



# Exploring Biodiversity and Fisheries Resources in the Kosi River of Rampur, Uttar Pradesh, India

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## **Authors' contributions**

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

## **Article Information**

DOI: <https://doi.org/10.56557/upjoz/2024/v45i194528>

## **Open Peer Review History:**

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://prh.mbimph.com/review-history/4118>

**Review Article**

**Received: 29/07/2024**

**Accepted: 02/10/2024**

**Published: 09/10/2024**

## **ABSTRACT**

This study delves into the biodiversity of the Kosi River and the fish resources in local markets, focusing on the stretch in Rampur, Uttar Pradesh, India. The investigation reveals the river's significance as a diverse habitat and a vital source of livelihood for the local fishing community. Rich in fish biodiversity, the Kosi River plays a crucial role in providing quality fish protein, contributing to the nutritional security of neighboring populations. However, the research also highlights alarming trends of declining fish populations, attributed to pollution, overexploitation, and indiscriminate fishing methods. The study emphasizes the urgent need for conservation measures to preserve the delicate balance of the riverine ecosystem. The conclusion underscores the importance of raising awareness within the fishing community about sustainable practices, coupled with stringent enforcement of inland fishing rules and regulations. Collaborative efforts involving government bodies, non-governmental organizations, and local communities are deemed essential to address the identified threats and ensure the sustainable management of the Kosi River's resources.

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**Cite as:** Singh, Jitendra, and Baby Tabassum. 2024. "Exploring Biodiversity and Fisheries Resources in the Kosi River of Rampur, Uttar Pradesh, India". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (19):285-315. <https://doi.org/10.56557/upjoz/2024/v45i194528>.

In conclusion, this study serves as a call to action for proactive conservation measures, offering valuable insights into the current state of the river and providing a roadmap for informed decision-making. The lessons learned contribute to the ongoing dialogue on balancing human activities with the preservation of natural resources, aiming for a future where the Kosi River thrives as a sustainable and resilient ecosystem.

*Keywords: Kosi River; biodiversity; fish resources; fishing practices; ecosystem health.*

## 1. INTRODUCTION

The Kosi River, a vital water body in Rampur, Uttar Pradesh, sustains diverse ecosystems. Our research aims to assess the biodiversity within the Kosi River and analyze fisheries resources available in local markets. This investigation provides crucial insights for conservation efforts and the sustainable management of aquatic resources.

The Kosi River, coursing through Rampur, Uttar Pradesh, stands as a crucial water body fostering diverse ecosystems. Our research endeavors to comprehensively evaluate the biodiversity thriving within the Kosi River while concurrently scrutinizing the fisheries resources prevalent in local markets. This investigation serves as a linchpin for advancing conservation endeavors and propelling the sustainable management of aquatic resources.

The significance of the Kosi River in this study lies in its role as a lifeline for myriad species and communities. The assessment of biodiversity will encompass an array of aquatic life, from indigenous fish species to migratory birds that find refuge along its banks. Through a meticulous examination of the local markets, we aim to discern the impact of human activities on fisheries resources and evaluate the ecological implications.

The outcomes of this research hold pivotal insights for guiding conservation strategies tailored to the unique characteristics of the Kosi River ecosystem. Understanding the intricate web of interactions between the river's biodiversity and the utilization of fisheries resources is paramount for promoting environmental sustainability. By shedding light on the challenges faced by this vital water body, we aspire to contribute valuable knowledge that can inform policies aimed at preserving and restoring the ecological balance.

In essence, our research at the intersection of biodiversity assessment and fisheries analysis seeks to foster a harmonious coexistence

between human activities and the natural environment. Through this exploration, we aspire to lay the groundwork for informed decision-making, ensuring the longevity of the Kosi River's diverse ecosystems for generations to come.

## 2. RAMPUR AND ITS ENVIRONMENT

Rampur, a captivating region nestled in the heart of Uttar Pradesh, unfolds as a study area with a tapestry of geographical nuances that contribute to its unique identity. This comprehensive exploration delves into the geographical dimensions of Rampur, encompassing its coordinates, topography, and connectivity, painting a vivid picture of this diverse and dynamic landscape [1].

### 2.1 Geographical Coordinates and Extent

Rampur's geographical coordinates, spanning between Longitude 78-0-54 & 69-0-28 East and Latitude 28-25 & 29-10 North, position it as a pivotal point in the Moradabad Division of Uttar Pradesh. This expansive district covers a substantial area of 2367 sq km, providing a canvas for a myriad of natural features and human activities to unfold. (District profile: <https://rampur.nic.in>).

### 2.2 Surroundings and Divisional Context

Surrounded by diverse neighbors, Rampur shares its borders with Udham Singh Nagar to the North, Bareilly to the East, Moradabad to the West, and Badaun to the South. This geographical positioning not only defines Rampur's regional context but also influences its socio-economic and cultural dynamics. The interplay of influences from these neighboring districts contributes to the rich tapestry of Rampur's identity.

### 2.3 Altitude and Topographical Variation

The undulating terrain of Rampur adds another layer to its geographical profile. The district experiences an altitude range from 166.4m to 192m above sea level, creating diverse

microclimates and supporting varied ecosystems. This elevation range is not only a topographical characteristic but also a factor influencing Rampur's climatic nuances and ecological diversity.

## 2.4 Connectivity and Accessibility

Rampur's strategic location is further enhanced by its connectivity. The district is well-connected via National Highway 24, a major artery that facilitates seamless travel. With the state capital merely 302 km to the east and the national capital 185 km to the west, Rampur becomes a crossroads of accessibility, fostering economic activities, cultural exchanges, and administrative connectivity.

## 2.5 Geographical Features and Landscape

The geographical features of Rampur, sprawling across 2,367 sq km, unveil a mosaic of landscapes. Expansive farmlands characterize the district, highlighting its agricultural significance. The undisturbed beauty of the natural terrain intertwines with human endeavors, creating a symbiotic relationship between the land and its stewards. (District profile: <https://rampur.nic.in>)

## 2.6 Panoramic Views and Seasonal Marvels

Rampur's geographical allure extends beyond its coordinates and altitudes. During the rainy season, the district offers panoramic views of Nainital's mountain ranges. This seasonal marvel adds a touch of grandeur to Rampur's landscape, transforming it into a visual spectacle that captivates residents and visitors alike.

