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ASSESSMENT AND ECOLOGICAL ANALYSIS OF ICHTHYOFAUNAL DIVERSITY IN RELATION TO PHYSICOCHEMICAL CHARACTERISTICS OF KOLHI DAM, WASHIM DISTRICT, MAHARASHTRA: A COMPREHENSIVE REVIEW

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Abstract: Freshwater ecosystems are among the most valuable natural systems because they support aquatic biodiversity while providing water, food, fisheries and livelihood opportunities. Fishes form an important component of freshwater communities and respond to changes in habitat structure, hydrology and water quality. Reservoir construction can substantially modify natural riverine conditions by changing water flow, sediment movement, habitat connectivity and physicochemical characteristics. These alterations may influence fish distribution, abundance, reproduction and community structure. The present review focuses on the ecological relationship between ichthyofaunal diversity and physicochemical characteristics of Kolhi Dam in Washim District, Maharashtra. Water temperature, pH, dissolved oxygen, turbidity, hardness, alkalinity, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrate and phosphate are among the environmental variables that can influence the condition and distribution of freshwater fishes. Previous research has demonstrated that the effects of dams on fish communities are not uniform. While impoundments can fragment natural habitats and restrict movement, reservoirs may also provide suitable environments for several fish species. Available information suggests that site-specific ecological studies of smaller reservoirs such as Kolhi Dam are comparatively limited. A systematic investigation involving seasonal fish sampling, taxonomic identification, physicochemical analysis and biodiversity indices would therefore provide an important baseline for understanding the ecological status of the reservoir. Such information could assist in identifying environmental pressures, conserving native fish diversity and developing sustainable fisheries-management practices in Washim District and the wider Vidarbha region.

Keywords: Ichthyofauna, fish diversity, Kolhi Dam, reservoir ecology, physicochemical parameters, water quality, seasonal variation, Washim, Maharashtra.

1.INTRODUCTION:

Freshwater habitats such as rivers, lakes, wetlands and reservoirs occupy a relatively small proportion of the Earth's surface but support a considerable share of aquatic biodiversity. They provide essential ecosystem services, including water storage, fisheries, nutrient cycling, food production and livelihood support. Because freshwater ecosystems are closely connected with human activities, they are particularly vulnerable to environmental disturbances and changes in land and water use (Dudgeon et al., 2006; Strayer & Dudgeon, 2010).

Fish are among the most important biological components of freshwater ecosystems. Different fish species occupy different ecological niches and trophic levels and contribute to energy transfer, nutrient cycling and food-web stability. Fish populations are strongly influenced by environmental factors such as temperature, pH, dissolved oxygen, turbidity, nutrient availability, water depth, vegetation and habitat structure. Consequently, changes in these conditions may be reflected in the composition and abundance of fish communities (Wetzel, 2001).

The development of dams and reservoirs has increased substantially in response to requirements for irrigation, water supply, hydropower and fisheries. Reservoirs can provide productive fishing grounds and create new aquatic habitats, but their formation also transforms naturally flowing river systems. Impoundment reduces current velocity, changes sediment transport, alters water-level fluctuations and can interrupt connectivity between upstream and downstream habitats. These changes may affect fish migration, feeding and breeding and may favour some species over others (Sugunan, 1995; Reid et al., 2019).

India has a rich freshwater fish fauna, and numerous taxonomic works have documented the distribution and identification of Indian fishes. Classical works by Day, Jayaram, Jhingran and Talwar and Jhingran continue to provide important foundations for ichthyological studies in the Indian subcontinent. At the same time, freshwater fishes are increasingly exposed to habitat degradation, pollution, overfishing, invasive species and modification of natural hydrological regimes (Sarkar et al., 2012; Reid et al., 2019).

Maharashtra contains numerous rivers, lakes and reservoirs that support agriculture, fisheries and local communities. The Washim region of Vidarbha contains several small and medium reservoirs, but detailed ecological information is not equally available for all of them. Kolhi Dam, situated approximately at **20.2291194° N latitude and 77.0264990° E longitude**, represents a freshwater system for which systematic information on fish diversity and associated water-quality conditions can be valuable. An integrated assessment of its ichthyofauna and environmental characteristics can help establish a scientific baseline for future monitoring.

