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Influence of Physico-Chemical Parameters on Fish Distribution: A Case Study of Two Reservoirs in Tonk District, Rajasthan

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Abstract: The present study investigates the influence of physico-chemical parameters on fish distribution and diversity in two major reservoirs of Tonk District, Rajasthan Bisalpur Dam and Isarda Dam, both located on the Banas River. A total of 25 fish species were recorded from Bisalpur Dam and 18 from Isarda Dam, belonging to families Cyprinidae, Channidae, Siluridae, Cichlidae, Schilbeidae, Notopteridae, Belonidae, Bagridae, and Poeciliidae. Monthly sampling was conducted over a period of 12 months using cast nets, drag nets, and hand nets. Physico-chemical parameters including water temperature, pH, dissolved oxygen (DO), turbidity, total dissolved solids (TDS), total suspended solids (TSS), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total alkalinity, and total hardness were measured following standard APHA methods. Results revealed that Bisalpur Dam exhibited significantly better water quality with higher DO (6.8–7.8 mg/L), lower turbidity (16–24 NTU), and near-neutral pH (7.1–7.5), which supported a richer and more diverse fish assemblage dominated by Indian Major Carps. Isarda Dam showed comparatively lower water quality due to higher siltation, turbidity (28–40 NTU), and lower DO (5.6–6.4 mg/L), resulting in dominance of hardy species like snakeheads and catfishes. Shannon-Wiener diversity index (H') and Simpson's index were calculated for both sites. The study concludes that physico-chemical gradients are primary determinants of fish community structure in these reservoirs, and that improved water resource management is essential for sustaining freshwater fish biodiversity in Tonk District.

Keywords: Physico-chemical parameters, Fish diversity, Bisalpur Dam, Isarda Dam, Banas River, Tonk, Rajasthan, ichthyofauna, water quality

1. INTRODUCTION

Freshwater ecosystems represent some of the most biologically productive and economically significant natural resources on earth. Reservoirs, in particular, are multi-purpose water bodies that serve critical roles in irrigation, drinking water supply, hydroelectric generation, and inland fisheries. In semi-arid regions like Rajasthan, where surface water is scarce and rainfall is erratic, reservoirs assume even greater ecological and socioeconomic importance. The fish populations inhabiting these water bodies not only contribute to local food security and livelihoods but also serve as sensitive bioindicators of ecosystem health.

Fish distribution and community composition in freshwater ecosystems are governed by a complex interplay of biotic and abiotic factors. Among these, physico-chemical parameters of water including temperature, pH, dissolved oxygen, turbidity, alkalinity, hardness, TDS, BOD, and COD play a foundational role in determining species richness, abundance, and feeding ecology. Each fish species has a specific tolerance range for these parameters, and any significant deviation from optimal conditions can result in physiological stress, reduced reproductive success, habitat abandonment, or even mortality.

Tonk District in Rajasthan is traversed by the Banas River, which feeds two major reservoirs: Bisalpur Dam and Isarda Dam. Bisalpur Dam, one of the largest dams in Rajasthan, was constructed in 1999 and primarily supplies drinking water to Jaipur, Ajmer, and Tonk cities. Isarda Dam is a smaller, more recently constructed reservoir

downstream on the same river. Despite their shared river system, the two reservoirs differ markedly in catchment characteristics, sedimentation load, water retention time, and anthropogenic pressures, leading to distinct physico-chemical environments that may differentially influence their fish communities.

Previous studies have documented fish faunal diversity in Bisalpur Reservoir, recording a variety of cyprinids and catfishes. However, systematic comparative studies evaluating how physico-chemical parameter gradients between the two reservoirs influence fish distribution patterns remain limited. The present study was therefore undertaken to: (i) document the ichthyofaunal diversity of Bisalpur and Isarda Dams; (ii) measure and compare physico-chemical water quality parameters across seasons; (iii) analyze the relationship between water quality and fish community structure; and (iv) provide recommendations for sustainable fishery management in the region.

2. STUDY AREA

2.1 Bisalpur Dam

Bisalpur Dam is situated on the Banas River in Tonk District, Rajasthan (25°53'N, 75°44'E), at an altitude of approximately 300 m above sea level. The dam was constructed in 1999 with a gross storage capacity of 1,095 million cubic meters (MCM). The reservoir spreads over an area of approximately 85.26 km² at full reservoir level. The catchment area is approximately 10,284 km². The dam draws water from the upper Banas basin, Berach River, and Menali River. The surrounding landscape is semi-arid with sparse vegetation, scrub forest, and agricultural land. The reservoir has relatively stable water levels due to its large storage capacity and receives water from multiple tributaries.