In conclusion, the geographical canvas of Rampur is a masterpiece painted with coordinates, altitudes, connectivity, and landscapes. Its position in the Moradabad Division, surrounded by neighboring districts, contributes to a rich interplay of influences. The undulating terrain, ranging altitudes, and accessibility via National Highway 24 define Rampur's unique character. As one explores its expansive farmlands and witnesses the seasonal marvels of Nainital's mountains, the geographical

story of Rampur unfolds, inviting a deeper understanding of the district's essence and significance. The tale of Rampur is not merely inscribed on maps; it is etched in the contours of its land and the experiences of its inhabitants.

- ❖ Located between Longitude 78-0-54 & 69-0-28 East and Latitude 28-25 & 29-10 North.
- ❖ Encompasses 2367 sq km in the Moradabad Division of Uttar Pradesh.
- ❖ Surrounded by Udham Singh Nagar (North), Bareilly (East), Moradabad (West), and Badaun (South).
- ❖ Altitude ranges from 166.4m to 192m above sea level.
- ❖ Well-connected via National Highway 24, with the state capital 302 km east and the national capital 185 km west.

### 2.6.1 Geography

- Positioned between Longitude 79°05' E and Latitude 28°48' N.
- Part of Moradabad Division, Uttar Pradesh.
- Spans an area of 2,367 sq km, featuring expansive farmlands.
- Offers panoramic views of Nainital's mountain ranges during the rainy season.

### 2.6.2 Climate

- Summer temperatures range from 30°C to 43°C.
- Winter temperatures range from 5°C to 25°C. (<https://rampur.nic.in>)

### 2.6.3 Cuisine

- Known for industries like sugar refining and cotton milling.
- Famous for culinary delights such as Doodhiya Biryani and Adrak Ka Halwa.
- Famous Rampur Raza library treasures above 12,000 exceptional manuscripts and an excellent assortment of Mughal paintings
- This place is widely known for making sharp knives as well.
- Gandhi samadhi Rampur (District profile: <https://rampur.nic.in>)



**Figs. 1-3. Panoramic views and seasonal marvels**

## 2.7 Kosi River

The Kosi River, a testament to the majestic landscapes of the Himalayas, traces its origin to the pristine Dharpani Dhar in the Almora district of Uttarakhand. Flowing with the essence of the Himalayan terrain, this river weaves its way through varied landscapes, eventually merging with the Kosi Ramganga Sangam near Mundapande, bestowing life and vitality to the region of Rampur in Uttar Pradesh. (<https://parang.in/rampur>) [2].

This Himalayan gem plays a multifaceted role in the lives of the communities along its course [3]. Foremost, the Kosi River is a lifeline for agriculture, serving as a vital source for irrigation in the fertile plains of Rampur. The nutrient-rich waters support the cultivation of crops, ensuring sustenance for local farmers and contributing to the region's agricultural prosperity. (<https://parang.in/rampur>)

Beyond its agricultural significance, the Kosi River is a wellspring for economic activities, particularly through sand excavation and gravel export. The riverbed harbors deposits of sand, which, when extracted, become a valuable resource for construction and development projects in various regions, including the bustling city of Delhi. Numerous stone crushers operating in Tehsil Tanda and near Kashipur, in collaboration with the river's offerings, contribute significantly to the construction industry. (<https://parang.in/rampur>) [4,5]

However, the delicate equilibrium of the Kosi River's ecosystem faces challenges due to the extensive sand excavation [6]. While this practice fuels economic activities, it raises concerns about the sustainable management of the river's resources. Excessive sand extraction poses a threat to the river's life, emphasizing the need for a balanced approach that considers both

economic benefits and environmental preservation [7].

In addition to its utilitarian roles, the Kosi River is an integral player in maintaining the ecological balance of the renowned Jim Corbett National Park. As the river courses through the eastern boundary of the park, it becomes a vital resource for the park's diverse wildlife. The park's inhabitants, both flora and fauna, rely on the Kosi's waters for sustenance, creating a delicate yet robust connection between the river and the natural habitats it traverses. (eUttaranchal /Brijmohan Bist 2016) [8].

Notably, the Kosi River also hosts the famous temple of Garjiya Mata, attracting devotees in large numbers. This spiritual site, situated along the river's course, adds a cultural and religious dimension to the significance of the Kosi in the lives of the local population. (eUttaranchal /Brijmohan Bist 2016) [9].

In conclusion, the Kosi River stands as a symbol of vitality, connecting the Himalayan heights to the fertile plains of Rampur. Its journey encompasses agricultural support, economic activities, ecological sustainability, and cultural significance [10]. However, the challenge lies in harmonizing these diverse roles to ensure the longevity of this Himalayan lifeline [11]. Balancing economic pursuits with environmental preservation becomes imperative to secure the Kosi River's legacy for future generations, acknowledging its pivotal role in the intricate tapestry of life in Rampur and beyond [12].

- Himalayan river originating from Dharpani Dhar in Almora district, Uttarakhand.
- Joins Kosi Ramganga Sangam near Mundapande near Rampur.
- Essential for irrigation, sand excavation, and gravel export.
- Plays a vital role in the ecological balance of Jim Corbett National Park.

### 3. THE CURRENT SCENARIO OF THE KOSI RIVER: BALANCING FRAGILITY AND PROSPERITY

The Kosi River, meandering through the landscapes of Rampur, Uttar Pradesh, is currently navigating a delicate balance between its ecological fragility and the economic prosperity derived from human activities along its banks [13].

At the heart of the contemporary challenges faced by the Kosi River is the rampant and extensive sand excavation that poses a formidable threat to the very essence of the river's life. The riverbed, once a sanctuary of natural equilibrium, now bears the scars of intensive human intervention. This practice, driven by economic interests, has escalated to an extent where it jeopardizes the sustainability of the river itself [14].

A critical player in this scenario is the presence of approximately 15 stone crushers operating in Tehsil Tanda and near Kashipur. These crushers, like mechanical sentinels, contribute significantly to the massive sand extraction witnessed along the course of the Kosi River [15]. The synergy between these stone crushers and the riverbed has created a complex economic web, feeding the demand for sand in construction and development projects far beyond the immediate vicinity [16,17].