2. ICHTHYOFAUNAL DIVERSITY AND RESERVOIR ECOLOGY

Ichthyofaunal diversity refers to the variety, composition, abundance and distribution of fish species within a particular aquatic environment. Fish communities do not occur randomly; their structure is influenced by environmental conditions, availability of food, habitat complexity, competition, predation and human activities. Consequently, changes in environmental conditions can result in changes in species richness and relative abundance.

Indian freshwater fish diversity has been extensively studied through taxonomic and ecological investigations. Day's classical descriptions of Indian fishes and subsequent works by Jayaram and Talwar and Jhingran established important references for species identification and distribution. These resources are particularly useful when conducting field surveys in reservoirs where several taxonomically similar species may occur.

A reservoir differs from a natural river because the creation of an impoundment changes the physical and biological characteristics of the original aquatic system. Water generally remains in the reservoir for longer periods, current velocity decreases and deeper lentic habitats develop. Sediment deposition and aquatic vegetation may also increase in particular areas. Such changes can benefit species adapted to standing or slow-moving water while reducing habitats required by species dependent on flowing water.

The influence of dams on fish diversity is therefore complex. Khedkar et al. (2014), in their investigation of the Godavari River basin, documented substantial fish diversity across sampled locations and demonstrated that dams can simultaneously contribute to habitat fragmentation and provide conditions supporting fish populations. This finding emphasizes that the ecological consequences of a reservoir should be evaluated on a site-specific basis rather than assuming that all impoundments have identical effects.

For Kolhi Dam, understanding the existing fish assemblage is therefore an important first step. A complete inventory should document species occurrence, relative abundance and seasonal changes. It should also distinguish, where possible, between native, introduced, stocked and economically important species.

3. PHYSICOCHEMICAL FACTORS AFFECTING FISH DIVERSITY

Water quality is closely associated with the health and productivity of aquatic ecosystems. Physicochemical measurements provide objective information about environmental conditions and can help explain changes observed in fish communities. The major parameters relevant to reservoir assessment are discussed below.

Water temperature influences metabolic activity, feeding, growth, reproduction and oxygen availability. Temperature generally changes seasonally and may become particularly important during periods of low water volume and high atmospheric temperature.

pH reflects the acidic or alkaline condition of water. Aquatic organisms generally function within particular pH ranges, while substantial departures from suitable conditions may affect physiological processes. pH also influences the chemical availability of several substances in water.

Dissolved oxygen (DO) is essential for respiration by fish and other aquatic organisms. Its concentration depends on temperature, atmospheric exchange, photosynthesis, decomposition and water movement. High organic matter loads can stimulate microbial decomposition and consequently reduce oxygen availability. Low DO conditions may therefore negatively affect fish species that are sensitive to oxygen depletion (Wetzel, 2001).

Biochemical oxygen demand (BOD) indicates the amount of oxygen required by microorganisms to break down biodegradable organic material. Elevated BOD generally suggests increased organic enrichment and may contribute to oxygen depletion.

Chemical oxygen demand (COD) estimates the oxygen requirement associated with chemically oxidizable substances in water. Together, BOD and COD can provide useful information about the organic and oxidizable load of a water body.

Turbidity represents the presence of suspended particles that reduce water clarity and light penetration. High turbidity may interfere with visual feeding, affect aquatic vegetation and alter fish breeding habitats. In reservoirs, turbidity commonly increases during periods of heavy rainfall because runoff carries soil and suspended material into the water body.

Hardness is primarily associated with dissolved calcium and magnesium salts. It contributes to the chemical characteristics of freshwater and may influence several biological and chemical processes.

Alkalinity represents the capacity of water to neutralize acids and is commonly associated with bicarbonate and carbonate ions. It contributes to the buffering capacity and chemical stability of aquatic ecosystems.