The fishery of Bisalpur is managed by the Rajasthan State Fisheries Department, and organized fishing activities including stocking of Indian Major Carps are regularly carried out. The reservoir supports a significant inland fishing community and provides livelihoods to several villages along its periphery. Dominant fish families include Cyprinidae, Channidae, and Siluridae.

2.2 Isarda Dam

Isarda Dam is located downstream on the Banas River at approximately 26°07'N, 75°49'E in Tonk District. It is a smaller reservoir with a storage capacity of approximately 90 MCM and a surface area of around 22 km² at full reservoir level. Being downstream of Bisalpur, Isarda receives sediment-laden inflows especially during monsoon, leading to higher turbidity and siltation compared to Bisalpur. The water retention time is shorter, and water levels fluctuate more dramatically with seasonal changes in river flow.

Isarda Dam is less intensively managed from a fisheries perspective, though artisanal fishing by local communities is practiced throughout the year. The reservoir's fish community is influenced both by natural colonization from the Banas River and by periodic stocking events. Hardy, stress-tolerant species tend to predominate here due to the more variable and challenging physico-chemical conditions.

2.3 Climate

Both reservoirs experience a semi-arid climate typical of eastern Rajasthan. The region receives an average annual rainfall of 550–700 mm, predominantly during the Southwest Monsoon (July–September). Summers (April–June) are extreme with temperatures reaching 42–46°C, while winters (November–February) are mild to cold with minimum temperatures of 5–10°C. These climatic extremes translate into significant seasonal fluctuations in water temperature, evaporation rates, and inflow-outflow dynamics in both reservoirs.

3. MATERIALS AND METHODS

3.1 Fish Sampling

Fish sampling was conducted monthly from both reservoirs over a period of 12 consecutive months. Multiple fishing gears were employed to ensure representative sampling of all ecological zones and species: cast nets (mesh sizes 1.5 cm, 2.5 cm, 4 cm), drag nets (25 m × 3 m, mesh size 1.5 cm), hand nets, and gill nets. Sampling was carried out at five fixed stations in each reservoir, covering littoral, pelagic, and benthic zones. Captured fish were identified in the field with reference to standard taxonomic keys (Jayaram, 1981; 1999), and total length (cm) and weight (g) were recorded. Specimens difficult to identify in the field were preserved in 4% formaldehyde and brought to the laboratory for detailed examination. All fish were released back into the reservoir after recording data wherever possible.

3.2 Physico-Chemical Analysis

Water samples were collected monthly from five stations in each reservoir at 0.5 m depth using a Van Dorn sampler. Temperature was recorded in situ using a calibrated mercury thermometer. Turbidity was measured using a digital turbidimeter (NTU). pH was measured using a digital pH meter (ELICO). Dissolved oxygen was measured by the Winkler titrimetric method. Total dissolved solids (TDS) and total suspended solids (TSS) were determined gravimetrically. Total alkalinity and total hardness were determined by standard titrimetric methods. Biochemical oxygen demand (BOD_5) was measured by the 5-day incubation method at 20°C, and chemical oxygen demand (COD) was determined by the dichromate reflux method. All analyses followed standard methods outlined by APHA (2012).

3.3 Diversity Indices

Fish community diversity was assessed using the following standard indices:

- **Shannon-Wiener Diversity Index (H'):** $H' = -\sum p_i \ln p_i$, where p_i is the proportion of the i-th species in the total catch.
- **Simpson's Diversity Index (D):** $D = 1 - \sum p_i^2$
- **Margalef's Species Richness (d):** $d = (S - 1)/\ln N$, where S = number of species and N = total number of individuals.
- **Pielou's Evenness Index (J'):** $J' = H'/H'_{max}$

3.4 Statistical Analysis

Pearson's correlation coefficient was used to assess the relationship between physico-chemical parameters and fish species abundance. One-way ANOVA was applied to test seasonal differences in parameters. All statistical analyses were performed using SPSS version 25.0. Significance was set at $p < 0.05$.

4. RESULTS

4.1 Fish Species Composition

A total of 25 fish species belonging to 9 families were recorded from Bisalpur Dam, while 18 species belonging to 6 families were recorded from Isarda Dam. Table 1 presents the checklist of fish species from both reservoirs.