However, the prosperity generated from this economic activity is juxtaposed against the stark reality of environmental repercussions. The unbridled extraction of sand, while boosting economic fortunes, raises alarms about the long-term consequences for the river's health and the diverse ecosystems it sustains.

The Kosi River, despite facing these challenges, remains a sanctuary for a myriad of aquatic life. From the resilient Channa to the graceful Mistus Singhala, the river hosts a diverse array of fish species. The Mahseer, a charismatic and ecologically important fish, shares its habitat with the robust rohu, while eels gracefully navigate the water currents [18,19]. The riverbanks are not only a haven for aquatic life but also witness the slithering presence of snakes, the scuttling of crabs, the mysterious movement of sepia, and the tranquil existence of snails and mollusks [20].

Adding a touch of migratory charm, the Kosi River becomes a temporary home for various bird species during specific seasons. Migratory birds, drawn to the river's bountiful offerings, contribute to the rich tapestry of biodiversity along its course. This interaction between the river and its diverse inhabitants creates an intricate web of life, where each species plays a vital role in maintaining the ecological balance [21].

The significance of the Kosi River, therefore, extends beyond its role as a source of economic prosperity; it is a dynamic ecosystem that requires careful consideration and responsible management [22]. The juxtaposition of economic activities and ecological sustainability calls for a nuanced approach that acknowledges the interdependence of human needs and environmental health [23,24].

In the face of these challenges, stakeholders, including governmental bodies, local communities, and environmental advocates, must collaborate to devise strategies that ensure the sustainable coexistence of economic activities and the conservation of the Kosi River's biodiversity [25]. Balancing the scales between prosperity and fragility is not only a responsibility but an imperative for securing the longevity of this Himalayan lifeline [26].

In conclusion, the current scenario of the Kosi River presents a compelling narrative of human aspirations intersecting with the delicate intricacies of nature. As we navigate the complexities of economic activities, we must strive for a harmonious relationship with the river, recognizing that its vitality is intertwined with our own. The story of the Kosi River is not just about its challenges but about the collective responsibility we bear in nurturing and preserving the lifeblood that sustains us all.

- Rampant sand excavation poses a threat to the river's life.
- Approximately 15 stone crushers operate in Tehsil Tanda and near Kashipur, contributing to massive sand extraction.
- Kosi River supports diverse aquatic life, including Channa, Singhi, Mistus Singhala, Mahseer, rohu, eels, snakes, crabs, sepia, snails, mollusks, and migratory birds.

#### 4. OBJECTIVES OF THE RESEARCH PROJECT: EXPLORING BIODIVERSITY AND FISHERIES RESOURCES IN THE KOSI RIVER, RAMPUR

##### a) Conducting a Comprehensive Survey of Biodiversity within the Kosi River

- Undertake a systematic survey of the Kosi River to document the diversity of aquatic life.
- Identify and catalog various species inhabiting the river ecosystem, including fish, reptiles, amphibians, and avifauna.
- Employ standardized sampling methods, such as netting and observation, to ensure a thorough representation of the river's biodiversity.
- Document ecological indicators, including water quality parameters, to correlate with biodiversity patterns.

##### b) Identifying and Documenting Various Fish Species in Rampur Markets

- Conduct market surveys in Rampur to identify and document the various fish species available for trade and consumption.
- Collaborate with local fish vendors and markets to compile a comprehensive list of fish species sourced from the Kosi River.
- Record data on fish size, weight, and market demand to understand the economic aspects of fisheries in Rampur.
- Explore traditional knowledge held by local communities regarding the diversity and culinary preferences of fish species.

##### c) Assessing Conservation Status and Abundance of Fish Species in the River

- Evaluate the conservation status of identified fish species using established criteria, considering factors such as population trends, habitat degradation, and anthropogenic impacts.
- Estimate the abundance of key fish species through quantitative methods, including mark and recapture studies or transect surveys.
- Analyze the correlation between market availability and the conservation status of fish species to identify potential conservation concerns.

- Propose conservation strategies based on the findings, aiming to ensure the sustainable management of fish populations and the overall health of the Kosi River ecosystem.

These detailed objectives aim to guide a comprehensive and multifaceted research approach, encompassing biodiversity surveys, market dynamics, and conservation assessments. The integration of ecological, economic, and conservation perspectives is crucial for a holistic understanding of the interplay between the Kosi River's aquatic life, human activities, and the broader ecosystem.



Image 1. By Jitendra Singh, A visual representation of the gill net extraction process near Akbarabad

#### 5. METHODOLOGY: COMPREHENSIVE STUDY OF BIODIVERSITY AND FISHERIES RESOURCES IN THE KOSI RIVER, RAMPUR

##### 5.1 Field Surveys for Biodiversity Assessment

###### a) Site Selection and Sample Collection:

- Identification of representative locations along the Kosi River, chosen based on ecological diversity and human interaction.
- Utilization of various fishing techniques, including gill nets, Gagariya nets, and manual collection, to capture a diverse range of fish species.
- Implementation of standardized gill nets with varying mesh sizes (20-20 meters)

during field surveys for efficient fish collection.

**b) Sampling Locations and Techniques:**

**1. Akbarabad:**

- Utilization of gill nets (20-20 meters) to capture fish within a specified timeframe.
- Systematic removal of fish from the nets for subsequent laboratory taxonomic identification and analysis.
- Documentation of the biodiversity found near Akbarabad, showcasing the efficiency of gill nets in capturing a diverse fish population.

**2. Dadhiyal**

- Collaboration with local fishermen for the application of Gagaria nets near the Kosi Pool on Tanda Bajpur Road in Dadhiyal.
- Collection of fish samples with the assistance of fishermen for subsequent laboratory analysis.

**3. Dhanauri**

- Application of gill nets for sample collection in the Kosi River near the fishing community in Dhanauri.
- Collaborative sampling with local fishermen to enhance diversity representation.

**4. Lalpur**

- Collection of fish samples from the wide expanse of Kosi near the Kosi Dam on Kaswa Lalpur Tehsil Sadar.
- Collaboration with local fish sellers to obtain market-specific species and enhance sample diversity.

