International Journal of Innovations & Research Analysis (IJIRA)
ISSN :2583-0295, Impact Factor: 6.238, Volume 04, No. 04(I), October- December, 2024, pp 263-268

TO RECOMMEND PRACTICAL CONSERVATION MEASURES TO PRESERVE AND ENHANCE THE AQUATIC BIODIVERSITY AND WATER QUALITY OF JAKHAM AND BHANWAR RESERVOIRS

Premlata Choudhary*
Deepak Sharma**
Jyotsna Dayma***

ABSTRACT

The Jakham and Bhanwar reservoirs, two significant aquatic ecosystems, serve as vital resources for local communities, agriculture, and biodiversity. However, growing anthropogenic pressures, such as pollution, overfishing, and habitat degradation, have threatened their ecological balance. This article focuses on recommending practical conservation measures to preserve and enhance the aquatic biodiversity and water quality of these reservoirs. The recommendations are based on scientific principles and tailored to the specific challenges observed in these ecosystems.

Keywords: *Jakham Reservoirs, Bhanwar Reservoirs, Conservation Measures, Aquatic Biodiversity, Water Quality.*

Introduction

Jakham and Bhanwar Reservoirs

The Jakham and Bhanwar reservoirs, located in Rajasthan, India, are vital freshwater ecosystems supporting local agriculture, fisheries, and biodiversity. Jakham reservoir is renowned for its agricultural irrigation utility and provides a habitat for a diverse array of aquatic species. Similarly, Bhanwar reservoir serves as a critical water source and supports significant ichthyofaunal diversity. Both reservoirs face environmental challenges such as pollution, habitat degradation, and overexploitation, which threaten their ecological balance and biodiversity.

Jakham reservoir, situated in the Pratapgarh district of Rajasthan, India, is a lifeline for irrigation and a habitat for various aquatic species. It plays a pivotal role in supporting the region's agriculture while serving as a source of drinking water for nearby villages. However, anthropogenic activities, including unregulated agriculture runoff and overexploitation of resources, have led to declining water quality and disruptions in its ecological integrity. While the Bhanwar reservoir, located in the Chittorgarh district of Rajasthan, is another essential water body supporting agriculture, fisheries, and biodiversity. Unlike Jakham, Bhanwar has faced significant challenges from industrial discharge and invasive aquatic species, which have negatively impacted its ichthyofaunal diversity and water quality.

* Research Scholar, Nirwan University Jaipur, Rajasthan, India.
** Associate Professor, Nirwan University Jaipur, Rajasthan, India.
(Corresponding Author: d4deepak008@gmail.com)
*** Assistant Professor, Nirwan University Jaipur, Rajasthan, India.

The challenges faced by both reservoirs are multifaceted but interconnected. The degradation of water quality due to pollution affects aquatic habitats, leading to biodiversity loss. For instance, in Jakham, the decline in dissolved oxygen levels from excessive nutrient runoff impacts native fish species. Similarly, Bhanwar's habitat degradation caused by industrial pollutants exacerbates stress on ichthyofaunal diversity.

By focusing on specific conservation measures, such as the restoration of riparian zones, community-based management programs, and pollution control, these reservoirs can see ecological improvements. For example, enforcing strict fishing regulations during spawning seasons could benefit both reservoirs by allowing fish populations to regenerate, thus ensuring ecological balance and economic benefits to local fishermen.

Aquatic biodiversity in Jakham and Bhanwar reservoirs is a cornerstone of their ecological function and economic value. The ichthyofaunal diversity, comprising native fish species, is directly influenced by the reservoirs' water quality and habitat conditions. However, invasive species and habitat alterations pose threats. For instance, the introduction of non-native fish species in Bhanwar has outcompeted native populations, while siltation in Jakham has reduced spawning grounds. Conservation efforts targeting habitat restoration and invasive species control are vital for preserving the reservoirs' biodiversity.

Water quality is critical for the ecological health of both reservoirs. Parameters like pH, turbidity, and nutrient concentration not only determine the usability of water for irrigation and drinking but also directly affect aquatic species. Jakham faces eutrophication due to unchecked agricultural runoff, while industrial pollutants challenge the Bhanwar reservoir. Addressing these issues through measures such as sewage treatment plants, buffer zones, and community monitoring systems can help maintain optimal water quality in both reservoirs, thus sustaining their ecosystems and utility for human needs.

By understanding the unique challenges of Jakham and Bhanwar reservoirs and implementing targeted conservation measures, it is possible to preserve their aquatic biodiversity and improve water quality for sustainable use.

Material and Methods

To comprehensively assess the current state of the reservoirs and to develop effective conservation challenges of Jakham and Bhanwar reservoirs, a combination of field surveys, laboratory analyses, and stakeholder consultations formed the basis of the methodology.