Table 1: Checklist of Fish Species Recorded from Bisalpur Dam and Isarda Dam

S.No.	Species	Common Name	Family	Bisalpur	Isarda
1	*Labeorohita*	Rohu	Cyprinidae	✓	✓

S.No.	Species	Common Name	Family	Bisalpur	Isarda
2	*Catlacatla*	Catla	Cyprinidae	✓	✓
3	*Cirrhinusmrigala*	Mrigal	Cyprinidae	✓	✓
4	*Cyprinus carpio*	Common Carp	Cyprinidae	✓	✓
5	*Ctenopharyngodonid*	Grass Carp	Cyprinidae	✓	✓
6	*Hypophthalmichthys molitrix*	Silver Carp	Cyprinidae	✓	✓
7	*Hypophthalmichthys nobilis*	Bighead Carp	Cyprinidae	✓	✗
8	*Oreochromis mossambicus/niloticus*	Tilapia	Cichlidae	✓	✓
9	*Tor putitora*	Golden Mahseer	Cyprinidae	✓	✗
10	*Tor khudree*	Deccan Mahseer	Cyprinidae	✓	✗
11	*Wallago attu*	Wallago/Freshwater Shark	Siluridae	✓	✓
12	*Mystusseenghala (Sperataseenghala)*	Seenghala Catfish	Siluridae	✓	✓
13	*Siloniasilondia*	Silond Catfish	Schilbeidae	✓	✓
14	*Ompokbimaculatus*	Butter Catfish	Siluridae	✓	✓
15	*Channa punctata*	Spotted Snakehead	Channidae	✓	✓
16	*Channa striata*	Striped Snakehead	Channidae	✓	✓
17	*Channa marulius*	Giant Snakehead	Channidae	✓	✓
18	*Notopterusnotopterus*	Featherback /	Notopteridae	✓	✓

S.No.	Species	Common Name	Family	Bisalpur	Isarda
		Knifefish			
19	*Xenentodoncancila*	Freshwater Garfish	Belonidae	✓	✓
20	*Mystus vittatus*	Striped Dwarf Catfish	Bagridae	✓	✓
21	*Mastacembelus armatus*	Spiny Eel	Mastacembelidae	✓	✗
22	Puntius sophore	Pool Barb	Cyprinidae	✓	✗
23	Puntius ticto	Ticto Barb	Cyprinidae	✓	✗
24	Gambusia affinis	Mosquitofish	Poeciliidae	✓	✗
25	Mystus tengara	Tengara Catfish	Bagridae	✓	✗

Cyprinidae was the most dominant family at both sites, comprising 52.0% (13 species) of total species richness at Bisalpur and 55.6% (10 species) at Isarda. Indian Major Carps Catlacatla, Labeorohita, and Cirrhinusmrigala collectively contributed the highest percentage to total catch biomass at both reservoirs, with Catla dominant at Bisalpur (16.8% of total catch) and Rohu dominant at Isarda (18.2%).

4.2 Seasonal Variation in Physico-Chemical Parameters

Table 2: Mean (±SD) Physico-Chemical Parameters of Bisalpur Dam and Isarda Dam Across Seasons

Parameter	Bisalpur (Pre-monsoon)	Bisalpur (Monsoon)	Bisalpur (Post-monsoon)	Isarda (Pre-monsoon)	Isarda (Monsoon)	Isarda (Post-monsoon)
Temperature (°C)	31.4 ± 1.2	28.6 ± 1.8	22.3 ± 2.1	32.1 ± 1.4	29.2 ± 2.0	23.0 ± 1.9
pH	7.4 ± 0.2	7.1 ± 0.3	7.5 ± 0.2	7.0 ± 0.3	6.7 ± 0.4	7.1 ± 0.3
DO (mg/L)	7.6 ± 0.4	6.8 ± 0.5	7.8 ± 0.3	6.2 ± 0.5	5.6 ± 0.6	6.4 ± 0.4
Turbidity (NTU)	18.4 ± 3.2	24.1 ± 5.6	16.2 ± 2.8	30.6 ± 4.8	40.2 ± 8.4	28.4 ± 5.1
TDS (mg/L)	312 ± 28	286 ± 34	298 ± 22	388 ± 42	354 ± 48	374 ± 38
Total Alkalinity	148 ± 12	134 ± 18	152 ± 14	124 ± 16	110 ± 20	128 ± 14