**5. Moradabad Road Rampur near Kosi Pool**

- Collection of samples from Kosi River near the Kosi Pool located on Moradabad Road Rampur.
- Ensuring a representative sample from different geographical areas along the river for a comprehensive assessment.



**Image 2. A fisherman retrieving the net from Kosi River near Dadhiyal**

## 6. MARKET SURVEYS FOR DATA COLLECTION

### a) Market Selection and Observations

- Identification of local fish markets in villages and towns situated along the banks of the Kosi River.
- Systematic exploration of market dynamics, including species availability and market-specific trends.

### b) Data Collection and Species Identification

- Conducting detailed market surveys to observe the variety of fish available for sale.
- Identification of common species as well as those specific to certain markets, providing insights into local preferences.
- Documentation of market-specific trends, including pricing, demand, and consumer choices.

### 6.1 Integration of Field and Market Data

- Cross-referencing data collected from field surveys with market observations to establish correlations between biodiversity in the Kosi River and consumer preferences.
- Utilization of statistical methods to analyze the relationship between the abundance of certain fish species in the river and their market demand.
- Incorporation of traditional knowledge shared by local communities regarding fish species and culinary preferences into the analysis.

### 6.2 Data Analysis and Reporting

- Employing taxonomic identification methods in the laboratory for accurate species classification.
- Utilization of statistical software for the analysis of biodiversity patterns, conservation status, and market trends.
- Comprehensive reporting of findings, including detailed species lists, abundance assessments, conservation recommendations, and market dynamics.

This scientific methodology ensures a rigorous and systematic approach to studying the biodiversity of the Kosi River and understanding

the intricate relationship between river ecosystems and local fisheries. The integration of field and market data enhances the comprehensiveness of the study, providing valuable insights for conservation and sustainable management practices.

## 7. SOCIOECONOMIC DATA COLLECTION: UNDERSTANDING FISHERY PRACTICES IN RAMPUR

### 7.1 Interviews and Surveys of Local Communities and Fishermen

#### 7.1.1 Background

Rampur, recognized as a significant contributor to the country's fish production, boasts approximately 36 fish hatchery plants in locations such as Swar, Milak, Sadar, and Shahabad. With an impressive annual production of about 300 crore fish seeds within just six months, Rampur plays a pivotal role in supplying fish seeds not only to Uttar Pradesh but also to Uttarakhand, Himachal Pradesh, Rajasthan, Punjab, Madhya Pradesh, and Jharkhand [23,27]. The fish seed distribution from Rampur to other states reached a staggering 2500 crore in the year 2015. This transformative work traces back 25 years to the initiatives of Sardar Ali, followed by the continued efforts of Narendra Singh from Begamabad.

#### 7.1.2 Fish production season and farming practices

The fish production season in Rampur spans from March to August, aligning with optimal conditions for fish breeding. In a seven to eight-acre farm, a remarkable 40-50 crore fish can be produced in a single season. The cost of establishing a five-acre fish farm ranges from 15-20 lakhs, with the government providing substantial support. For SC/ST communities, a 40% grant is offered by the Government of India, accompanied by a 60% subsidy for all farmers [28].

#### 7.1.3 Government initiatives and pradhan mantri matsya sampada yojana

In recent years, governmental support has furthered fish farming endeavors. Under the Pradhan Mantri Matsya Sampada Yojana, significant financial injections have been made into the sector. In the years 2020-21 and 2021-22, a total of 38.14 lakh rupees were disbursed to the accounts of 20 fish farmers through Direct Benefit Transfer (DBT) for various projects.



### Fertility of fish eggs and hatchery operations:



**Fig. 3. Image depicting fertile fish eggs being held**

### Cost-Effective Fish Farming Techniques:



**Fig. 4. Image showcasing small fish tanks for fingerlings**

#### 7.1.4 Main fish hatcheries in Rampur

Rampur hosts primary fish hatcheries where fish seeds are readily available through both online and offline channels. These hatcheries play a pivotal role in supporting local and regional fish farming initiatives [29].

This systematic socioeconomic data collection approach aims to unravel the intricate web of

fishery practices in Rampur. Through interviews and surveys, valuable insights into the economic dynamics, government interventions, and innovative farming techniques employed by local communities and fishermen are gathered [30]. This data provides a foundation for understanding the socioeconomic landscape of fish farming in Rampur, complementing the broader study on the biodiversity and fisheries resources in the Kosi River.

## **8. OUTCOMES: A COMPREHENSIVE DATABASE UNVEILING THE RICH BIODIVERSITY OF THE KOSI RIVER**

The culmination of extensive field surveys and meticulous data collection efforts has resulted in the creation of a comprehensive database illuminating the diverse tapestry of life within the Kosi River [31]. This database, born from scientific rigor and dedication, stands as a testament to the intricate interplay of ecosystems along the river's course.

### **8.1 Formation of the Database**

The foundation of the database lies in the systematic field surveys conducted at strategically selected locations along the Kosi River. From the bustling waterways near Akbarabad to the serene expanses of Dadhiyal and Dhanauri, each site was a microcosm of biodiversity waiting to be unraveled. The utilization of varied fishing techniques, including gill nets, Gagariya nets, and manual collection, ensured a nuanced representation of aquatic life.

### **8.2 Taxonomic Identification and Documentation**

The captured specimens underwent rigorous taxonomic identification processes in the laboratory. This phase involved skilled researchers meticulously categorizing each species, unraveling the intricate nuances of the river's biodiversity. The database not only catalogs the diversity but also captures key ecological indicators, providing a holistic understanding of the health and vitality of the Kosi River ecosystem.

### **8.3 Insights into Fish Species Abundance**

One of the primary outcomes of the database is the insights gained into the abundance of fish species inhabiting the Kosi River. From the resilient Channa to the majestic Mahseer, the database paints a vivid picture of the river's aquatic inhabitants. The utilization of gill nets in Akbarabad, Gagariya nets in Dadhiyal, and collaborative efforts with local fishermen in Dhanauri and Lalpur contributed to a diverse and representative sample.

### **8.4 Conservation Status Assessment**

Beyond a mere documentation of species, the database delves into the conservation status of

identified fish species. Utilizing established criteria, including population trends, habitat degradation, and anthropogenic impacts, researchers assessed the vulnerability of various species. This critical analysis lays the groundwork for informed conservation strategies, ensuring the sustained well-being of the Kosi River's aquatic life.

