 0.2	1.6 ± 0.2	≤ 1
8	Phosphates (mg/L)	2.0 ± 0.2	1.5 ± 0.2	1.1 ± 0.1	≤ 0.1

Table 1 shows the seasonal variation in physicochemical parameters of water in Kuber Talab. The temperature was highest during summer (31.2°C) and lowest in winter (23.1°C), reflecting seasonal climatic conditions. The pH remained within permissible limits but showed slightly alkaline nature in all seasons.

Dissolved oxygen (DO) levels were lowest in summer (4.0 mg/L), falling below the standard limit, indicating stress conditions for aquatic organisms. In contrast, DO levels improved during monsoon and winter due to dilution and lower temperature.

Biochemical oxygen demand (BOD) and chemical oxygen demand (COD) values were higher than permissible limits in all seasons, particularly in summer, indicating high organic pollution and presence of decomposable matter. Total dissolved solids (TDS) also exceeded the limit during summer, suggesting accumulation of dissolved substances.

Nitrate and phosphate concentrations were significantly higher than permissible limits throughout the study period. These elevated nutrient levels indicate eutrophication caused by agricultural runoff, sewage discharge, and detergent input. The data indicate that water quality is most deteriorated during summer, while slight improvement is observed during monsoon and winter due to dilution effects.

Table 2: Fish Biodiversity Recorded in Kuber Talab

S. No.	Fish Species	Common Name	Status	Abundance (%)
1	*Catla catla*	Catla	Dominant	34%
2	*Labeo rohita*	Rohu	Common	26%
3	*Cirrhinus mrigala*	Mrigal	Common	18%
4	*Clarias batrachus*	Magur	Tolerant species	22%

Table 2 presents the composition and relative abundance of fish species recorded in Kuber Talab. The fish community is dominated by *Catla catla* (34%), indicating its adaptability and favorable conditions for growth. *Labeo rohita* (26%) and *Cirrhinus mrigala* (18%) were recorded as common species, representing the Indian major carp group.

The presence of *Clarias batrachus* (22%), a pollution-tolerant species, indicates environmental stress and poor water quality conditions. This species thrives in low oxygen environments and is often associated with polluted habitats. The dominance of carp species suggests some degree of ecological stability; however, the considerable presence of tolerant species reflects the impact of anthropogenic activities on fish diversity.

Table 3: Diversity Indices of Fish Community

Index Type	Value
Shannon-Wiener Index (H')	1.35
Simpson's Index (D)	0.70
Species Richness	4
Evenness	0.78

Table 3 shows the diversity indices of the fish community in Kuber Talab. The Shannon-Wiener Index (1.35) indicates moderate diversity, suggesting dominance of a few species. Simpson's Index (0.70) also reflects moderate diversity with partial dominance. Species richness (4) indicates limited diversity, while evenness (0.78) shows relatively uniform distribution among species. These values suggest that although fish species are present, the ecosystem is under stress and lacks high biodiversity.

The results clearly indicate that anthropogenic activities have negatively impacted water quality and fish biodiversity in Kuber Talab. High nutrient levels, organic pollution, and reduced dissolved oxygen have led to ecological imbalance. The dominance of *Catla catla* and presence of pollution-tolerant species like *Clarias batrachus* confirm the degraded condition of the aquatic ecosystem.

DISCUSSION:

The present study highlights the significant impact of anthropogenic activities on the water quality and fish biodiversity of Kuber Talab, Anantpur (Rewa). The observed variations in physicochemical parameters across seasons clearly indicate that the aquatic ecosystem is under environmental stress, primarily due to human interference.

The seasonal analysis of water quality parameters revealed that the summer season exhibited the highest level of pollution, characterized by elevated temperature, BOD, COD, TDS, nitrates, and phosphates, along with reduced dissolved oxygen (DO). The decrease in DO during summer can be attributed to increased temperature and enhanced microbial decomposition of organic matter, which consumes dissolved oxygen. Such conditions are unfavorable for most aquatic organisms and may lead to stress or mortality in fish populations.

The consistently high values of BOD and COD suggest a heavy organic load in the pond, indicating contamination from domestic sewage, agricultural runoff, and other anthropogenic sources. Elevated nutrient levels, particularly nitrates and phosphates, further confirm the occurrence of eutrophication. These nutrients promote excessive algal growth, which upon decomposition further depletes oxygen levels, creating hypoxic conditions in the water body.

Fish biodiversity analysis reflects the influence of these degraded environmental conditions. The dominance of *Catla catla* indicates that the pond still supports economically important species, possibly due to its adaptability and favorable feeding conditions. However, the relatively lower abundance of *Labeo rohita* and *Cirrhinus mrigala* suggests that not all carp species are equally tolerant to the prevailing environmental stress. The significant presence of *Clarias batrachus*, a pollution-tolerant species, is an important ecological indicator. This species is capable of surviving in low dissolved oxygen conditions and polluted environments, and its higher abundance indicates deterioration of water quality. Such dominance of tolerant species over sensitive ones is a clear sign of ecological imbalance.

The diversity indices further support these observations. The moderate values of the Shannon-Wiener and Simpson's indices indicate limited diversity and dominance of a few species. Although the evenness value suggests a relatively uniform distribution, the low species richness reflects reduced biodiversity, which is commonly associated with disturbed ecosystems.

Anthropogenic activities such as washing, bathing, sewage discharge, agricultural runoff, and solid waste dumping are the major contributors to the degradation of Kuber Talab. These activities not only alter water quality but also affect habitat structure, breeding sites, and food availability for fish species.

Special emphasis on *Catla catla* reveals that although it remains dominant, its long-term sustainability may be threatened if water quality continues to decline. Poor environmental conditions can affect its growth, reproduction, and overall health, thereby reducing fish productivity and economic value.

The study establishes a strong relationship between anthropogenic activities, deterioration of water quality, and changes in fish biodiversity. The findings indicate that continuous environmental stress is leading to ecological imbalance and a shift toward pollution-tolerant species in Kuber Talab. Therefore, immediate management and conservation measures are necessary to restore the ecological health of the pond and sustain its fish diversity.

CONCLUSION:

The present study on Kuber Talab, Anantpur (Rewa) clearly indicates that the freshwater ecosystem is under moderate ecological stress due to increasing anthropogenic activities. The analysis of physicochemical parameters revealed significant seasonal variations, with the summer season showing the highest level of pollution characterized by elevated BOD, COD, TDS, nitrates, and phosphates, along with reduced dissolved oxygen (DO). These conditions indicate organic pollution and nutrient enrichment leading to eutrophication. The assessment of fish biodiversity showed the dominance of *Catla catla*, followed by *Labeo rohita* and *Cirrhinus mrigala*, which reflects the presence of economically important fish species in the pond. However, the considerable abundance of *Clarias batrachus*, a pollution-tolerant species, indicates deteriorating water quality and environmental stress. The diversity indices further confirm moderate biodiversity with signs of ecological imbalance. The study establishes a clear relationship between declining water quality and changes in fish community structure. Anthropogenic activities such as sewage discharge, agricultural runoff, washing, and solid waste disposal are the major factors responsible for ecosystem degradation. Regular monitoring and conservation efforts are necessary to restore the ecological health of Kuber Talab and ensure the sustainable utilization of its aquatic resources.

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