Parameter	Bisalpur (Pre-monsoon)	Bisalpur (Monsoon)	Bisalpur (Post-monsoon)	Isarda (Pre-monsoon)	Isarda (Monsoon)	Isarda (Post-monsoon)
(mg/L)						
Total Hardness (mg/L)	182 ± 22	164 ± 28	188 ± 20	210 ± 30	192 ± 34	218 ± 28
BOD (mg/L)	2.4 ± 0.6	3.2 ± 0.8	2.1 ± 0.5	3.8 ± 0.9	4.6 ± 1.2	3.4 ± 0.8
COD (mg/L)	14.2 ± 3.4	18.6 ± 4.8	12.8 ± 3.0	22.4 ± 5.2	28.8 ± 6.4	20.2 ± 4.6

Water temperature showed a similar seasonal pattern in both reservoirs, with peak values in pre-monsoon (May–June) and lowest values in winter months (December–January). Dissolved oxygen showed an inverse relationship with temperature, with highest DO values recorded in post-monsoon and lowest during monsoon and pre-monsoon periods. Turbidity was highest during monsoon in both reservoirs due to increased runoff and silt input, with Isarda showing significantly higher turbidity compared to Bisalpur throughout the year ($p < 0.01$). BOD and COD were significantly higher in Isarda, indicating greater organic load, likely from agricultural runoff and livestock activities in the catchment

4.3 Fish Diversity Indices

Table 3: Diversity Indices for Fish Communities in Bisalpur Dam and Isarda Dam

Index	Bisalpur Dam	Isarda Dam
Species Richness (S)	25	18
Total Individuals (N)	1,842	1,564
Shannon-Wiener Index (H')	2.48	2.24
Simpson's Index (D)	0.887	0.862
Margalef's Richness (d)	3.19	2.89
Pielou's Evenness (J')	0.814	0.773

Shannon-Wiener diversity index was higher at Bisalpur (H' = 2.48) compared to Isarda (H' = 2.24), reflecting greater species diversity and more equitable distribution of individuals among species. Simpson's index also indicated moderately high diversity at both sites, with Bisalpur again showing a higher value. Margalef's

richness index confirmed higher species richness per unit individuals at Bisalpur. Pielou's evenness index indicated that Bisalpur had a more evenly distributed fish community, while Isarda showed greater dominance by a few stress-tolerant species.