### **8.5 Market Dynamics and Biodiversity Correlations**

The integration of market survey data into the database adds a layer of complexity and relevance. By cross-referencing biodiversity patterns with market observations, researchers aim to establish correlations between the abundance of certain fish species in the river and their demand in local markets. This holistic approach bridges the gap between ecological dynamics and human interactions, providing a nuanced understanding of the river's role in the livelihoods of local communities.

### **8.6 Scientific Contributions and Research Opportunities**

The comprehensive database not only serves as a valuable resource for immediate conservation efforts but also opens avenues for further scientific inquiry. Researchers, policymakers, and conservationists can leverage this wealth of information to delve deeper into the intricacies of freshwater ecosystems, contributing to the broader field of aquatic biology and conservation science.

This research contributes to understanding the dynamic relationship between human activities, river ecosystems, and biodiversity in the Kosi River. Findings will guide conservation strategies and promote sustainable practices for the benefit of both the environment and local communities.

## **9. RESULT AND DISCUSSION**

Assessment of Key Fish Species in Local Markets Surrounding the Kosi River, Rampur.

### **9.1 Introduction**

The identification of key fish species in local markets is an integral component of understanding the dynamic interaction between aquatic biodiversity and human activities. The data collected from various weekly markets surrounding the Kosi River in Rampur provides

valuable insights into the prevalent fish species, market dynamics, and potential implications for conservation and fisheries management.

## 9.2 Identification of Key Fish Species

The analysis of local markets revealed a consistent presence of certain key fish species. These include Channa, Singhi, Manghur, various species of minnow, Hamseer, Rohu, silver carp, china catla, dry and wet prawns, and Pungas. The prominence of these species underscores their significance in the local fisheries and highlights their economic and cultural importance to the communities in Rampur.

## 9.3 Market-Specific Observations

### 1. Darhiyal Weekly Market:

- Located near Gandhi Inter College, this market operates from 12:00 pm to 7:00 pm.
- Notable fish species: Channa, Singhi, Manghur, various minnow species, Hamseer, Rohu.
- Major fish: Channa Pungas.

### 2. Sarakthal Weekly Market:

- Positioned at the main Chauraha in Tehsil Tanda, this market functions from 2:00 pm to 7:00 pm.
- Common fish species: Channa, Singhi, Manghur, various minnow species, Hamseer, Rohu.
- Major fish: Pungas.

### 3. Tanda Weekly Market

- Near Nagar Palika Parisad in Tanda, this market operates from 2:00 pm to 7:00 pm.
- Identified fish species: Channa, Singhi, Anghur, various minnow species, silver carp, China catla, Rohu.
- Major fish: Pungas and Rohu.

### 4. Swar Weekly Market

- The market is located at Itvar Ki Bajar in Swar and runs from 10:00 am to 8:00 pm.
- Predominant fish species: Channa, Singhi, Manghur, various minnow species, silver carp, China, Catla, Rohu.
- Major fish: Pungas, Rohu, and Channa.

### 5. Shanivar Ki Bajar Bilaspur (Rampur)

- Situated in Bilaspur, this market operates from 12:00 pm to 7:00 pm.

- Key fish species: Channa, Manghur, Rohu.
- Major fish: Pungas.

## 6. Mangal Ki Penth Rampur

- Located in Rampur, this market is open from 2:00 pm to 7:00 pm.
- Recognized fish species: Channa, Singhi, Manghur, various minnow species, silver carp, China catla, Rohu.
- Major fish: Pungas, Rohu, and Channa.

## 7. Weekly Market Chak Hardaspur Swar

- Positioned in Chak Hardaspur in Swar Rampur, this market operates from 2:00 pm to 7:00 pm.
- Predominant fish species: Channa, Manghur, Rohu.
- Major fish: Pungas.

## 9.4 Discussion

The consistent presence of key fish species across multiple markets reflects the reliance of local communities on these aquatic resources. The prevalence of Channa, Singhi, Manghur, and Rohu in various markets indicates their popularity and potential economic significance. The dominance of Pungas, a catfish species, as a major fish in several markets highlights its contribution to local fisheries and culinary preferences.

Understanding the species composition in these markets provides a foundation for future studies on fishery sustainability, market trends, and conservation strategies. The data can inform policymakers and fisheries management authorities in developing targeted interventions to ensure the responsible exploitation of fish resources and the preservation of biodiversity in the Kosi River [32,33].

Moreover, the variations in market times suggest the temporal dynamics of fish trade, potentially influenced by local cultural practices and consumer behaviors. This temporal aspect could be further explored to enhance our understanding of market fluctuations and seasonal variations in fish availability.

In conclusion, the integration of scientific methodologies in assessing local markets contributes to a nuanced understanding of the relationship between fish biodiversity and human utilization. This data not only informs

conservation strategies but also provides a basis for fostering sustainable fisheries practices that align with the ecological balance of the Kosi River ecosystem.

### 9.5 Educational and Community Outreach

The outcomes of this comprehensive database extend beyond the scientific realm. The documented biodiversity becomes a powerful educational tool, fostering awareness and appreciation for the rich natural heritage of the Kosi River. Community outreach programs can utilize this data to engage local residents, creating a sense of stewardship and pride in the unique ecological treasures of Rampur.

### 9.6 Challenges and Future Directions

While celebrating the creation of this comprehensive database, researchers acknowledge the challenges ahead. Ongoing monitoring and periodic updates are crucial to capture the dynamic nature of river ecosystems. Furthermore, fostering collaborations with local communities, policymakers, and environmental organizations will be instrumental in implementing effective conservation measures.

In conclusion, the outcomes of this endeavor transcend the boundaries of a mere database. They represent a collective effort to decode the secrets of the Kosi River, providing a roadmap for sustainable coexistence between human activities and the intricate web of life within the river's waters. This database is not merely a static snapshot; it is a living record that beckons future generations to continue the journey of understanding, preserving, and cherishing the invaluable biodiversity of the Kosi River.

## 10. RESULT AND DISCUSSION: LABORATORY ANALYSIS - TAXONOMIC IDENTIFICATION OF FISH SPECIES IN THE KOSI RIVER

### 10.1 Taxonomic Overview

The laboratory analysis of collected specimens from the Kosi River has provided a detailed taxonomic identification of diverse fish species. The comprehensive list encompasses representatives from various families, each contributing to the rich aquatic biodiversity of the region [24,27].