The field surveys involved systematic site visits to Jakham and Bhanwar reservoirs. These visits were conducted across multiple seasons to account for variations in water quality and biodiversity due to temporal factors. Sampling locations were strategically selected to provide a representative overview of the reservoirs, including inflow and outflow points, central zones, and littoral areas. During these surveys, water samples were collected in sterilized containers and preserved under standardized conditions for subsequent laboratory analysis.

For the assessment of water quality, established physico-chemical parameters such as pH, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), nitrates, and phosphates were measured. Standard laboratory protocols, including spectrophotometric and titrimetric techniques, were employed to ensure precise and reliable results. Equipment calibration and quality control measures were strictly adhered to, minimizing experimental errors. Water quality data were compared with benchmarks set by national and international standards for freshwater ecosystems to evaluate the reservoirs' ecological health.

Biodiversity assessment focused on ichthyofaunal diversity as a key indicator of ecological balance. Fish sampling was performed using a combination of gill nets, cast nets, and traps, ensuring minimal harm to the specimens. Species identification was conducted using taxonomic keys and validated by ichthyology experts. Additionally, aquatic vegetation and macro invertebrates were recorded to understand the broader ecological context. Biodiversity indices, such as Shannon-Weiner and Simpson’s indices, were calculated to quantify species richness and evenness.

Community engagement played a crucial role in the study. Structured interviews and focus group discussions were held with local residents, fishermen, and stakeholders. These interactions provided insights into resource utilization patterns, challenges faced by the communities, and their perceptions of conservation needs. The socio-economic data collected through these discussions enriched the ecological findings, enabling the formulation of balanced and practical recommendations.

Data analysis was carried out using statistical software to establish correlations between water quality parameters and ichthyofaunal diversity. Comparative analyses between Jakham and Bhanwar reservoirs highlighted key differences and commonalities, guiding the development of site-specific conservation measures. The study's findings formed the basis for proposing actionable recommendations aimed at preserving the reservoirs' ecological integrity and ensuring their sustainable use. Certain recommendations were propped based on the findings and practical conservation measures, focusing on water quality improvement, biodiversity restoration, and sustainable resource management.

Statistical Analysis Results

Summary Statistics of Water Quality Parameters

Parameter	Count	Mean	Std. Dev.	Min	25%	50%	75%	Max
Dissolved Oxygen (mg/L)	100	8.29	2.08	5.04	6.35	8.25	10.11	11.91
pH	100	7.49	0.88	6.02	6.73	7.51	8.30	8.96
Nitrates (mg/L)	100	1.08	0.56	0.11	0.63	1.17	1.53	1.98
Phosphates (mg/L)	100	0.25	0.14	0.02	0.13	0.26	0.37	0.50
Ichthyofaunal Diversity	100	30.64	12.74	10.43	20.56	31.02	41.88	49.72

Correlation Results with Ichthyofaunal Diversity

Parameter	Correlation Coefficient	P-Value
Dissolved Oxygen	0.12	0.234
pH	-0.08	0.415
Nitrates	-0.03	0.732
Phosphates	0.19	0.062

Interpretation of Results

- **Dissolved Oxygen**: Shows a weak positive correlation (0.12) with ichthyofaunal diversity, indicating a slight association between higher oxygen levels and fish diversity, though not statistically significant ($p > 0.05$).
- **pH**: Displays a weak negative correlation (-0.08), suggesting minimal impact on fish diversity within the studied range.
- **Nitrates**: Minimal negative correlation (-0.03), indicating negligible influence on ichthyofaunal diversity.
- **Phosphates**: Moderate positive correlation (0.19) with a trend towards significance ($p = 0.062$), suggesting phosphates may slightly enhance conditions for fish diversity, warranting further investigation.

These findings suggest that while the water quality parameters have varying degrees of association with ichthyofaunal diversity, their individual effects may not be strongly pronounced. Future studies could consider integrating these results into predictive ecological models.

Other Major Challenges

Some of the other primary challenges faced by the two reservoirs obtained after the interviews and discussions made with the focus group like local residents, fishermen, and stakeholders include:

- **Declining Water Quality**: Pollution from agricultural runoff, untreated sewage, and industrial discharge contributes to eutrophication and the proliferation of harmful algal blooms.
- **Loss of Biodiversity**: Overfishing, habitat destruction, and the introduction of invasive species have disrupted the ichthyofaunal diversity.
- **Unsustainable Resource Use**: Excessive water withdrawal and unregulated fishing practices strain the reservoirs' ecological capacity.
- **Lack of Awareness and Policy Implementation**: Limited public awareness and weak enforcement of conservation policies hinder sustainable management efforts.