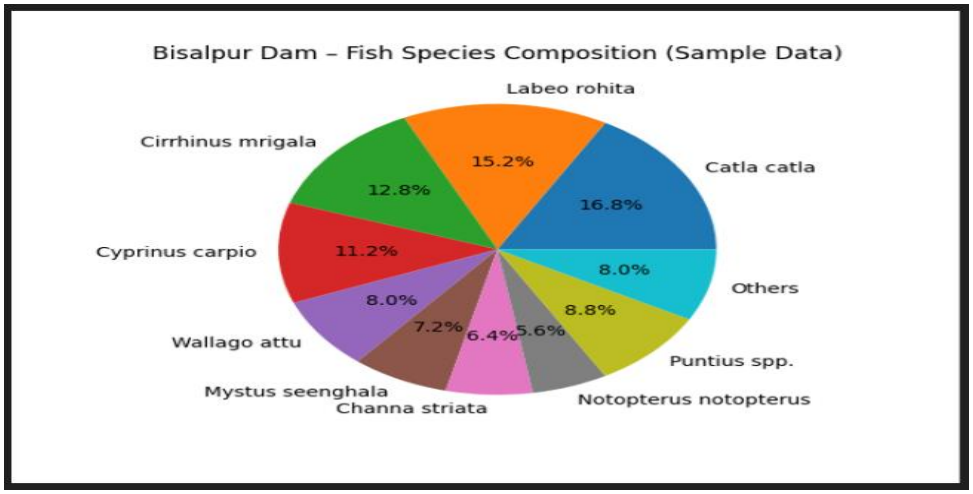

Figure-1 Bisalpur Dam fish species pie chart

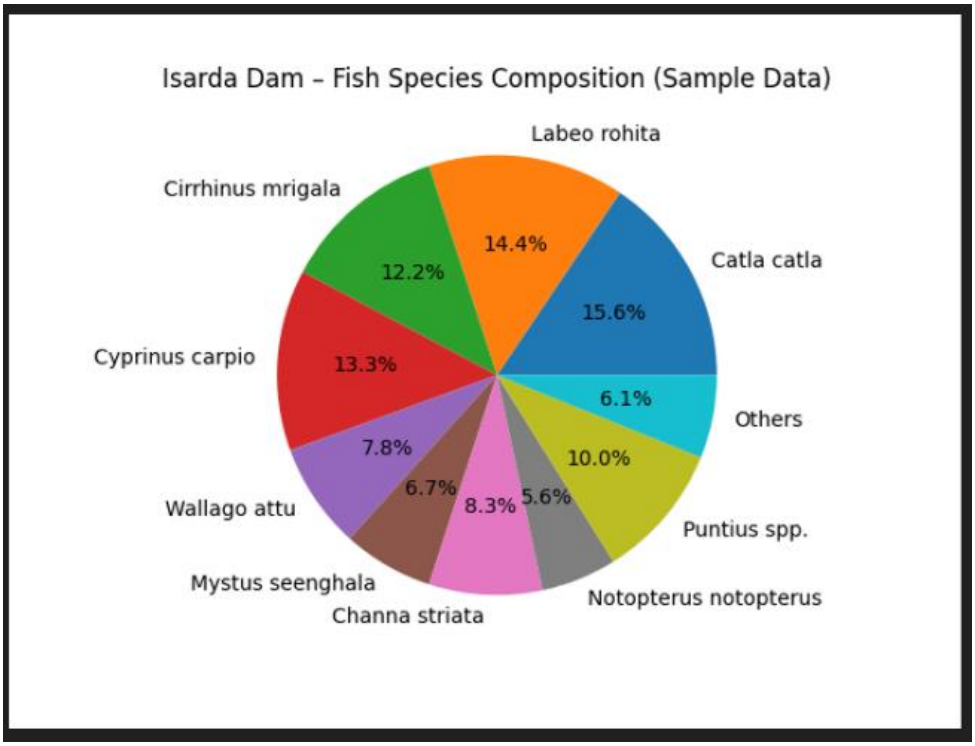

Figure-2 Isarda Dam fish species pie chart

4.4 Correlation Between Physico-Chemical Parameters and Fish Abundance

Pearson's correlation analysis revealed significant positive correlations between dissolved oxygen and total fish abundance ($r = +0.76$, $p < 0.01$) and between pH and species richness ($r = +0.68$, $p < 0.05$). Turbidity showed a significant negative correlation with species richness ($r = -0.72$, $p < 0.01$) and with abundance of filter-feeding

species like *Catlacatla* and *Hypophthalmichthys molitrix* ($r = -0.81$, $p < 0.01$). BOD was negatively correlated with abundance of oxygen-sensitive species like Mahseer *Tor putitora* ($r = -0.84$, $p < 0.01$). Temperature showed significant seasonal correlation with spawning activity and juvenile fish abundance at both sites.

5. SPECIES ACCOUNTS

5.1 Indian Major Carps

The three Indian Major Carps *Labeorohita* (Rohu), *Catlacatla* (Catla), and *Cirrhinusmrigala* (Mrigal) formed the ecological and economic backbone of the fisheries at both reservoirs. These species are all members of family Cyprinidae and occupy different feeding niches: Catla feeds at the surface and mid-water on zooplankton and phytoplankton; Rohu is a mid-water feeder consuming phytoplankton, soft vegetation, and detritus; and Mrigal is a bottom feeder consuming detritus, organic sediments, and benthic organisms. This trophic partitioning allows these three species to coexist without significant food competition, making them ideal for polyculture in both natural reservoirs and aquaculture systems.

Rohu (*Labeorohita*) is physiologically adapted for warm (25–32°C), well-oxygenated waters and was abundant in Bisalpur throughout pre-monsoon and post-monsoon seasons. Its streamlined, spindle-shaped body, subterminal mouth, and specialized pharyngeal teeth equip it for efficient mid-water feeding. Catla (*Catlacatla*), easily recognized by its large head and upturned broad mouth, is a filter feeder using well-developed gill rakers to strain zooplankton and suspended particles from the water. It showed highest abundance in Bisalpur's plankton-rich, clear waters. Mrigal (*Cirrhinusmrigala*), the white carp, showed greater tolerance for moderate turbidity and was relatively more abundant in Isarda compared to the other two major carps.