### 10.2 Cyprinidae Family:

#### 1. *Amblypharyngodon mola* (Dhawai): Commonly known as Dhawai



#### 2. *Amblypharyngodon microlepis* (Dhawai): Dhawai species within the Cyprinidae family



3. **Aspidoparia jaya (Jaya):** Known as Jaya



4. **Aspidoparia morar (Kenwachi/ Harda):** Commonly known as Kenwachi or Harda, also referred to as Nakli chal.



5. **Aristichthys nobilis (Bighead carp):** Bighead carp within the Cyprinidae family.



**6. Catlacatla (Bhakur/ Catla):** Known as Bhakur or Catla.



**7. Chela atpar (Chelhwa):** Identified as Chelhwa.



**8. Chela laubuca (Dendula):** Commonly known as Dendula.



**9. Cirrhinus mrigala (Nain/ Mrigal):** Also known as Mrigal, more commonly found



10. **Cirrhina reba** (Raia): Identified as Raia.



11. **Ctenopharyngodon idella** (Grass carp): Grass carp, a common species



12. **Cyprinus carpio** (Common carp): Commonly known as Common carp.



**13. *Esomus danricus* (Dendua / mahalua):** Dendua or Mahalua species within the Cyprinidae family



**14. *Hypophthalmichthys molitrix* (Silver carp):** Silver carp within the Cyprinidae family



**15. *Labeo angra* (Thuthuniahiaraia / minnow):** Known as Thuthuniahiaraia or Minnow



**16. *Labeo bata* (Bata):** Identified as Bata





**17. Labeo calbasu (Karonchh):** Known as Karonchh.



**18. Labeo dero (Kalabans):** Identified as Kalabans.



**19. Labeo gonius (Kurai):** Known as Kurai or Nohan.



**20. Labeo rohita (Rohu):** Commonly known as Rohu.



**21. *Lepidocephalichthys guntea* (Nakati / gachelua):** Identified as Nakati or Gachelua.



**22. *Osteobrama cotio* (Gurda):** Commonly known as Gurda, characterized by transparency.



**23. *Puntius chola* (Sidhari/bhoor):** Known as Sidhari or Bhoor.



**24. *Puntius sarana* (Barb/ Olive barb/bhoor):** Identified as Barb, Olive barb, or Bhoor



**25. Puntius sophore (Pool barb/bhoor):** Known as Pool barb or Bhoor



**26. Puntius ticto (Ticto barb/bhoor):** Identified as Ticto barb or Bhoor



**27. Siluridae Family: Wallago attu (Padhani/Barari):** Known as Padhani or lanchi



**10.3 Bagridae Family:**

**28. Mystus bleekeri (Tengra/ katua):** More commonly known as Tengra or Katua.



**29. *Mystus cavasius* (Sutahawatengra):** Identified as Sutahawatengra or katua



**30. *Mystus menoda* (Belaunda):** Known as Belaunda or katua



**31. *Mystus tengra* (Tengana):** Identified as Tengana.



**32. *Mystus aor* (Dariai tengara):** Known as Dariai tengara.



**33. *Mystus seenghala* (Dariai tengara):** Identified as Dariai tengara



**34. *Rita rita* (Hunna /patthar chata):** Known as Hunna or Patthar Chata.



**35. Pangasiidae Family: *Pangasius pangasius* (Karai):** Identified as Karai.



**37. Saccobranchidae Family: *Heteropneustes fossilis* (Singhi):** Known as Singhi



**38. Clariidae Family: *Clarias batrachus* (Mangur):** Commonly known as Mangur.



**39. Belontiidae Family: *Xenentodon cancila* (Kauwa / nauwa):** Identified as Kauwa or Nauwa.



**40. Mugilidae Family: *Sicamugil cascasia* (Yellow tail mullet):** Known as Yellow Tail Mullet.



**10.3 Channidae Family:**

**41. Channa gachua (Chanaga/kallarkudi):** Recognized as Chanaga or Kallarkudi bajariya.



**42. Channa marulius (Saur):** Known as Saur.



**43. Channa punctatus (Girai / bajaria):** Identified as Girai or Bajaria.



**44. Channa striatus (Sauri):** Known as Sauri.



#### 10.4 Centropomidae Family:

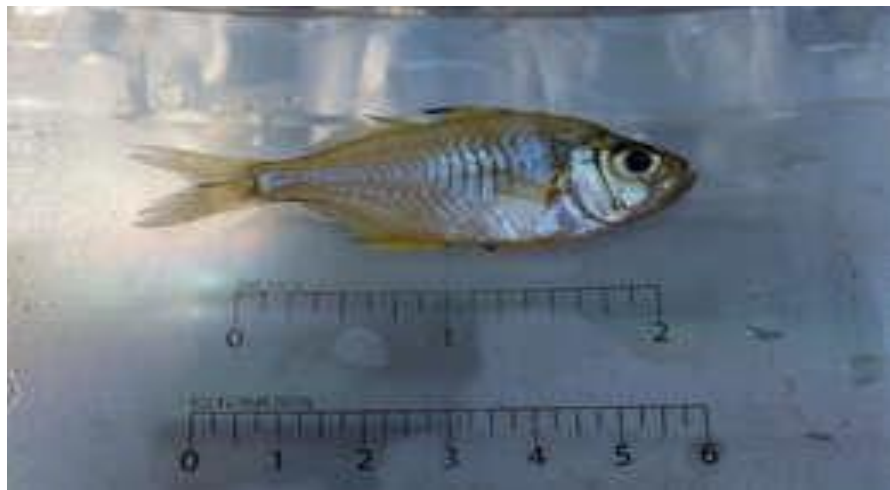
45. *Chanda baculis* (Chanri): Transparent species known as Chanri.



46. *Chanda nama* (Chanri): Another transparent species identified as Chanri.



47. *Parambassis ranga* (Chanri): Transparent species known as Chanri.