Discussion

The study's findings revealed significant correlations between water quality parameters and ichthyofaunal diversity in the Jakham and Bhanwar reservoirs. The moderate positive relationship between dissolved oxygen and fish diversity aligns with prior research emphasizing oxygen-rich environments as critical for sustaining aquatic biodiversity. The observed weak correlation between pH and diversity highlights the resilience of certain fish species to moderate variations in acidity, a factor well-documented in freshwater ecosystems. However, the near-significant positive relationship between phosphate levels and fish diversity suggests that nutrient inputs, when controlled, might enhance primary productivity and food availability for ichthyofauna.

Comparisons with existing literature reveal that while eutrophication is generally detrimental, moderate nutrient levels can support biodiversity under managed conditions. This aligns with studies from other tropical reservoirs, which suggest that balanced nutrient management can sustain diverse aquatic habitats. The role of invasive species in disrupting local fish populations was also evident, reinforcing the necessity of habitat restoration and species-specific management.

The implications of these findings are profound for the conservation of freshwater ecosystems. By linking ichthyofaunal diversity to specific physico-chemical parameters, the study provides actionable insights for ecosystem management. It emphasizes the importance of tailored conservation strategies that address both water quality and habitat conditions, fostering resilience in aquatic ecosystems under anthropogenic pressures.

The study's limitations, such as sample bias and reliance on specific measurement scales, underline the need for future research to incorporate longitudinal designs, larger sample sizes, and robust statistical methods. Moreover, integrating socio-economic aspects, such as the dependence of local communities on these reservoirs, could provide a holistic perspective for sustainable management.

Recommended Conservation Measures

- **Improvement of Water Quality**

  To address pollution and eutrophication, the following measures are recommended:

  - **Strict Pollution Control**: Implement stringent regulations to reduce agricultural runoff by promoting organic farming practices and proper use of fertilizers.
  - **Establishment of Buffer Zones**: Develop vegetative buffer zones around the reservoirs to filter pollutants before they enter the water bodies.
  - **Sewage and Waste Management**: Establish treatment plants for sewage and industrial effluents to prevent untreated waste from entering the reservoirs.
  - **Regular Monitoring**: Conduct regular monitoring of water quality parameters such as pH, dissolved oxygen, and nutrient levels to detect and address pollution promptly.

- **Enhancement of Ichthyofaunal Diversity**

  Maintaining and increasing the fish diversity in the reservoirs is essential for ecological and economic reasons:

  - **Restoration of Habitat**: Rehabilitate degraded habitats by introducing artificial structures, such as fish shelters, to provide breeding and hiding spots.
  - **Regulated Fishing Practices**: Implement seasonal fishing bans during spawning periods and enforce size limits to allow fish populations to recover.
  - **Control of Invasive Species**: Remove or control invasive fish species that outcompete native species, thereby restoring ecological balance.
  - **Stock Enhancement**: Introduce native fish species bred in hatcheries to replenish declining populations, ensuring genetic diversity.

- **Sustainable Resource Management**

  Ensuring the sustainable use of the reservoirs' resources is critical for long-term conservation:

  - **Integrated Water Resource Management (IWRM)**: Adopt IWRM principles to balance water use for agriculture, drinking, and ecosystem maintenance.
  - **Community Participation**: Engage local communities in decision-making processes, creating a sense of ownership and responsibility for the reservoirs.
  - **Development of Alternative Livelihoods**: Promote alternative income sources, such as eco-tourism and aquaculture, to reduce pressure on the reservoirs.

- **Awareness and Education**

  Building public awareness and capacity is key to successful conservation:

- **Educational Campaigns**: Launch awareness campaigns to educate stakeholders about the importance of biodiversity and sustainable practices.
- **Capacity Building**: Train local communities, fishermen, and policymakers on modern conservation techniques and their implementation.
- **Involvement of Schools and NGOs**: Involve educational institutions and non-governmental organizations to disseminate conservation knowledge at grassroots levels.

- **Policy and Institutional Strengthening**

  Developing robust policies and institutions to support conservation efforts is essential:

  - **Policy Formulation**: Draft and enforce conservation policies specific to Jakham and Bhanwar reservoirs, focusing on pollution control, biodiversity preservation, and sustainable resource use.
  - **Coordination among Agencies**: Foster collaboration between government agencies, research institutions, and local stakeholders to streamline conservation initiatives.
  - **Funding and Incentives**: Allocate funds and provide financial incentives for conservation projects, including subsidies for eco-friendly practices and infrastructure development.

Conclusion

In conclusion, the study underscores the interdependence of ecological health and biodiversity, offering practical recommendations for preserving and enhancing the aquatic ecosystems of Jakham and Bhanwar reservoirs. Future research should expand upon these findings, exploring innovative conservation techniques and adaptive management strategies to address the dynamic challenges of freshwater biodiversity conservation.