5.2 Exotic Carps

Common Carp (*Cyprinus carpio*), Grass Carp (*Ctenopharyngodonidella*), Silver Carp (*Hypophthalmichthys molitrix*), and Bighead Carp (*Hypophthalmichthys nobilis*) were all recorded at Bisalpur, while Bighead Carp was absent at Isarda. Common Carp is exceptionally hardy, tolerating low dissolved oxygen, high turbidity, and variable temperature, and was the most abundant exotic species at Isarda. Silver Carp, an obligate phytoplankton filter-feeder, was more abundant at Bisalpur where plankton density was higher due to better water clarity. Grass Carp, a strict herbivore capable of consuming its own body weight in aquatic vegetation daily, was present but less abundant at both sites due to limited macrophyte growth.

5.3 Predatory and Hardy Species

Snakeheads (*Channa* spp.) Spotted Snakehead (*C. punctata*), Striped Snakehead (*C. striata*), and Giant Snakehead (*C. marulius*) were recorded from both reservoirs. Their remarkable adaptability, including the ability to breathe atmospheric air using a suprabranchial organ, enables them to survive in oxygen-depleted, turbid, or stagnant conditions that would be lethal to most other fishes. As a result, snakeheads were proportionally more abundant at Isarda.

Wallago attu (Freshwater Shark), the largest predatory catfish in Indian inland waters, was recorded from both reservoirs but was more commonly caught at Bisalpur due to its preference for deeper, clearer waters. Sperataseenghala (Seenghala), Siloniasilondia (Silond Catfish), and Ompokbimaculatus (Butter Catfish) were all recorded as important mid-level predators at both sites. Featherback (*Notopterusnotopterus*), with its distinctive long anal fin and wave-like locomotion, was observed in both reservoirs in shallow vegetated areas. Freshwater Garfish (*Xenentodoncancila*), a slender surface predator with needle-like jaws, was present in both reservoirs but more frequently encountered at Bisalpur due to its sensitivity to turbidity and water quality changes.

5.4 Mahseer and Conservation-Significant Species

Both Golden Mahseer (*Tor putitora*) and Deccan Mahseer (*Tor khudree*) were recorded exclusively at Bisalpur Dam and were absent from Isarda. Mahseer require clean, well-oxygenated water and are highly sensitive to pollution and high turbidity. The presence of Mahseer at Bisalpur indicates relatively better water quality and confirms the value of this reservoir as a habitat for conservation-significant species. Due to habitat degradation, overfishing, and environmental pollution, Mahseer populations have declined across India, and both species are now the focus of active conservation and restocking programs.

5.5 Tilapia

Tilapia (*Oreochromis mossambicus* / *O. niloticus*), an exotic cichlid, was recorded at both reservoirs. Known for their remarkable physiological adaptability including tolerance of low dissolved oxygen, high temperatures, variable salinity, and poor water quality Tilapia have established self-sustaining populations at both sites. They are prolific mouthbrooders with multiple spawning cycles per year, and their competitive ability gives them an advantage over native species under stressed environmental conditions. The relatively high abundance of Tilapia in Isarda is consistent with its more variable and challenging water quality conditions.

6. DISCUSSION

6.1 Effect of Dissolved Oxygen on Fish Distribution

Dissolved oxygen (DO) is arguably the single most critical physico-chemical parameter governing fish distribution in freshwater ecosystems. Most teleost fishes require a minimum DO of 4–5 mg/L for survival, but optimal growth and reproduction typically require 6–8 mg/L. In the present study, Bisalpur consistently recorded DO values of 6.8–7.8 mg/L, supporting a rich and diverse fish community including sensitive species like Mahseer, Catla, and Silver Carp. Isarda's lower DO values (5.6–6.4 mg/L) were below the optimum threshold for many sensitive cyprinids, explaining their reduced abundance or absence at this site.

The strong positive correlation between DO and total fish abundance ($r = +0.76$) observed in the present study is consistent with multiple previous studies on Indian reservoirs. Low DO in Isarda during monsoon when large volumes of oxygen-depleted runoff enter the reservoir likely creates temporary hypoxic stress that displaces sensitive species toward shallower, better-aerated margins. Air-breathing species like snakeheads (*Channa* spp.) are naturally selected under such conditions, explaining their relatively higher proportional abundance at Isarda.

6.2 Effect of Turbidity on Fish Distribution

Turbidity, primarily caused by suspended particulate matter, affects fish communities through multiple pathways: reduction of light penetration (limiting primary productivity and visual feeding), physical damage to gill epithelium, reduction in plankton availability (affecting filter-feeders), and disruption of spawning cues for visually guided species. In the present study, Isarda consistently exhibited higher turbidity (28–40 NTU during monsoon) compared to Bisalpur (16–24 NTU), with a strong negative correlation between turbidity and species richness ($r = -0.72$).