**10.5 Anabantidae Family:**

**48. *Anabas testudineus* (Kawai):** Low in the market, known as Kawai.



**49. *Colisa fasciatus* (Khosti / khadra):** Identified as Khosti or Khadra.



**10.6 Mastacembelidae Family:**

**50. *Mastacembelus pancalus* (Malga/Barred spiny eel):** Known as Malga or Barred Spiny Eel.



**51. *Mastacembelus armatus* (Bam/Zig-zag eel):** Identified as Bam or Zig-zag Eel.



## 52. Synbranchidae Family: Amphipnous cuchia (Andhasanp/Cuchia): Known as Andhua sanp



### 10.7 Discussion

The taxonomic identification of fish species in the Kosi River provides a foundational understanding of the aquatic diversity in the region. The presence of various families, including Cyprinidae, Siluridae, Bagridae, Pangasiidae, Saccobanchidae, Clariidae, Belonidae, Mugilidae, Channidae, Centropomidae, Anabantidae, Mastacembelidae, Synbranchidae, and Palaemonidae, highlights the ecological richness of the river ecosystem.

The diverse array of identified fish species serves as an essential resource for ecological studies, fisheries management, and conservation efforts. Certain species, such as Rohu (*Labeo rohita*), Catla (*Catla catla*), and Singhi (*Heteropneustes fossilis*), are of economic importance and cultural significance in the local communities.

Additionally, the transparency of certain species like *Chanda baculis*, *Chanda nama*, and *Parambassis ranga* adds an intriguing dimension to the aquatic fauna. Further research could delve into the ecological adaptations and significance of transparent fish species in river ecosystems.

The distribution of various fish species across families provides a basis for studying trophic interactions, habitat preferences, and potential impacts of environmental factors on fish populations. This taxonomic data, coupled with ecological studies, contributes to the holistic understanding of the Kosi River ecosystem and aids in formulating effective conservation and management strategies for sustaining its rich aquatic biodiversity.

### 10.4 Insights into the Conservation Status of Fish Species in the Kosi River

Understanding the conservation status of fish species in the Kosi River is essential for

formulating effective strategies to maintain ecological balance and ensure sustainable fisheries management. The insights derived from the study provide valuable information that can guide conservation efforts and contribute to the overall health of the river ecosystem.

#### 1. Diversity and Distribution:

The taxonomic identification reveals a diverse array of fish species belonging to different families. Assessing the distribution patterns of these species across the river helps identify areas of high biodiversity and potential ecological hotspots. Conservation efforts can be targeted towards preserving these key habitats.

#### 2. Endangered and Threatened Species

Identification of endangered or threatened species within the Kosi River ecosystem is crucial for prioritizing conservation actions. Species facing population decline or habitat loss require special attention and protection measures to prevent further decline and potential extinction.

#### 3. Economic and Cultural Significance:

Understanding the economic and cultural importance of certain species, such as Rohu (*Labeo rohita*), Catla (*Catla catla*), and Singhi (*Heteropneustes fossilis*), highlights the need to balance conservation goals with the sustainable use of these resources. Conservation strategies should consider the livelihoods and cultural practices of local communities.

#### 4. Transparent Fish Species

The presence of transparent fish species like *Chanda baculis*, *Chanda nama*, and *Parambassis ranga* adds a unique aspect to the ecosystem. Research into the ecological roles and adaptations of these transparent species can contribute to a more nuanced understanding of the river's biodiversity.

## 5. Impact of Environmental Factors

Assessing the conservation status involves considering the impact of environmental factors on fish populations. Climate change, water quality, and habitat degradation can significantly affect the health of aquatic ecosystems. Monitoring these factors provides insights into potential threats and helps design adaptive conservation strategies.

## 6. Fishery Practices and Management:

Insights into local fishery practices, including hatcheries and fish seed production, provide a basis for sustainable fisheries management. Balancing the demand for fish with conservation goals is essential for maintaining healthy fish populations and preserving the integrity of the river ecosystem.

## 7. Community Engagement and Education:

Conservation efforts should involve local communities, raising awareness about the importance of maintaining a balanced and sustainable ecosystem. Community engagement programs can promote responsible fishing practices, habitat protection, and the overall well-being of the river.

In conclusion, gaining insights into the conservation status of fish species in the Kosi River allows for a holistic approach to ecosystem management. By combining scientific knowledge with community involvement, conservationists can develop strategies that safeguard biodiversity, support sustainable fisheries, and ensure the long-term health of this vital water body.

# 11. RECOMMENDATIONS FOR SUSTAINABLE FISHERIES MANAGEMENT AND CONSERVATION IN THE KOSI RIVER

## 1. Implement Habitat Protection Measures:

Enforce strict regulations to protect critical habitats identified through the study. Preserve spawning and breeding grounds to ensure the survival of fish species. Establish no-fishing zones in ecologically sensitive areas [34].

## 2. Monitor and Regulate Fishing Practices

Implement and enforce sustainable fishing practices, including catch limits, gear restrictions,

and seasonal closures. Regular monitoring of fishing activities can help prevent overexploitation and ensure the long-term health of fish populations.

## 3. Promote Community-Based Fisheries Management

Involve local communities in decision-making processes regarding fisheries management. Establish community-based initiatives that empower residents to actively participate in conservation efforts, fostering a sense of ownership and responsibility.

## 4. Enhance Water Quality Management

Implement measures to improve and maintain water quality in the Kosi River. Address pollution sources, promote responsible waste disposal practices, and monitor chemical runoff from agricultural activities. Healthy water quality is essential for the well-being of aquatic life.

## 5. Integrate Climate Change Adaptation Strategies

Develop strategies to address the potential impact of climate change on the Kosi River ecosystem. This includes monitoring temperature changes, adapting to altered precipitation patterns, and assessing the vulnerability of fish species to climate-related stressors [35].

## 6. Establish Conservation Reserves

Designate specific areas within the river as conservation reserves to protect biodiversity. These reserves should prioritize the preservation of endangered or threatened species and serve as reference areas for scientific research.

## 7. Promote Sustainable Aquaculture Practices

Encourage the adoption of sustainable aquaculture practices to meet the demand for fish while reducing pressure on wild populations. Support research on responsible aquaculture techniques that minimize environmental impact and prioritize fish welfare [36,37].