Nitrate and phosphate are essential nutrients required for biological productivity. However, excessive nutrient input from agricultural runoff, sewage and other sources may promote eutrophication. Increased nutrient availability can stimulate algal production and subsequently influence dissolved oxygen dynamics and fish habitat quality.

Because these parameters interact, fish diversity should not be interpreted using a single water-quality variable. For example, temperature affects oxygen solubility, while nutrient enrichment may influence algal production and oxygen concentrations. A multi-parameter assessment therefore provides a more reliable understanding of reservoir ecology (APHA, 2017; Wetzel, 2001).

4. SEASONAL VARIATION IN FISH COMMUNITIES

Seasonal changes are particularly important in tropical freshwater systems. In Maharashtra, the pre-monsoon, monsoon and post-monsoon periods can produce substantial differences in rainfall, water level, temperature, turbidity, nutrient availability and habitat conditions.

During the monsoon, rainfall and catchment runoff can transport sediments, nutrients and organic matter into the reservoir. Increased water volume and temporary connectivity with inflowing channels may provide opportunities for fish movement and dispersal. The post-monsoon period may provide favourable feeding and recruitment conditions because of increased food availability and changes in habitat extent.

In contrast, the pre-monsoon period is often associated with declining water levels and relatively higher temperatures. Reduction in water volume may concentrate fish populations in particular habitats and modify physicochemical conditions. Such seasonal changes can influence both the number of species recorded and their relative abundance.

Consequently, a single sampling period may provide only a partial picture of the fish community. Repeated sampling during different seasons is necessary to identify consistent ecological patterns. A two-year study covering pre-monsoon, monsoon and post-monsoon periods would provide stronger evidence than a short-term survey because it would allow comparison between corresponding seasons across different years.

5. THREATS TO FRESHWATER FISH BIODIVERSITY

Freshwater fish populations are exposed to several interacting environmental pressures. Major threats include habitat modification, pollution, excessive fishing, invasive species and alteration of natural hydrological processes (Dudgeon et al., 2006). Climate change and increasing demand for freshwater resources can further intensify these pressures (Reid et al., 2019).

In reservoir systems, potential threats include uncontrolled fishing, destructive fishing practices, introduction of non-native species, degradation of shoreline vegetation, agricultural runoff, domestic wastewater, nutrient enrichment and sedimentation. Frequent or extreme water-level fluctuations may also influence spawning and nursery habitats.

Agricultural activities surrounding a reservoir can be particularly important because fertilizers, soil particles and other materials may enter the water during rainfall. Continued nutrient loading may alter productivity and water quality. Similarly, domestic wastewater can increase organic matter and nutrient concentrations.

Fishing pressure must also be considered when evaluating fish diversity. A reservoir may contain commercially valuable species that experience greater exploitation than less desirable species. Introduction or stocking of fish for fisheries enhancement can have positive economic effects, but inappropriate stocking may alter native communities or food-web relationships. Therefore, increased fish production should not automatically be interpreted as evidence of improved ecological health (Sarkar et al., 2012).

6. RESEARCH GAP AND SIGNIFICANCE OF KOLHI DAM

Although fish diversity has been studied in several major rivers and reservoirs of India, ecological information is comparatively limited for many smaller water bodies. This is an important research gap because reservoirs can differ greatly in their physical characteristics, catchment pressures, fisheries practices and biological communities.

A systematic study of Kolhi Dam can provide several important outcomes. First, it can establish an inventory of fish species occurring in the reservoir. Second, repeated seasonal sampling can reveal changes in species richness, abundance and community composition. Third, physicochemical monitoring can provide information about the quality of the aquatic environment. Finally, statistical analysis can help determine whether variations in water quality are associated with differences in fish diversity.

The proposed study can therefore serve as a baseline for future ecological monitoring. It may also provide information useful to local fisheries managers, researchers and conservation agencies. Particular attention should be given to economically important species, native species and any species requiring conservation attention.