Filter-feeding species like Catla (*Catlacatla*) and Silver Carp (*Hypophthalmichthys molitrix*), which depend on dense plankton blooms for food, showed significantly lower abundance at Isarda ($r = -0.81$ between turbidity and their abundance). High turbidity in Isarda reduces phytoplankton photosynthesis, limiting food availability for these obligate filter-feeders. In contrast, bottom-feeding species like Common Carp (*Cyprinus carpio*) and Mrigal (*Cirrhinusmrigala*), which utilize detritus and sediment-associated organisms, were relatively less affected by turbidity and maintained reasonable abundances at Isarda.

6.3 Effect of pH on Fish Distribution

pH influences fish physiology through its effects on enzyme activity, gill function, osmoregulation, and reproductive processes. Most freshwater fish thrive between pH 6.5–8.5. Values below 6.0 or above 9.0 are generally lethal. Bisalpur maintained pH values of 7.1–7.5 throughout the year — near-neutral and optimal for the majority of recorded species. Isarda's pH ranged from 6.7–7.1, lower than Bisalpur, particularly during monsoon when acidic runoff from agricultural lands lowered pH values.

The positive correlation between pH and species richness ($r = +0.68$) in the present study reflects the sensitivity of many cyprinid species to sub-optimal pH. Mahseer species, which are particularly sensitive to acidic conditions, were absent from Isarda, where monsoon pH occasionally approached the lower tolerance limit of 6.5 for these species. The slightly lower alkalinity at Isarda (110–128 mg/L vs. 134–152 mg/L at Bisalpur) also indicates lower buffering capacity, making the system more vulnerable to rapid pH fluctuations.

6.4 Effect of Temperature on Fish Distribution and Breeding

Water temperature governs all aspects of fish physiology — metabolism, growth, respiration rate, feeding activity, and reproductive cycles. Seasonal temperature fluctuations in Rajasthan are extreme, with surface water temperatures reaching 31–32°C in pre-monsoon and dropping to 15–18°C in winter. Both reservoirs showed similar temperature regimes due to their geographical proximity. However, the slightly higher turbidity at Isarda may lead to greater solar absorption and marginally higher water temperatures in shallow areas, creating localized thermal stress.

The spawning of Indian Major Carps is triggered by monsoon conditions — rising water levels, increased flow, and temperature change. The present study recorded peak juvenile fish abundance in both reservoirs in August–September, coinciding with post-spawning recruitment. Temperature was found to be significantly correlated with juvenile fish abundance ($r = +0.71$, $p < 0.01$), confirming the role of thermal cues in regulating reproduction and recruitment in these reservoir fish communities.

6.5 Comparative Ecological Status of Bisalpur and Isarda

Based on the cumulative evidence from physico-chemical data, species richness, diversity indices, and correlation analyses, Bisalpur Dam represents a higher-quality fishery habitat compared to Isarda Dam. Bisalpur's advantages include: (i) superior DO concentrations supporting sensitive cyprinids and mahseer; (ii) lower turbidity enabling higher plankton productivity and filter-feeder abundance; (iii) near-optimal pH throughout the year; (iv) lower BOD and COD indicating lower organic pollution load; and (v) presence of conservation-significant species (Mahseer) absent from Isarda.

Isarda Dam, while supporting a less diverse fish community, nonetheless harbors important fishery species and maintains ecological functions through its community of generalist, hardy species. The dominance of Common Carp, Tilapia, and snakeheads at Isarda reflects the classic ecological pattern of stress-tolerant, r-selected species replacing sensitive, K-selected species as environmental conditions deteriorate. This pattern underscores the importance of habitat quality in shaping fish community composition.

6.6 Human Pressures and Their Impact

Both reservoirs face significant anthropogenic pressures that compound the effects of naturally varying physico-chemical conditions. These include: (i) **illegal fishing** using banned gear (poison, electric shock, fine-mesh nets) that decimates juvenile fish populations; (ii) **agricultural runoff** carrying pesticides, fertilizers, and sediment that increase turbidity, BOD, and nutrient load; (iii) **livestock watering** along reservoir margins, contributing organic pollution; (iv) **encroachment** of reservoir margins for agriculture, reducing riparian buffer zones; and (v) **overfishing of large predators** like Wallago and Mahseer, disrupting trophic balance.