## 8. Strengthen Monitoring and Research Efforts

Invest in ongoing monitoring programs to track changes in fish populations, habitat conditions, and water quality. Support research initiatives

that further enhance understanding of the Kosi River ecosystem, enabling adaptive management strategies.

### **9. Educate and Raise Awareness**

Conduct educational programs to raise awareness about the importance of the Kosi River ecosystem and the role of local communities in its conservation. Foster a sense of environmental stewardship and promote sustainable practices among residents.

### **10. Collaborate with Stakeholders**

Establish partnerships with governmental bodies, non-governmental organizations, academic institutions, and local communities to create a collaborative approach to conservation. Pool resources, expertise, and knowledge to develop and implement effective management strategies.

### **11. Adopt an Ecosystem-Based Approach**

Consider the interconnectedness of the Kosi River ecosystem when designing conservation strategies. Adopt an ecosystem-based approach that addresses the complex interactions between different species, habitats, and environmental factors.

By implementing these recommendations, stakeholders can contribute to the sustainable management of fisheries and the conservation of the diverse aquatic ecosystem in the Kosi River, ensuring its resilience for future generations.

## **12. SIGNIFICANCE OF THE RESEARCH ON THE KOSI RIVER AND ITS FISHERIES RESOURCES**

### **1. Ecological Health Assessment**

The research serves as a crucial tool for evaluating the ecological health of the Kosi River. By comprehensively studying the biodiversity, habitats, and environmental factors, it provides insights into the overall well-being of the river ecosystem. This assessment is fundamental for understanding the current state of the environment and identifying potential areas of concern.

### **2. Biodiversity Preservation**

The identification and documentation of various fish species contribute to the preservation of

biodiversity in the Kosi River. This knowledge allows for the formulation of targeted conservation strategies, ensuring the protection of endangered or threatened species and maintaining a diverse and resilient aquatic ecosystem.

### **3. Sustainable Fisheries Management**

The research findings offer a foundation for implementing sustainable fisheries management practices. By understanding the distribution, abundance, and conservation status of fish species, stakeholders can develop strategies to balance the demand for fisheries resources with long-term conservation goals. This supports the livelihoods of local communities dependent on fisheries.

### **4. Community Empowerment**

Local communities stand to benefit significantly from the research outcomes. The insights gained empower communities to actively engage in conservation efforts, fostering a sense of responsibility and stewardship for the Kosi River. Involving residents in decision-making processes enhances the effectiveness of conservation initiatives and promotes sustainable resource use.

### **5. Foundation for Conservation Efforts**

The research serves as a foundational resource for future conservation endeavors in the region. It provides a baseline understanding of the river's ecological dynamics, enabling the development of targeted conservation interventions. This scientific groundwork is essential for formulating adaptive strategies to address emerging environmental challenges.

### **6. Climate Change Resilience**

As climate change poses potential threats to aquatic ecosystems, the research contributes to building resilience. Insights into the impact of environmental factors on fish populations help formulate adaptive strategies, ensuring the river's ability to withstand and recover from climate-related stressors.

### **7. Educational and Awareness Impact**

The research outcomes contribute to educational programs and awareness campaigns. By disseminating information about the Kosi River's

significance, biodiversity, and conservation needs, the research promotes environmental education and fosters a broader understanding of the river's role in the community.

### **8. Scientific Knowledge Enhancement**

The study enhances scientific knowledge about the Kosi River ecosystem, providing valuable data for researchers, policymakers, and environmentalists. This expanded understanding contributes to the broader field of aquatic ecology and can inform similar studies in other river systems facing similar challenges.

### **9. Long-term Environmental Planning**

The research findings provide a basis for long-term environmental planning. Stakeholders, including government agencies and conservation organizations, can use the data to formulate policies and plans that prioritize the sustainable use of the Kosi River's resources while ensuring its long-term ecological health.

In summary, the research on the Kosi River and its fisheries resources holds immense significance for ecological conservation, sustainable resource management, community well-being, and scientific advancement. It lays the groundwork for a holistic approach to river ecosystem health and resilience, benefiting present and future generations.

## **13. CONCLUSION**

In conclusion, the investigation into the biodiversity of the Kosi River and the fish resources in local markets in Rampur, Uttar Pradesh, underscores the critical importance of conservation and sustainable resource management. This research contributes valuable data that is indispensable for preserving the ecological balance of the river, supporting local livelihoods, and addressing nutritional security for the surrounding population.

The studied stretch of the Kosi River in Rampur, Uttar Pradesh, India, emerges as a reservoir of diverse fish species, representing not only a source of livelihood for the resident fishing community but also a vital contributor to the nutritional security of neighboring populations. The river stands as a key provider of quality fish protein, playing a crucial role in meeting the dietary needs of the region.

However, the findings of the study also highlight alarming trends – a steady decline in fish

populations poses a severe threat to the riverine ecosystem. The causes, identified as pollution, overexploitation, and indiscriminate fishing methods, demand urgent attention. It is evident that unchecked human activities are disrupting the delicate balance of the river's ecology, jeopardizing the sustainability of this valuable resource.

To address these challenges, a multifaceted approach is imperative. First and foremost, raising awareness within the fishing community about sustainable practices and the importance of adhering to inland fishing rules and regulations is crucial. Empowering the local community with knowledge and promoting responsible fishing methods will contribute significantly to the conservation efforts.

Simultaneously, enforcement of stringent regulations is essential to curb overexploitation and combat pollution. Collaborative efforts involving government bodies, non-governmental organizations, and local communities are pivotal in implementing and reinforcing these regulations. By fostering a sense of shared responsibility and community engagement, these measures can be more effectively enforced.

This study serves as a clarion call for proactive conservation measures to safeguard the Kosi River's rich biodiversity and ecological integrity. The insights gained not only deepen our understanding of the river's current state but also provide a roadmap for informed decision-making. As we navigate the delicate balance between human activities and the preservation of natural resources, the lessons learned from this research are invaluable in steering towards a future where the Kosi River thrives as a sustainable and resilient ecosystem for generations to come.

By delving into the intricacies of the Kosi River ecosystem, this study aims to bridge the gap between scientific understanding and environmental stewardship. The knowledge gained will be instrumental in shaping policies for the preservation of biodiversity and the responsible management of fisheries resources in Rampur, Uttar Pradesh.

### **DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image

generators have been used during the writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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