7. PROPOSED METHODOLOGICAL FRAMEWORK

A comprehensive assessment of Kolhi Dam should combine fish sampling with water-quality analysis and biodiversity statistics. Four representative sampling locations, designated **S1, S2, S3 and S4**, may be selected according to differences in habitat, shoreline characteristics, human activities and proximity to inflowing water.

Sampling should preferably cover three major seasons—pre-monsoon, monsoon and post-monsoon—for two consecutive years. Fish may be sampled using appropriate methods such as gill nets, cast nets, traps and hook-and-line techniques. Sampling effort should be standardized as far as practical so that differences between stations and seasons can be compared reliably.

Collected fish should be identified using recognized taxonomic references, including Day, Jayaram and Talwar and Jhingran. Photographs and field records should be maintained for taxonomic verification. Current scientific nomenclature should be checked before the final publication of the research.

Water samples should be collected during the same sampling periods. Temperature, pH and dissolved oxygen can preferably be measured at the sampling site, while BOD, COD, turbidity, hardness, alkalinity, nitrate and phosphate can be determined using standard analytical procedures described by APHA (2017).

Fish-community structure may be evaluated using species richness, relative abundance, frequency of occurrence, Shannon-Wiener diversity, Simpson's diversity, Margalef's richness and Pielou's evenness. Mean and standard deviation can be calculated for physicochemical variables.

Correlation analysis can subsequently be used to examine relationships between environmental variables and fish diversity. Pearson's correlation may be appropriate when the assumptions of parametric analysis are satisfied, whereas Spearman's rank correlation can be applied to non-normal data. Multivariate approaches such as principal component analysis, cluster analysis, canonical correspondence analysis or redundancy analysis may provide additional information about associations between fish assemblages and environmental gradients.

8. CONSERVATION AND MANAGEMENT IMPLICATIONS

Effective management of Kolhi Dam should aim to balance fisheries utilization with the conservation of aquatic biodiversity. Regular monitoring of fish communities and water quality should form the basis of management decisions.

Fishing pressure should be assessed and regulated where necessary, particularly during breeding periods. Destructive fishing methods should be discouraged, while important spawning and nursery habitats should be protected. Maintenance of natural or semi-natural shoreline vegetation can reduce erosion and provide habitat for aquatic organisms.

Pollution control should receive particular attention. Agricultural runoff, domestic wastewater and excessive nutrient inputs should be minimized through appropriate catchment-management practices. Reduction of soil erosion can also help control sediment accumulation and turbidity.

The ecological effects of introduced or stocked fish should be monitored. Fisheries enhancement programmes should be designed carefully so that increased production does not compromise native biodiversity. Long-term management should therefore consider not only the quantity of fish harvested but also species composition, habitat quality and ecological stability.

9. CONCLUSION

Freshwater fish communities are important components of aquatic ecosystems and can provide useful indicators of environmental change. Their diversity and abundance are determined by a combination of physicochemical conditions, habitat characteristics, hydrological processes, food availability and human activities. Reservoirs such as Kolhi Dam provide important water and fisheries resources, but their ecological characteristics differ from those of naturally flowing river systems.

Previous studies have identified habitat alteration, pollution, overexploitation, invasive species and hydrological modification as major pressures on freshwater biodiversity. Research in the Godavari basin has also demonstrated that reservoirs may simultaneously contribute to habitat fragmentation and support considerable fish diversity. These findings indicate the need for site-specific assessment rather than broad assumptions about the ecological effects of dams.

Kolhi Dam warrants systematic investigation because reliable information on its fish community and associated water-quality conditions can support future conservation and fisheries-management decisions. A two-year assessment involving four sampling stations and three major seasons would provide a stronger ecological baseline than a single-season survey.

Analysis of temperature, pH, dissolved oxygen, BOD, COD, turbidity, hardness, alkalinity, nitrate and phosphate together with fish-diversity indices can help clarify relationships between environmental conditions and ichthyofaunal composition. The resulting information could contribute to sustainable fisheries, protection of native fish diversity and long-term ecological monitoring of Kolhi Dam and other reservoirs in Washim District and the Vidarbha region of Maharashtra.

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