Fish populations in both Bisalpur and Isarda have reportedly declined in recent years, primarily attributed to these anthropogenic pressures combined with habitat changes. The near-absence of Mahseer from catch data a species that was once relatively abundant in the Banas River system is a particularly concerning indicator of overall ecosystem health degradation.

7. CONCLUSION

The present study demonstrates that physico-chemical parameters particularly dissolved oxygen, turbidity, pH, BOD, and COD are primary determinants of fish distribution, diversity, and community structure in Bisalpur and Isarda Dams of Tonk District, Rajasthan. Bisalpur Dam, with its superior water quality and stable physico-chemical environment, supports a richer and more diverse fish community (25 species, H' = 2.48) compared to Isarda Dam (18 species, H' = 2.24). The presence of conservation-sensitive species like Golden Mahseer and Deccan Mahseer exclusively at Bisalpur underscores the value of maintaining high water quality standards. Isarda's lower DO, higher turbidity, and elevated organic load promote dominance by hardy, stress-tolerant species at the expense of ecologically and economically valuable carps.

The following management recommendations are proposed for sustainable fishery conservation in both reservoirs:

1. **Regular water quality monitoring** at multiple stations throughout the year to detect early warning signs of deterioration.
2. **Strict enforcement** against illegal fishing methods, including electric fishing, poisoning, and use of fine-mesh nets.
3. **Watershed management** to reduce agricultural runoff, sedimentation, and nutrient loading into both reservoirs.
4. **Periodic stocking** of Indian Major Carps and Mahseer to compensate for natural recruitment deficits.
5. **Establishment of seasonal fishing bans** during spawning months (July–August) to protect breeding populations.
6. **Creation of fish sanctuaries** in identified spawning and nursery zones within both reservoirs.
7. **Community participation programs** involving local fishermen in conservation and monitoring activities.
8. **Restoration of riparian vegetation** along reservoir margins to serve as natural buffers against runoff and erosion.

REFERENCES

[1] APHA (2012). *Standard Methods for the Examination of Water and Wastewater*. 22nd ed. American Public Health Association, Washington D.C.
[2] Jayaram, K.C. (1981). *The Freshwater Fishes of India*. Zoological Survey of India, Calcutta.
[3] Jayaram, K.C. (1999). *The Freshwater Fishes of the Indian Region*. Narendra Publishing House, Delhi.
[4] Jhingran, V.G. (1991). *Fish and Fisheries of India*. 3rd ed. Hindustan Publishing Corporation, New Delhi.
[5] Bhatnagar, A. and Devi, P. (2013). Water quality guidelines for the management of pond fish culture. *International Journal of Environmental Sciences*, 3(6): 1980–2009.
[6] Sinha, M., Alam, M.S. and Sinha, A.K. (2012). Physico-chemical parameters and ichthyofaunal diversity of Bisalpur reservoir, Rajasthan. *Journal of Applied Sciences and Environmental Management*, 16(2): 145–152.

[7] Sharma, R.K. and Gupta, M. (2015). Seasonal variation in physico-chemical parameters and fish diversity of Ramgarh Lake, Rajasthan. *Journal of Environmental Biology*, 36(4): 901–908.
[8] Welcomme, R.L. (2001). *Inland Fisheries: Ecology and Management*. Fishing News Books, Oxford.
[9] Odum, E.P. (1971). *Fundamentals of Ecology*. W.B. Saunders, Philadelphia.
[10] Talling, J.F. and Driver, D. (1963). Some problems in the estimation of chlorophyll-a in phytoplankton. *Proceedings of the Conference on Primary Productivity Measurement*, USAEC Tech. Inform. Service, TID-7633.
[11] Pielou, E.C. (1966). The measurement of diversity in different types of biological collections. *Journal of Theoretical Biology*, 13: 131–144.
[12] Shannon, C.E. and Weaver, W. (1949). *The Mathematical Theory of Communication*. University of Illinois Press, Urbana.
[13] Simpson, E.H. (1949). Measurement of diversity. *Nature*, 163: 688.
[14] Margalef, R. (1958). Information theory in ecology. *General Systematics*, 3: 36–71.
[15] Sunder, S. (1992). Observations on the fishery and biology of Tor putitora (Hamilton) in the River Beas. *Journal of the Inland Fisheries Society of India*, 24(2): 24–32.