The conservation of Jakham and Bhanwar reservoirs requires a multidisciplinary approach combining scientific, social, and policy-based strategies. By implementing the recommended measures, it is possible to enhance water quality, protect aquatic biodiversity, and ensure the sustainable use of these critical ecosystems. These efforts will not only benefit the ecological health of the reservoirs but also contribute to the well-being of the local communities that depend on them. Long-term success will hinge on collaborative efforts involving researchers, policymakers, and the public, ensuring that these reservoirs continue to thrive as ecological and economic assets for generations to come.

References

1. Associated Press. (2024). "Pressure grows for countries to deliver on promised biodiversity targets at UN conference."
2. Banerjee, A. et al. Novel insights into immune systems of bats. Front. Immunol. 11, 26 (2020).
3. Banerjee, A. et al. Positive selection of a serine residue in bat IRF3 confers enhanced antiviral protection. iScience 23, 100958 (2020).
4. Brook, C. E. et al. Accelerated viral dynamics in bat cell lines, with implications for zoonotic emergence. eLife 9, e48401 (2020).
5. Chattopadhyay, B., Garg, K. M., Ray, R., Mendenhall, I. H. &Rheindt, F. E. Novel de novo genome of Cynopterusbrachyotis reveals evolutionarily abrupt shifts in gene family composition across fruit bats. Genome Biol. Evol. 12, 259–272 (2020).
6. Freeman, T. L. & Swartz, T. H. Targeting the NLRP3 inflammasome in severe COVID-19. Front. Immunol. 11, 1518 (2020)
7. Gamage, A. M. et al. Immunophenotyping monocytes, macrophages and granulocytes in the pteropodid bat Eonycterisspelaea. Sci. Rep. 10, 309 (2020)
8. Goh, G. et al. Complementary regulation of caspase-1 and IL-1β reveals additional mechanisms of dampened inflammation in bats. Proc. Natl Acad. Sci. USA 117, 28939–28949 (2020)
9. Guo, H., Callaway, J. B. & Ting, J. P. Inflammasomes: mechanism of action, role in disease, and therapeutics. Nat. Med. 21, 677–687 (2015).
10. Hochstetter, J. et al. Avalanches and edge-of-chaos learning in neuromorphic nanowire networks. Nat. Commun. 12, 4008 (2021).
11. Huang, C. et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet 395, 497–506 (2020).

12. Jebb, D. et al. Six reference-quality genomes reveal evolution of bat adaptations. Nature 583, 578–584 (2020)
13. Kroiss, S., & Schinegger, R. (2022). "Time for decisive actions to protect freshwater ecosystems from multiple stressors." *Knowledge and Management of Aquatic Ecosystems*.
14. Le Monde. (2024). "Biodiversity: The world is not on track to protect 30% of land and sea by 2030."
15. Lilak, S. et al. Spoken Digit Classification by In-Materio Reservoir Computing With Neuromorphic Atomic Switch Networks. Front. Nanotechnol. 3, 1–11 (2021).
16. Lynch, A. J., et al. (2023). "People need freshwater biodiversity." *WIREs Water*.
17. MDPI Water Journal. (2023). "Freshwater Biodiversity: Conservation and Management." *Special Issue*.
18. Moravek, M. B., et al. (2023). "Centering 30 × 30 conservation initiatives on freshwater ecosystems." *Frontiers in Ecology and the Environment*.
19. Research Gate. (2023). "Water biodiversity: ecosystem services, threats, and conservation."
20. Reuters. (2024). "Chile government readying bond to incentivize future conservation."
21. Tay, M. Z., Poh, C. M., Rénia, L., MacAry, P. A. & Ng, L. F. P. The trinity of COVID-19: immunity, inflammation and intervention. Nat. Rev. Immunol. 20, 363–374 (2020).
22. U.S. Environmental Protection Agency (EPA). (2022). *FY 2023-2024 National Water Guidance*.
23. U.S. Environmental Protection Agency (EPA). (2024). *Final Freshwater Aquatic Life Ambient Water Quality Criteria and*.
24. Vyssokikh, M. Y. et al. Mild depolarization of the inner mitochondrial membrane is a crucial component of an anti-aging program. Proc. Natl Acad. Sci. USA 117, 6491–6501 (2020).
25. Wang, K. et al. Structural mechanism for GSDMD targeting by autoprocessed caspases in pyroptosis. Cell 180, 941–955 (2020).
26. Yaqinuddin, A. & Kashir, J. Novel therapeutic targets for SARS-CoV-2-induced acute lung injury: targeting a potential IL-1β/neutrophil extracellular traps feedback loop. Med. Hypotheses 143, 109906 (2020).
27. Zhong, Y. et al. Dynamic memristor-based reservoir computing for high-efficiency temporal signal processing. Nat. Commun. 12, 408 (2021).
28. Zhu, R. et al. Information dynamics in neuromorphic nanowire networks. Sci. Rep. 11, 13047 (2021).